

1. Agenda

Documents:

[2024_07_15AGENDA.PDF](#)

2. Meeting Materials

Documents:

[2024_07_15CLEMSONPARK.PDF](#)

[2024_07_15RECREATIONMASTERPLAN.PDF](#)

[2024_07_15PUBLICHEARINGSETBACKS.PDF](#)

[2024_07_15PUBLICHEARINGWWTP.PDF](#)

[2024_07_15WWTPCONSTRUCTION.PDF](#)

[2024_07_15ANIMALCRUELTY \(1\).PDF](#)

[2024_07_15BONDORDINANCE.PDF](#)

[2024_07_15FOIA \(1\).PDF](#)



CITY OF Clemson SOUTH CAROLINA

Agenda, Clemson City Council July 15th, 2024 Council Chamber, Clemson City Hall

5:00 p.m. Public Hearing Authorizing the execution and delivery of an intergovernmental wastewater capacity and services agreement and a project management agreement for wastewater treatment plant expansion in connection with the expansion of the Pendleton/Clemson regional wastewater treatment plant; and other matters relating thereto.

5:30 p.m. Public Hearing 2024-R-02 Proposed Text Amendment (Non-residential Setbacks and PD Acreage)

The regular meeting will begin following the Public Hearing, but not before 6pm.

Call To Order: Regular Council Meeting

Invocation and Pledge of Allegiance: Council Member Smith

Oath of Office: Parking Enforcement Officer Lennie Roper

Public Session: (3-minute limit per speaker)

Approval of Minutes: July 1st, 2024

Reports/Discussion

- a. Recreation master plan presentation. – Parks and Recreation Director Jay Bennett
- b. Receive a Clemson Park Update from the Russell Design Office – Paul Russell
- c. Discuss the city's current FOIA policy and provide staff and legal counsel guidance on any desired amendments. – City Administrator Andy Blondeau
- d. Staff Reports

Policy Action (2-minute limit per speaker)

Ordinances

- a. Consider 2nd reading to enact the Seventh Supplemental Bond Ordinance for the issuance of water and sewer revenue bonds. – City Administrator Andy Blondeau
- b. Consider 2nd reading of an ordinance to amend City Ordinance Section 4-6 Cruelty to Animals. and Section 4-31 Outside shelter requirements for Dogs. – Police Chief Jorge Campos

Other Policy Items

- a. Consider approving the construction contract with Harper Corporation for the construction of the Pendleton/Clemson Wastewater Treatment Plant expansion contingent upon the anticipated approval SC Rural Infrastructure Authority – Utilities Director Benjie McGill

Mayor-Council reports/comments/new business

Adjourn



CITY OF CLEMSON
AGENDA ITEM REQUEST FORM

Requested By:

Date Submitted:

Council Meeting Date:

Type of Request: (check only one)

☒ Report/Discussion

☐ Policy/Action

☐ Executive Session

Agenda Item Summary: (brief for public information and posted agenda)

Agenda Item Detail: (expand as necessary for clarification)

**CITY OF CLEMSON
AGENDA ITEM REQUEST FORM**

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☒ **Report/Discussion**

☐ **Policy/Action**

☐ **Executive Session**

Agenda Item Summary: (brief for public information and posted agenda)

Agenda Item Detail: (expand as necessary for clarification)



Parks and Recreation Master Plan

ZEC EIGHT INSIGHTS
PUBLIC SPACES, PLACES, AND PROGRAMS | CONSULTING

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Acknowledgments

City Council

Lillian Boatwright
Bob Brookover
John W. Ducworth, III
John Fulmer
Alesia Smith
Catherine Watt

Mayor

Robert Halfacre

Parks, Recreation, Arts, Culture, and Tourism Advisory Committee

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Kari Carson	Fran McGuire
Bailey Dull	Kyle McLean
Peter Hyatt	Misty O'Dell
Robert Kemp	Michael Steele

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Lindsey Watley, *Community Programs & Events Director*
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Master Plan Acceptance Resolution (Council)

Placeholder.

Master Plan Support Letter (PRACT Committee)



CITY OF Clemson PARKS & RECREATION

July 15, 2024

Dear Clemson City Council Members,

I am writing to express my strong support for the Parks and Recreation Master Site Plan for the City of Clemson. The PRACT Advisory Committee is pleased to support this initiative, which aligns with our goals of creating, maintaining, and improving a comprehensive parks and recreation system that enhances quality of life, promotes community well-being, and provides diverse opportunities for residents to engage in recreational activities.

The Master Site Plan has the potential to significantly enhance the livability and economic growth of Clemson. To ensure excellence in program delivery and community service, the plan includes increasing the professional staff for the Parks and Recreation Department. This is a critical consideration for the move forward. Furthermore, the plan focuses on enhancing accessibility and connectivity within neighborhoods and expanding the Green Crescent Trail. In addition, the plan allows for expanding programming for events, youth activities, fitness, wellness, and outdoor recreational facilities for youth and adult sports. To further encourage engagement, expansion of parks as central gathering places that support community organizations and families is planned. Ensuring safety, preserving open spaces, developing partnerships, and opportunities for sustainability are also addressed in the plan.

The PRACT Advisory Committee is eager to support the City of Clemson to ensure the successful implementation of this plan. We feel confident that the Master Site Plan will have a profound and positive impact on Clemson and its residents. We strongly support this initiative and look forward to its successful execution.

Sincerely,

Bill Carraway
Committee Chairman
PRACT Advisory Committee



Chapter 1 - Introduction

1.1 Area Context

Clemson, South Carolina is located in Pickens and Anderson counties, and is home to Clemson University. Originally named Calhoun, the community changed its name to Clemson 54 years after the university was established, reflecting its identification with the university. Beyond the university, Clemson is home to the South Carolina Botanical Garden, Fort Hill Plantation, Bob Campbell Geology Museum, and Lake Hartwell – a popular recreation area.

The Clemson Parks and Recreation Department (CPRD) oversees the city’s parks and greenspaces; provides community athletics, events, and camps; works with the City of Central to provide the Central-Clemson Recreation Center; and provides public enrichment via the Clemson Area African American Museum (CAAAM).

1.2 Master Plan

This *Parks and Recreation Master Plan* will be the agency’s foundational document stating how the agency will achieve its mission, goals, and objectives and will guide decisions for provision of facilities, programs, and services including development of the capital improvement program. **Of note, this plan is a living document that reflects the consensus of the participants at the time and should change as people and issues change.** This *Parks and Recreation Master Plan* updates the most recent version finalized in 2012.

1.2.1 Planning Process

The formal planning process commenced in late July 2023 and followed five main tasks (**Figure 1**). Creating the *Parks and Recreation Master Plan* involved in-person site visits and meetings, virtual public engagement techniques, and application of data research, analyses, and assessments.

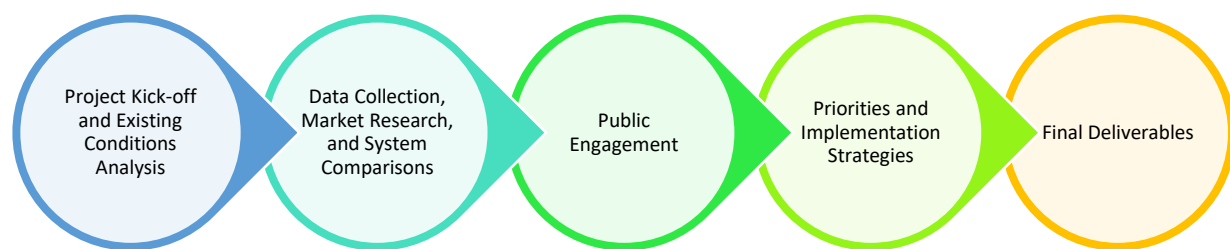


Figure 1: Planning Process

1.3 Master Plan Goals and Objectives

At the project’s onset, the consultant met with CPRD staff to understand their goals and objectives for this planning effort. The following overarching goals and objectives resulted:

- Realistic implementation strategies.
- More representative voices heard within Clemson.
- More focus on streamlining our operations, along with corresponding budget implications.
- Identifying our system’s “health” and what do we do as a result?
- Help us plan for future growth and ensure we “tell our story.”



Chapter 2 - City of Clemson Population

2.1 Demographics

All demographic data was obtained from Esri in October 2023. Esri specializes in delivering the world's most powerful mapping and spatial analytics software available.

2.1.1 Population

Clemson's population has grown by 35% since the 2010 Census and is projected to increase by another 4% by 2028. According to historic Census data, this past decade's growth was the largest since the 1980s.

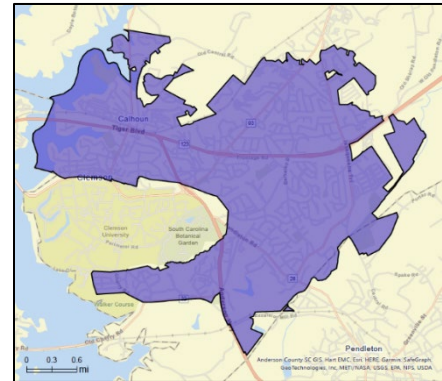


Figure 2: Clemson City Boundaries

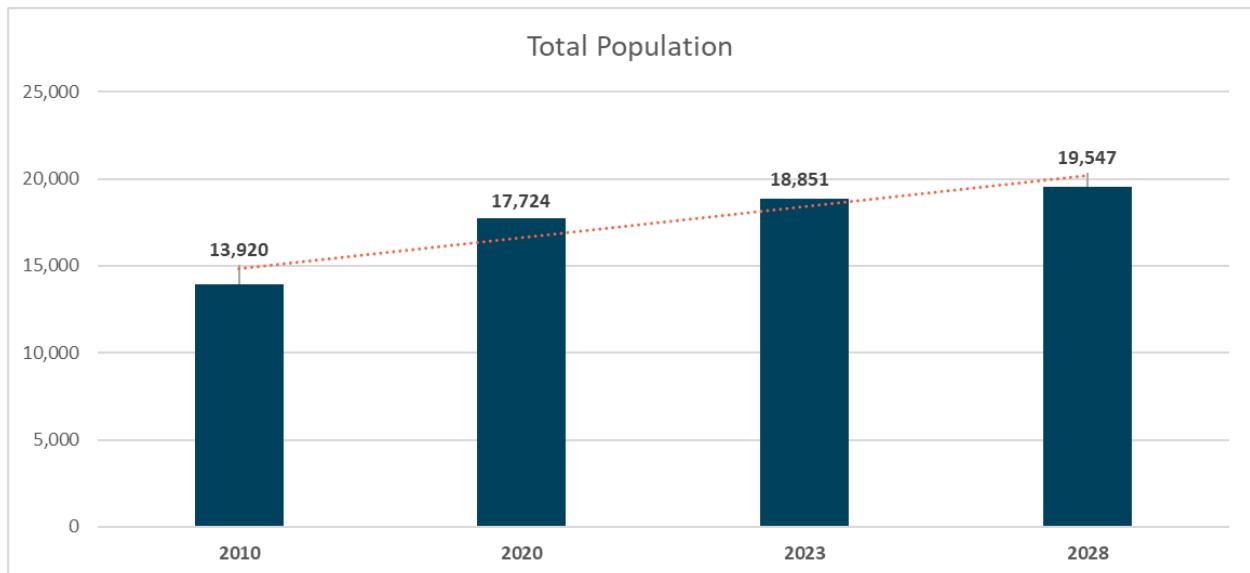


Figure 3: Clemson Population

2.1.2 Age Segmentation

Clemson's median age is 26.3, an increase of 1.7 years since the 2010 Census. The effect Clemson University has on the city is profound as South Carolina's median age is 39.7 years old. Therefore, it is not a surprising that almost two-thirds of Clemson's population is below 35 years old. Looking ahead over the next five years, the city's age segments are projected to remain stable in terms of overall percentages; therefore, it does not appear one age segment over another should command more programmatic attention based on population stats alone.

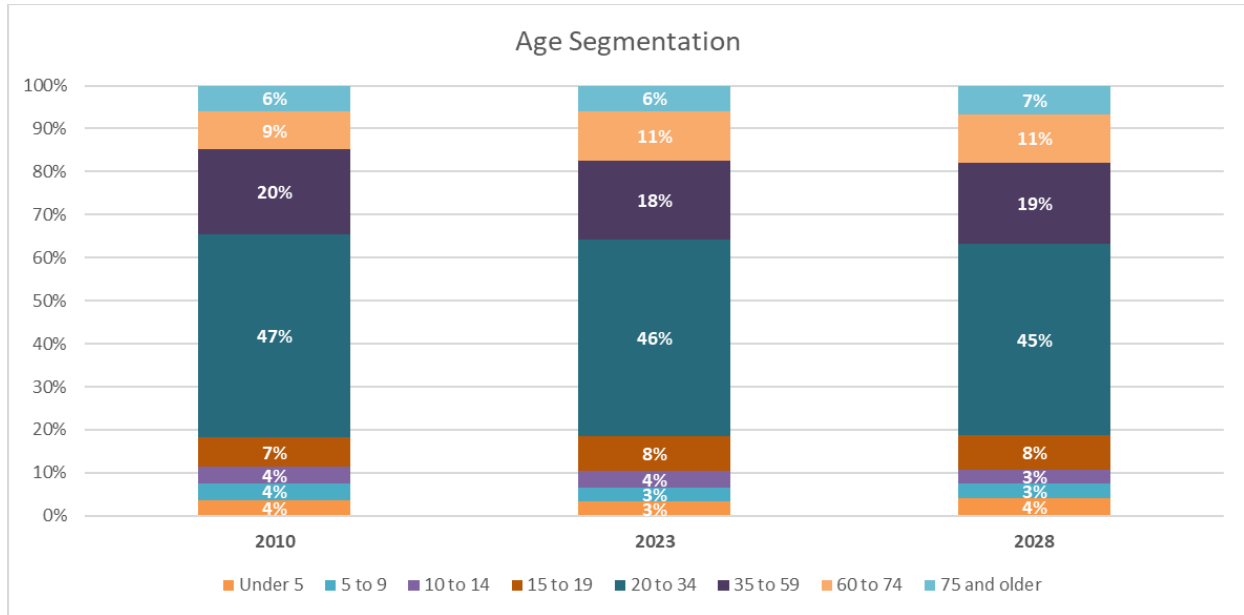


Figure 4: Age Segmentation Breakdown (2010-2028)

2.1.3 Race and Ethnicity

Clemson is less diverse than the state average (69% White); however, trends indicate the city is moving closer to reflecting the state's demographic mix. Of note, ethnicity is recorded separately from race as people who identify their origin as Hispanic, Latino, or Spanish may be of any race (Figure 6).

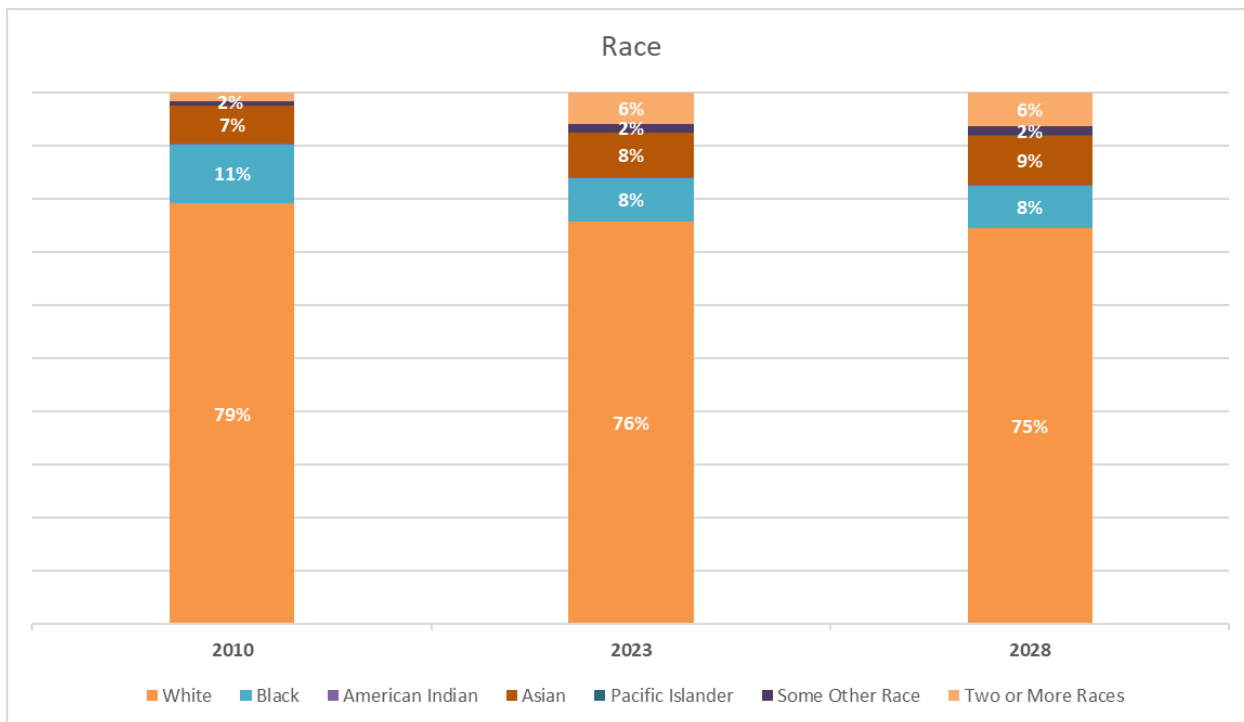


Figure 5: Race Statistics (2010-2028)

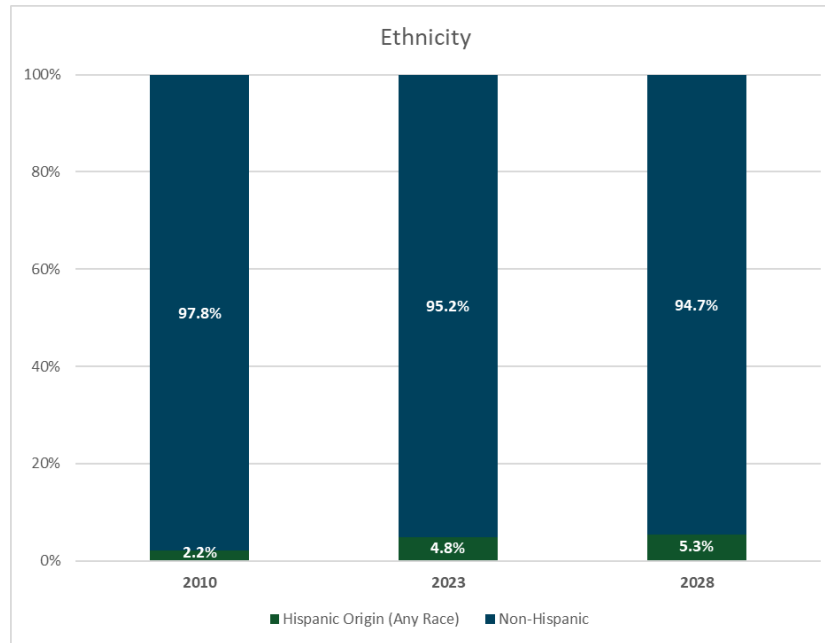


Figure 6: Ethnicity Statistics (2010-2028)

2.1.4 Household Characteristics

The average household size has fluctuated slightly since 2010. This is probably influenced by student housing outside of campus, but within the city limits.

Household Statistics			
Characteristic	2010	2023	2028
Total Households	6,038	7,835	8,209
Avg. Household Size	2.23	2.27	2.25
Median Age	24.6	26.3	27.0

Figure 7: Household Statistics (2010-2028)

2.1.5 Household Income

Clemson's median household income is \$40,209, a figure well-below the median household income for the entire state of South Carolina (\$64,115). Additionally, the median household income is projected to increase by 7% by 2028 (Figure 8). The largest household income category in the city is the less than \$15,000 group; again, indicative of the general younger population that makes up the city (Figure 9).

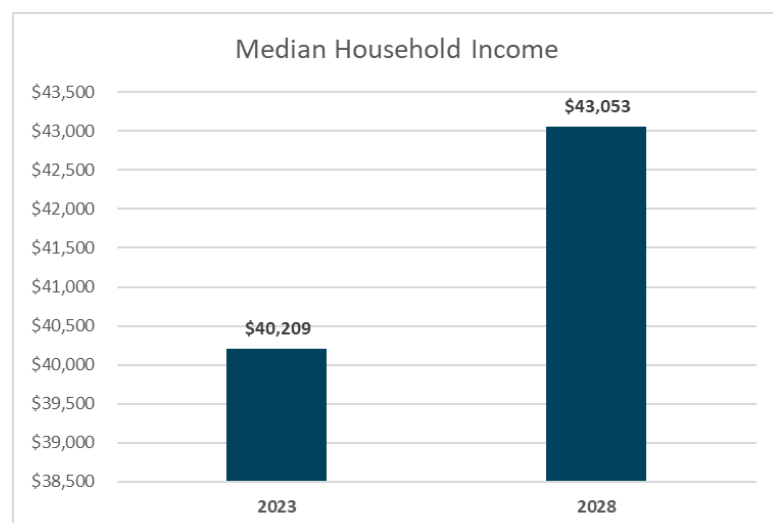


Figure 8: Median Household Income (2023-2028)

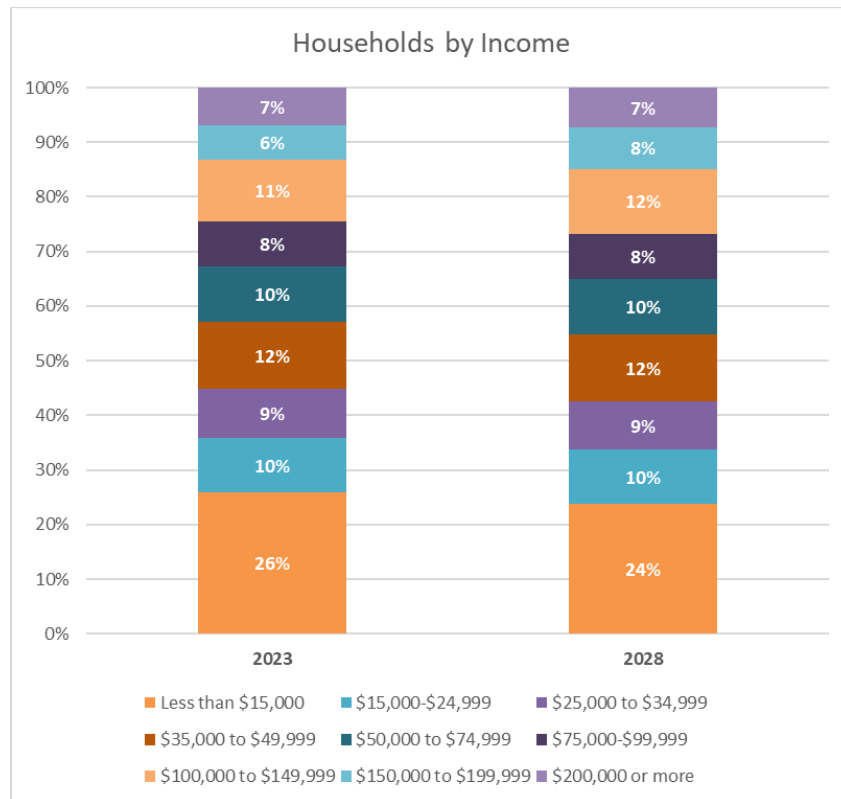


Figure 9: Household Income by Category (2023-2028)

2.1.6 Poverty

A grassroots movement including United Ways, corporations, nonprofits, and foundations from 23 states (and the District of Columbia) produces research that focuses on how to improve life across the country for Asset Limited, Income Constrained, Employed (ALICE) populations. ALICE represents the growing number of individuals and families who are working but are unable to afford the basic necessities of housing, childcare, food, transportation, health care, and technology. Each ALICE Report uses standardized measurements to quantify the cost of a basic household budget in each county in each state, and to show how many households are struggling to afford it.

ALICE households earn more than the federal poverty level, but less than the basic cost of living for the county (the ALICE Threshold). For Pickens County, 19% of households are in poverty, but 31% are considered ALICE households. This means the county’s population is above both the poverty state average of 14% and the state average for ALICE Households of 29%. In Pickens County, the percentage of households in poverty and ALICE households have increased yearly since 2016.

Figure 10 shows Pickens County’s ALICE households by County Subdivision, with the top three percentages highlighted in red on the left. Clemson has the second highest amount of ALICE households, slightly below Central. This means the county’s largest ALICE population is concentrated in the park department’s planning boundaries. With Central located to the northeast, this may indicate a need to identify connectivity corridors, park land, and programming locations to expand the department’s reach. These statistics reinforce the need for more assets, amenities, and opportunities within the city and the department should be a leading partner in providing recreational services and forming partnerships that enhance access to amenities, quality of life features, and needed services.



Census County Division		Percent of Households Below ALINE
1	Central	55%
2	Clemson	53%
3	Easley	43%
4	Easley East	39%
5	Liberty	46%
6	North Pickens	46%
7	Pickens	48%
8	Six Mile	40%



Figure 10: Pickens County ALINE Population by Subdivision (left) and Overall Subdivision Map (right)

2.1.7 Educational Attainment

Clemson's largest educational attainment category for the population 25 years and older is a graduate/professional degree, followed by those with a bachelor's degree. Only 5% of the population does not have a high school diploma or equivalent, a statistic below the state average of 9.5%. These statistics indicate Clemson residents are well-educated compared to state averages.

Educational Attainment	
Level	2023
Less than 9th Grade	2%
9th - 12th Grade, No Diploma	3%
High School Graduate	10%
GED/Alternative Credential	3%
Some College, No Degree	13%
Associate Degree	7%
Bachelor's Degree	28%
Graduate/Professional Degree	36%

Figure 11: Educational Attainment Statistics (2023)

2.1.8 Disability Status

Approximately 9% of the civilian noninstitutionalized population reports having a disability, a statistic below the state average of 14.5%. Over half (52%) of all those older than 75 residing in Clemson report having a disability. As the population with reported disabilities increases with age, it is beneficial to examine the need for inclusive playgrounds, sensory trails, increased facility accessibility, and providing recreation facilities and amenities with all abilities and ages in mind.

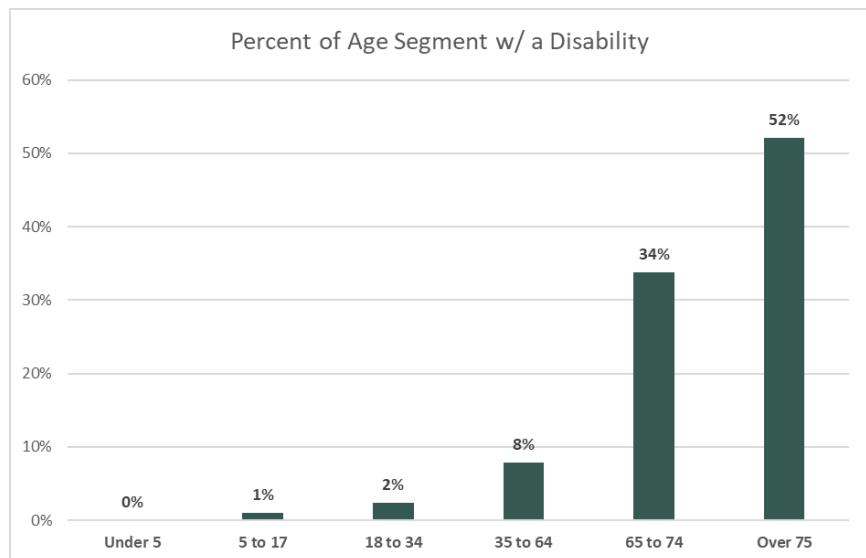


Figure 12: Disability Statistics (2023)



2.1.9 Employment

Clemson’s overall unemployment rate is 4%, slightly below the state average of 4.4%. Clemson’s largest employed age segment (45-54) exhibits a low unemployment rate, an encouraging statistic. Additionally, there is an obvious willingness to work in both younger and older age groups. These statistics support the idea of utilizing youth internships and training programs along with focused volunteerism and part-time work (at a minimum) for older residents.

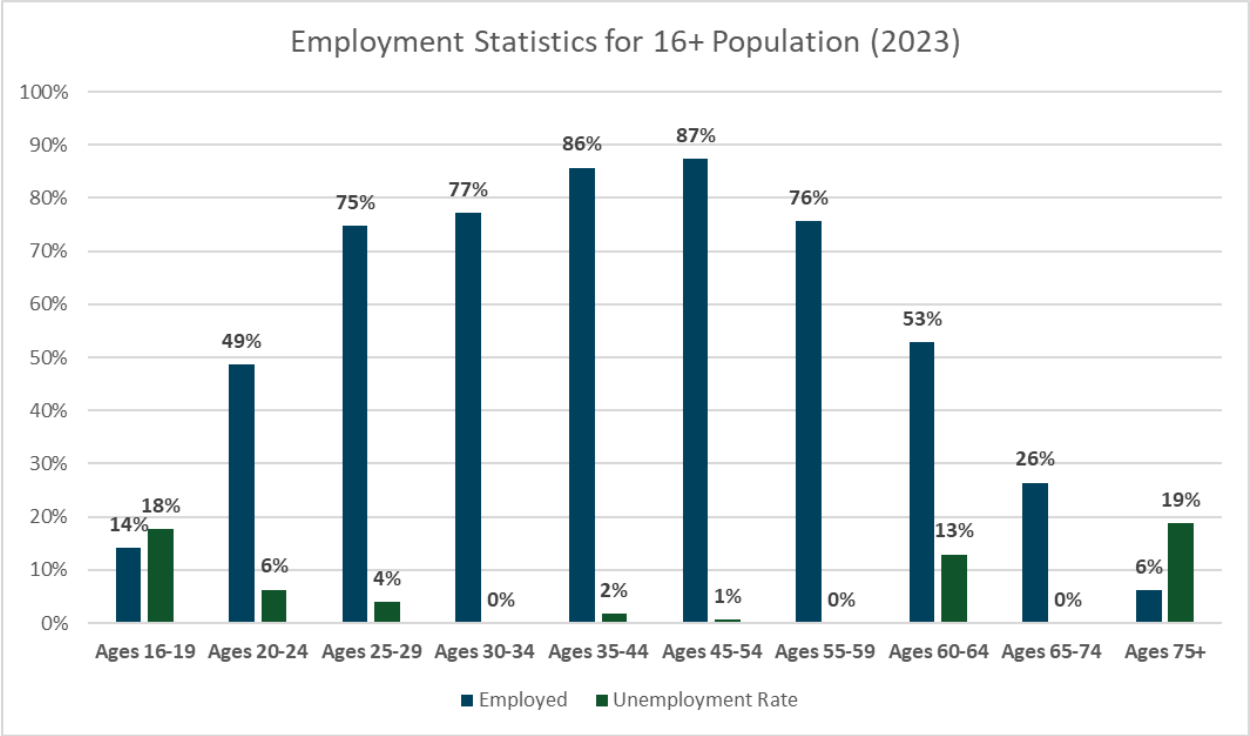


Figure 13: Employment Statistics (2023)





Clemson's top five leading industries combine to represent 75% of all industries within the city. This statistic indicates Clemson's industry composition is more concentrated into a few sectors. In terms of partnerships, the department should look to maximize opportunities with the largest employment industries while simultaneously looking for niche opportunities with industries not as represented within the community.

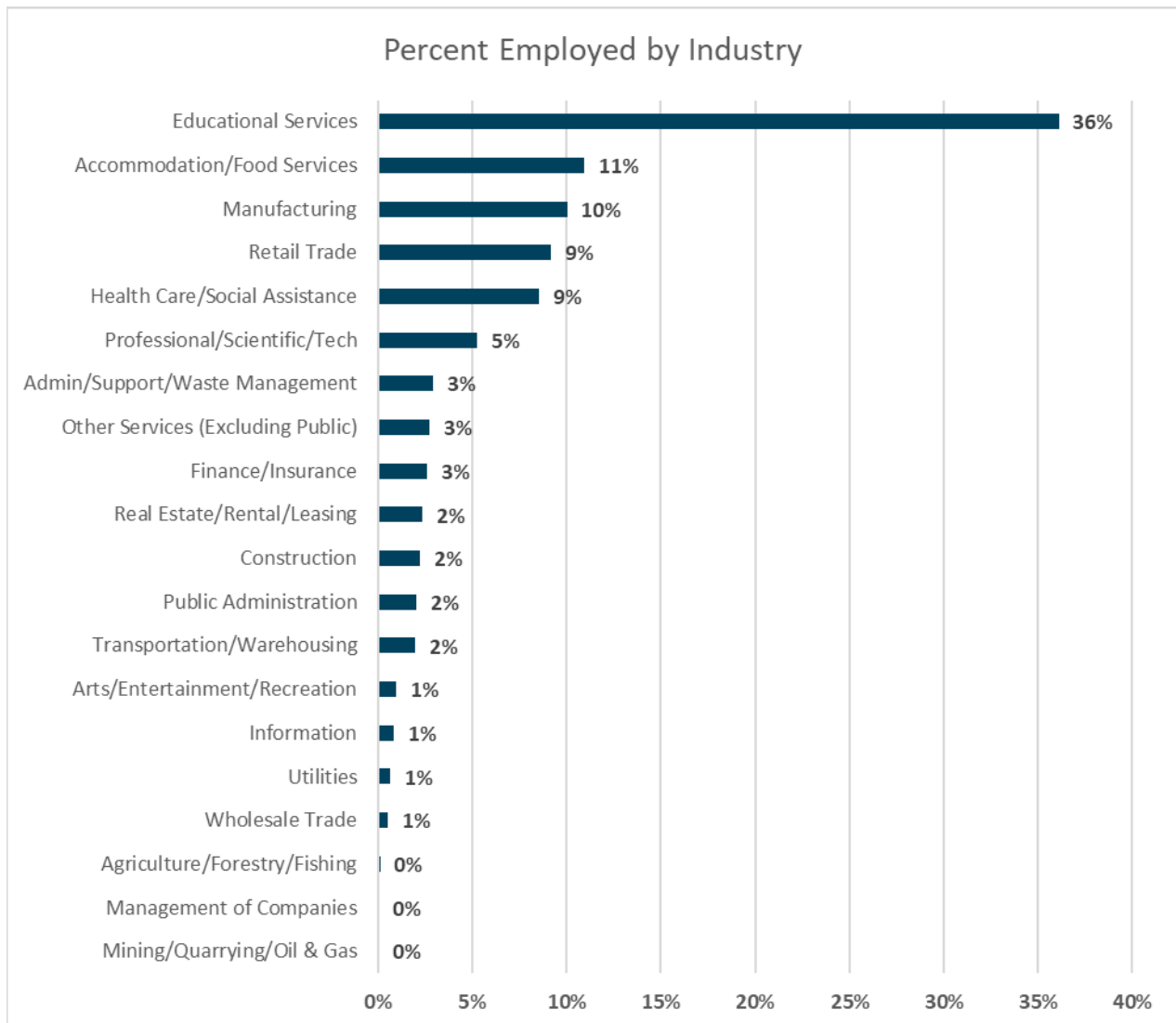


Figure 14: Industry Composition (2023)



2.2 Market Potential Index

Esri's Market Potential data measures the likely demand for a product or service in an area. A Market Potential Index (MPI) compares the demand for a specific product or service in an area with the national demand for that product or service. A value of more than 100 represents higher demand, and a value of less than 100 represents lower demand. For example, a service with a score of 125 translates into being 25% higher than the national average.

MPI scores were pulled for four categories:

1. Exercise/Personal Health Activities
2. Sport Activities
3. Outdoor Activities
4. Enrichment Activities

2.2.1 Exercise/Personal Health Activities

Many of the recorded activities score near or above the national average: yoga, jogging/running, weightlifting, walking for exercise, aerobics, and swimming. In terms of overall participation, walking for exercise is expected to have 33% population participation, followed by weightlifting (15%), swimming (14%), yoga (13%), and jogging/running (13%). These statistics indicate amenities such as trails, tracks, pools, and indoor recreation space may be popular within the city.

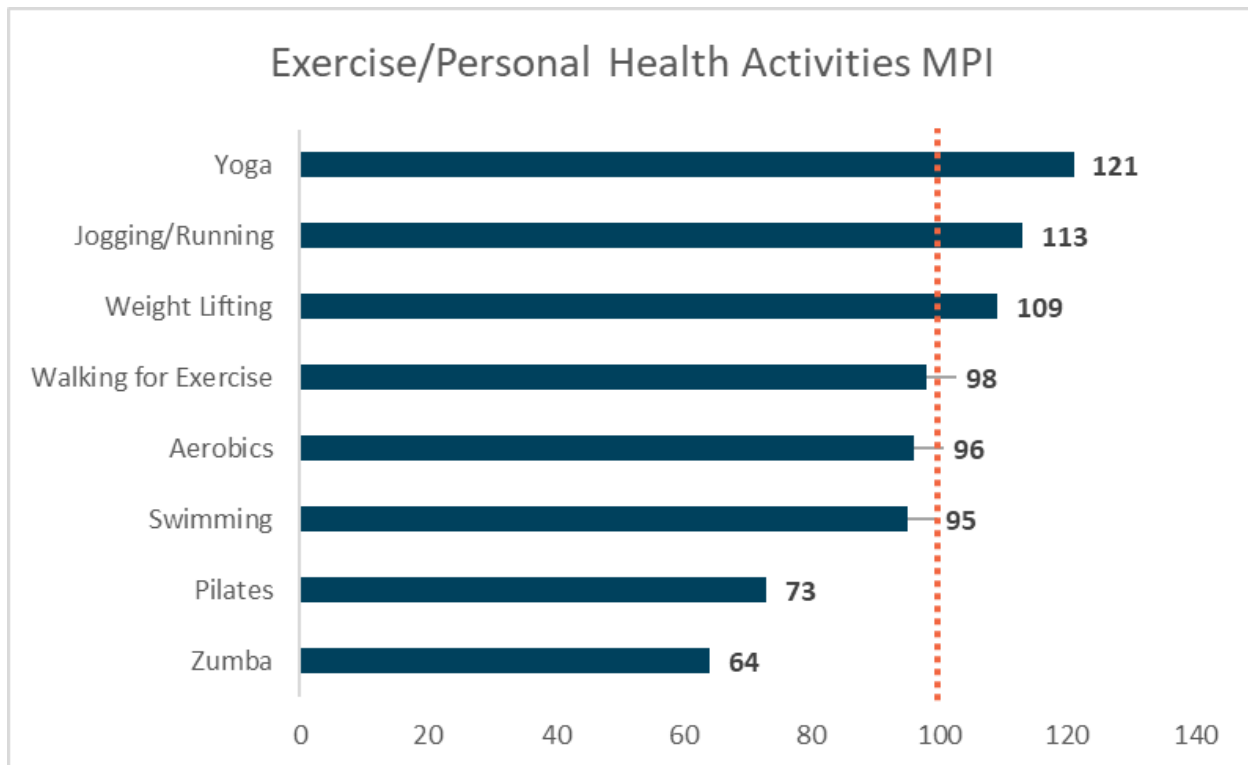


Figure 15: Exercise/Personal Health Activities MPI Scores for Clemson



2.2.2 Sport Activities

There is a high expected market potential for sport activities within the city. All recorded activities except for soccer are above the national average. The top five activities for expected population percentage participation include golf (10%), bowling (8%), basketball (7%), tennis (6%), and Frisbee (4%). These statistics support the expansion and implementation of sport opportunities.

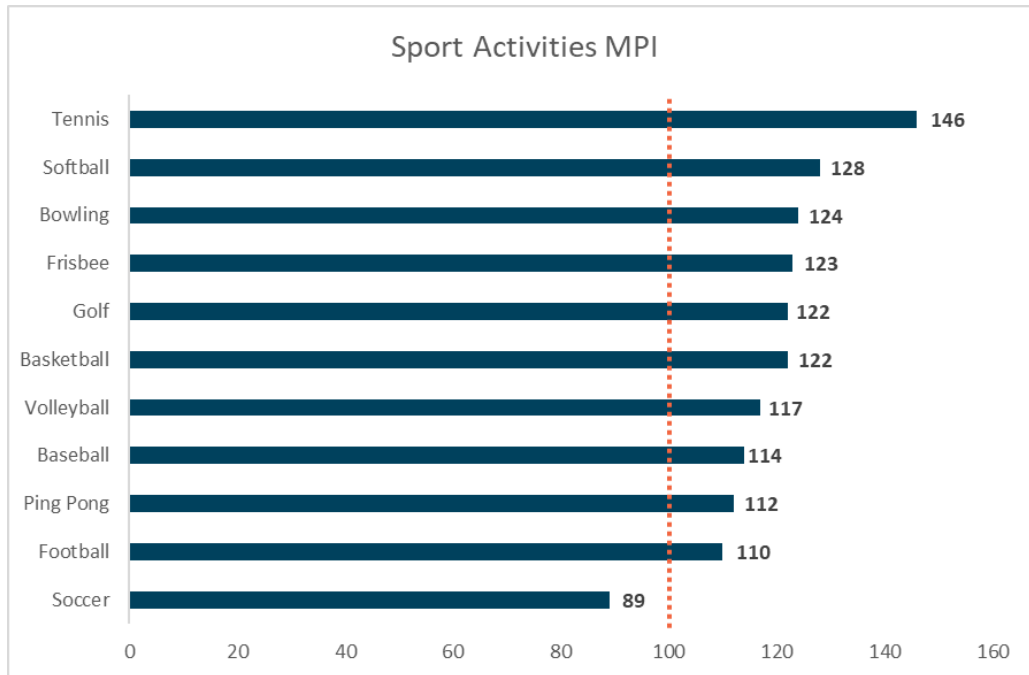


Figure 16: Sport Activities MPI Scores for Clemson

2.2.3 Outdoor Activities

Almost all recorded outdoor activities score near or above national averages. These statistics reinforce the idea of increasing and leveraging water access to Lake Hartwell and facilitating access to nature-based activities within the parks system.

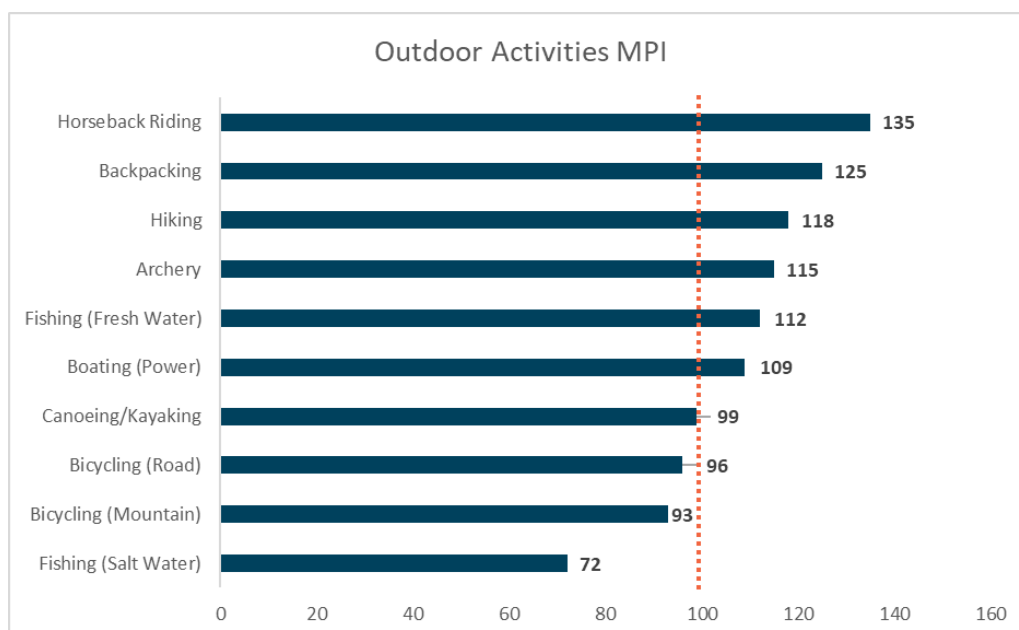


Figure 17: Outdoor Activities MPI Scores for Clemson



2.2.4 Enrichment Activities

Figure 18 presents an extensive list of enrichment type activities that Clemson residents are expected to participate in according to market research. The intent of this list is to show diverse resident interest while identifying what role the department can play (if any) in facilitating access to these types of activities and experiences. Based on MPI scores, Clemson residents exhibit large interests in games (electronic, board, and card) and arts and culture activities (music, art, visual, and performance).

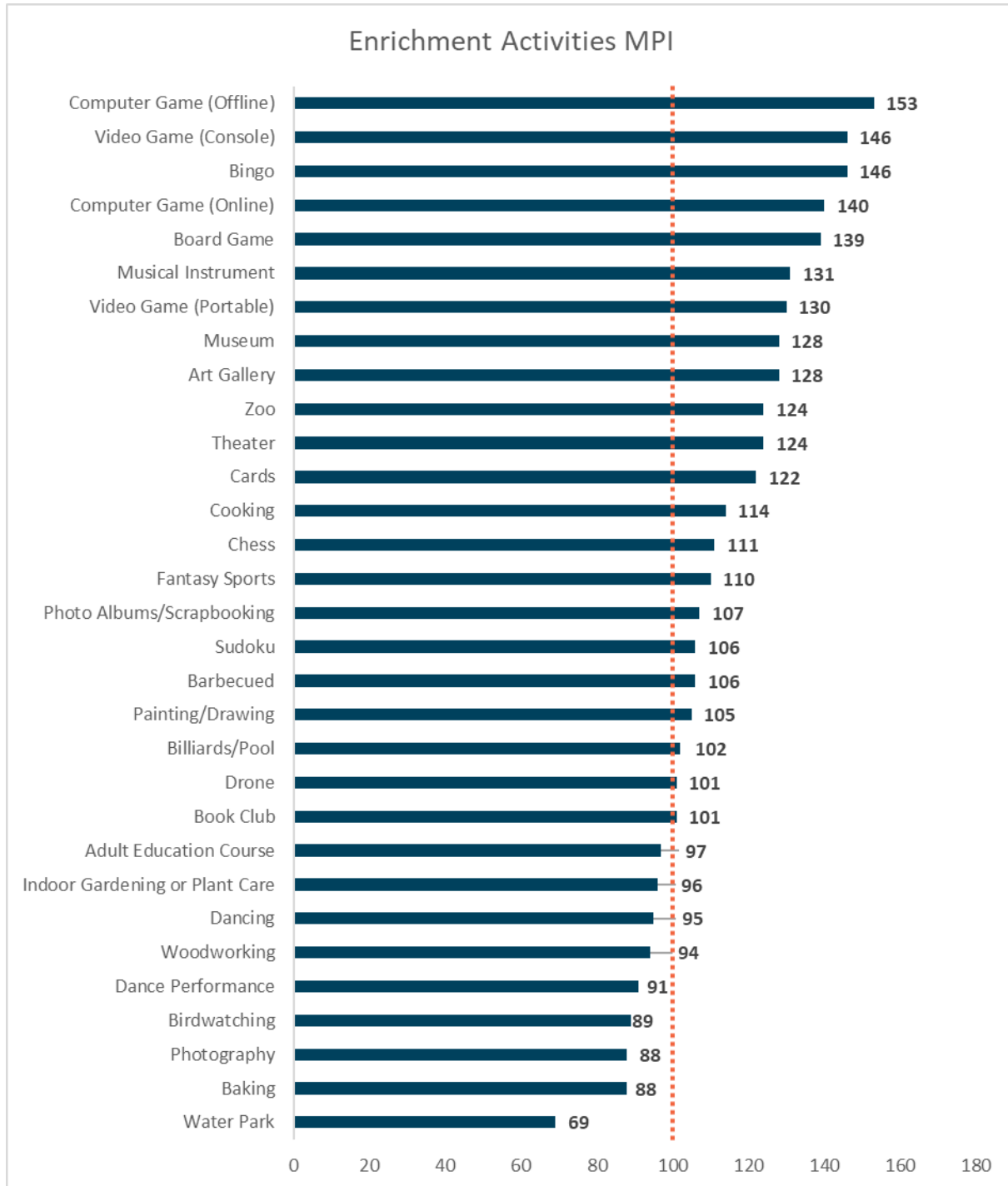


Figure 18: Enrichment Activities MPI Scores for Clemson



2.3 Spending Potential Index (SPI)

Esri's U.S. Consumer Spending data is based on the latest Consumer Expenditure Surveys (CEX) from the Bureau of Labor Statistics. The Spending Potential Index (SPI) compares the average amount spent locally for a project to the average amount spent nationally. Like the MPI score, an index of 100 reflects the national average.

SPI scores were pulled for two categories:

2. Entertainment/Recreation Fees and Admissions
3. Sports, Recreation, and Exercise Equipment

2.3.1 Entertainment/Recreation Fees and Admissions

Clemson residents exhibit below average SPI index scores for all spending categories within Entertainment/Recreation Fees and Admissions and Sports, Recreation, and Exercise Equipment topics. These trends may have major implications for the parks department as both spending power *and* willingness to pay/spend may be influential factors on department fees for services and programs. This also translates to marketing efforts because residents' willingness to spend on recreational activities may be low, but there is still spending occurring meaning the parks department needs to compete to be the leading destination for those dollars.

Entertainment/Recreation Fees and Admissions	
Activity	SPI
Tickets to Parks or Museums	73
Tickets to Theatre/Operas/Concerts	72
Admission to Sporting Events, excl. Trips	71
Membership Fees for Social/Recreation/Health Clubs	69
Fees for Participant Sports, excl. Trips	63
Fees for Recreational Lessons	57

Figure 19: Entertainment/Recreation Fees and Admissions SPI Scores for Clemson

Sports, Recreation, and Exercise Equipment	
Activity	SPI
Hunting and Fishing Equipment	91
Camping Equipment	75
Bicycles	72
Winter Sports Equipment	68
Rental/Repair of Sports/Recreation/Exercise Equipment	68
Water Sports Equipment	66
Exercise Equipment and Gear, Game Tables	64
Other Sports Equipment	62

Figure 20: Sports, Recreation, and Exercise Equipment SPI Scores for Clemson



2.4 Tapestry Segmentation

Esri's Tapestry Segmentation classifies United States neighborhoods into 67 unique segments, based on demographics and socioeconomic characteristics. Tapestry Segmentation allows organizations to understand what makes their customers, or in this case residents, unique. Understanding the city's individual uniqueness can help with planning for programs and services.

The top five Tapestry Segments for Clemson account for 100% of the city's overall population, compared to just 7% across the United States. Additionally, the city's top five Tapestry Segments are categorized into four LifeMode groups: Scholars and Patriots, GenXurban, Senior Styles, and Cozy Country Living.

Tapestry Segmentation			
Tapestry Segment (Top Five)	Clemson	U.S.	LifeMode Group
College Towns (14B)	33.5%	0.9%	Scholars and Patriots
In Style (5B)	31.9%	2.2%	GenXurban
Dorms to Diplomas (14C)	27.0%	0.5%	Scholars and Patriots
Retirement Communities (9E)	7.3%	1.2%	Senior Styles
Heartland Communities (6F)	0.4%	2.2%	Cozy Country Living
Sum	100%	7.0%	

Figure 21: Clemson Tapestry Segmentation Breakdown

In terms of geographic distribution, **Figure 22** shows how the Tapestry LifeModes are distributed across the city. Senior Styles is in the southwestern portion of the city, GenXurban is in the central and southern portions, Cozy Country is to the east, and Scholars and Patriots is spread throughout the remaining areas.

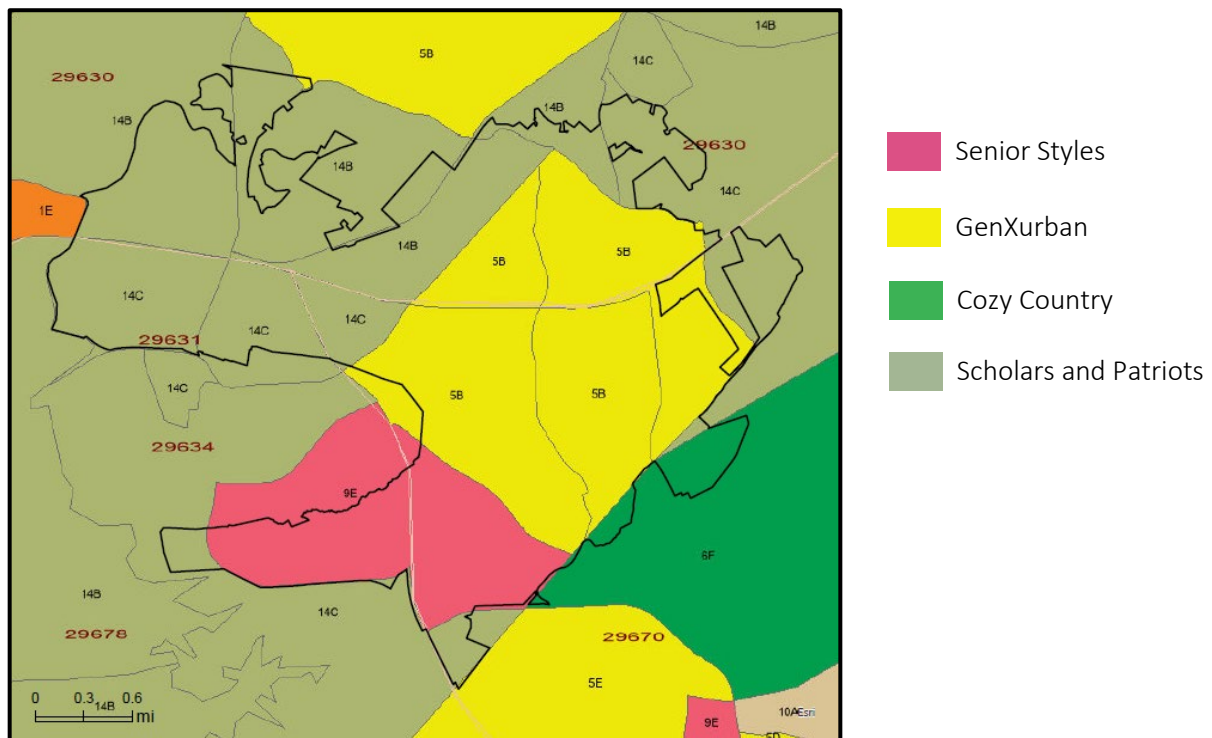


Figure 22: Clemson Tapestry Segmentation Map



2.4.1 Tapestry Segmentation and Recreation

Based on market research characteristics, the following key indicators are provided:

College Towns (33.5%)

About half the residents of *College Towns* are enrolled in college, while the rest work for a college or the services that support it. Students have busy schedules, but make time between studying and part-time jobs for socializing and sports. Students that are new to managing their own finances tend to make impulse buys and splurge on the latest fashions. This digitally engaged group uses computers and cell phones for all aspects of life including shopping, schoolwork, news, social media, and entertainment. *College Towns* residents are all about new experiences, and they seek out variety and adventure in their lives.

Key Recreation Insight

Bike and pedestrian friendly. Popular activities include backpacking, Pilates, and Frisbee. This group likes to go out to the movies and out for drinks.

In Style (31.9%)

In Style denizens embrace an urbane lifestyle that includes support of the arts, travel, and extensive reading. They are connected and make full use of the advantages of mobile devices. Professional couples or single households without children, they have the time to focus on their homes and their interests. The population is slightly older and already planning for their retirement.

Key Recreation Insight

Actively support the arts, theater, concerts, and museums.

Dorms to Diplomas (27%)

On their own for the first time, *Dorms to Diplomas* residents are just learning about finance and cooking. Frozen dinners and fast food are common options. Shopping trips are sporadic, and preferences for products are still being established. Many carry a balance on their credit card so they can buy what they want now. Although school and part-time work take up many hours of the day, the remainder is usually filled with socializing and having fun with friends. They are looking to learn life lessons inside and outside of the classroom. This is the first online generation, having had lifelong use of computers, the internet, and cell phones.

Key Recreation Insight

Socializing, having fun, and learning new things are valued. Active on and off campus, residents participate in many sports and activities like Frisbee, bowling, weightlifting, jogging, and yoga.

Retirement Communities (7.3%)

Retirement Communities neighborhoods are evenly distributed across the country. They combine single-family homes and independent living with apartments, assisted living, and continuous care nursing facilities. Over half of the housing units are in multiunit structures, and the majority of residents have a lease. This group enjoys watching cable TV and stays up to date with newspapers and magazines. Residents take pride in fiscal responsibility and keep a close eye on their finances. Although income and net worth are below national averages, residents enjoy going to the movies, fishing, and taking vacations. While some residents enjoy cooking, many would rather dine out.



Key Recreation Insight

Typically, more frugal and pay close attention to finances. Enjoy playing cards, reading books, and traveling.

Heartland Communities (0.4%)

Well settled and close-knit, *Heartland Communities* residents are semirural and semiretired. These older householders are primarily homeowners, and many have paid off their mortgages. Their children have moved away, but they have no plans to leave their homes. Their hearts are with the country; they embrace the slower pace of life here but actively participate in outdoor activities and community events. Traditional and patriotic, these residents support their local businesses, always buy American, and favor domestic driving vacations over foreign plane trips.

Key Recreation Insight

To support their local community, residents participate in public activities. Motorcycling, hunting, and fishing are popular; walking is the main form of exercise.

2.5 Demographic Implications

2.5.1 Continuing to Enhance Connectivity, Walkability, and Access to Park Spaces

When combining key statistics such as disability status, MPI scores, and Tapestry Segmentation profiles, it is evident the city needs to continue providing non-motorized transportation routes, access to water-based recreation, and facilitate nature-based outdoor recreation opportunities. When combined with the types of park spaces already in the system, it is clear this is a strong direction for the future of the parks department.

2.5.2 Addressing Inequity

ALICE statistics indicate there is a need within the city's boundaries for access to essential services. The department can play a large role in addressing systemic inequities by facilitating access to recreation resources and programs through partnerships. Additionally, more focus on connecting Clemson and Central residents is important based on ALICE household numbers. This is also supported by the fact many Clemson students live off campus in Clemson and surrounding communities.

2.5.3 Outdoor Recreation

Local market research shows a proclivity to participate in outdoor recreation activities. Since there are water resources throughout the city, it will be important to develop a strategy to enhance access and utility. Many communities around the country are "reclaiming" water resources for reinforcing community pride and establishing the social fabric. Waterfront trails, overlooks, watercraft access points, event spaces, and more are all ways communities are activating their water spaces. Additionally, land-based outdoor recreation activities should be expanded within the city and the department should identify existing and future locations to broaden programmatic offerings – both leader-lead and self-directed recreation experiences.

2.5.4 Sports and Athletics

It is evident athletics can be a large community asset and regional draw based on MPI scores. Facility improvements such as formalizing fields and enhancing support amenities will be critical. Formalizing fields refers to redesigning spaces for their intended use. For example, making more dedicated rectangular fields instead of sharing spaces with diamond fields. Support amenities typically refer to



spectator seating, shade, restrooms, walking paths, activities/play structures for multiple generations, parking, concessions, and lighting.

2.5.5 Willingness to Pay

Since market research shows a low potential willingness to pay for recreation services, the department must be able to fully articulate and express how it is financially supported, why program pricing exists the way it does, and why gap areas may exist in both capital and operational budgets. All recreation programming should adhere to an overall cost recovery philosophy to support the department's decision-making. It is not the intent of a cost recovery framework to mandate 100% cost recovery; rather, it is the philosophy's intent to outline *why* a particular program or service's pricing structure exists the way it does within the context of revenue generation goals. Additionally, monies generated through earned income opportunities should be reinvested to continue enhancing recreation programming and opportunities.





Chapter 3 - Parks and Recreation System Analysis

The CPRD system contains 16 park locations categorized into Pocket Parks/Urban Plazas, Neighborhood Parks, Community Parks, Regional Parks, Greenspaces/Natural Areas, and Special Use Parks (Figure 23). The system contains sites that tend to be clustered together and/or are away from population centers. There are opportunities to expand neighborhood park land as more housing developments are created.

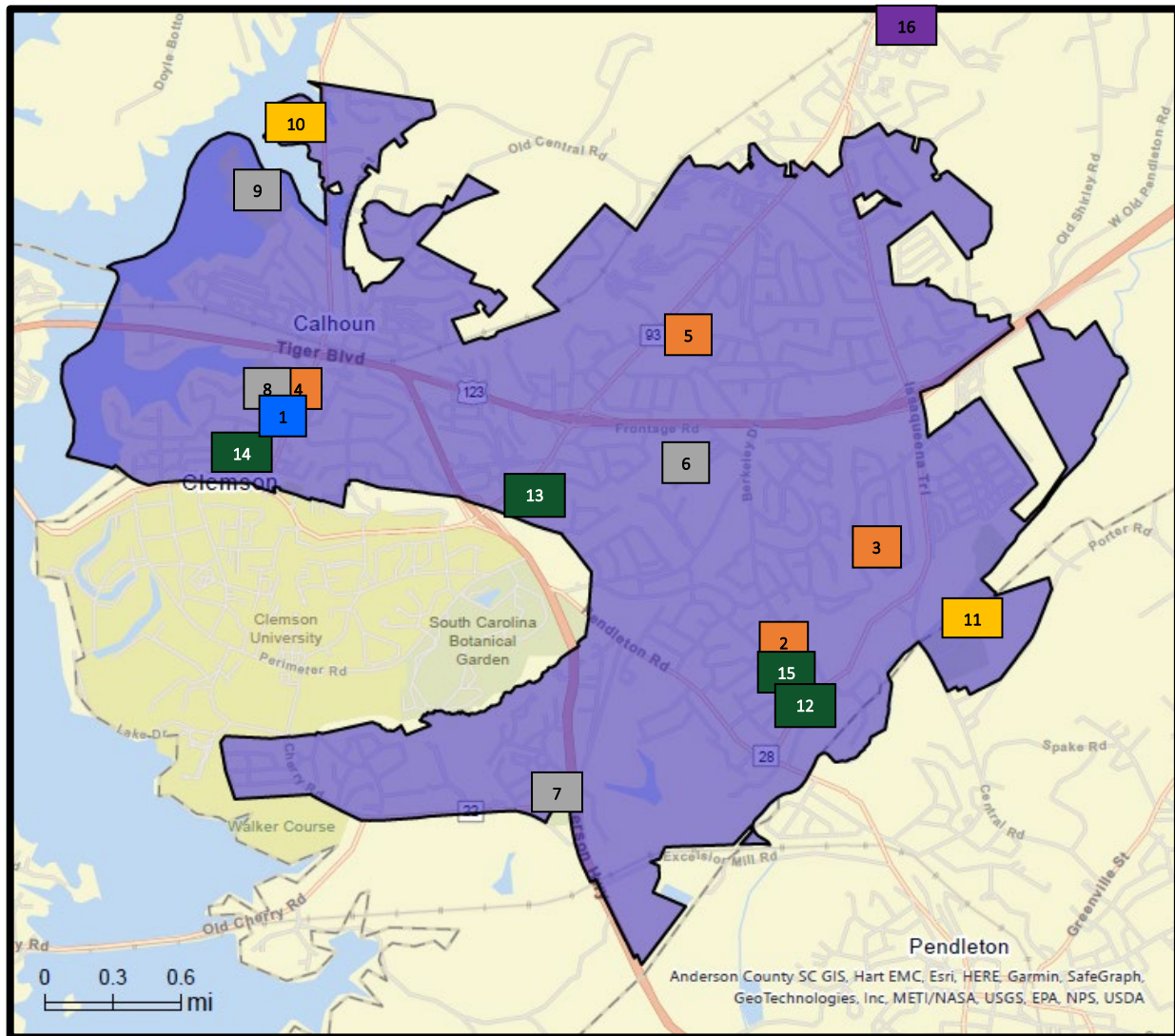


Figure 23: Clemson Planning Area with Park System Highlighted

1	Catherine Smith Plaza	9	Mountain View Park		Pocket Parks/Urban Plazas
2	Ashley Dearing Park	10	Twelve Mile Recreation Area		Neighborhood Parks
3	Earle Anderson Park	11	W.C. Nettles Park		Community Parks
4	Jaycee Park	12	Berkeley Orchard		Regional Parks
5	Rotary Park	13	Gateway Park		Greenspace/Natural Areas
6	Clemson Park	14	Shanklin-Sams Greenspace		Special Use
7	Dawson Park	15	Tottie's Place		
8	Larry W. Abernathy Waterfront Park	16	Central-Clemson Recreation Center		



3.1 System Progression

The Clemson park system has grown in terms of locations, maintained acres, and recreational experiences offered to the community. **Figure 24** shows a chronological progression of the park system to what it is today. System additions related to staffing are indicated in bold. As shown in the progression, the system has expanded at a much larger rate than staffing.



Figure 24: Clemson Park System Progression



3.2 Supply Analysis

Parks and recreation agencies have often employed a research technique called benchmarking when developing system planning documents. Benchmarking is intended to help an agency understand how they “stack up” or compare to agencies of similar size, nature, and scope. Today, the National Recreation and Park Association (NRPA) compiles data from municipalities and parks and recreation agencies across the country annually via their Park Metrics database. Park Metrics provides insights into “average” statistics in terms of park land provided per 1,000 residents, trail miles, full-time equivalents (FTEs), budget allocation, and much, much more, diminishing the need to develop customized benchmarking forms and research. As a result, this comparison’s results are two-fold: 1) they provide an overview of Clemson Parks & Recreation’s (“Clemson”) inventory and supply and 2) they show how the inventory and supply relates to agencies of similar scope.

All metric standards represent the *median* statistic based on the NRPA’s park and recreation agency performance benchmarking tool. It should also be noted that this process is self-selected, meaning park and recreation agencies choose to participate *and* upload their own information. For each benchmark category, the median metric is presented. For the purposes of this benchmark, metrics for all cities, service population of less than 20,000 people, 1,501-2,500 population per square mile, and maintain 10-19 parks are listed to provide additional lenses to view benchmark metrics.

Park	Acreage
Pocket Parks/Urban Plazas	
Catherine Smith Plaza	0.40
Subtotal	0.40
Neighborhood Parks	
Ashley Dearing Park	4.60
Earle Anderson Park	4.90
Jaycee Park	1.10
Rotary Park	0.30
Subtotal	10.90
Community Parks	
Clemson Park	6.00
Dawson Park	8.20
Larry W. Abernathy Waterfront Park	10.20
Mountain View Park	33.30
Subtotal	57.70
Regional Parks	
Twelve Mile Recreation Area	28.50
W.C. Nettles Park	136.20
Subtotal	164.70
Greenspace/Natural Areas	
Berkeley Orchard	4.80
Gateway Park	4.60
Shanklin-Sams Greenspace	2.50
Tottie's Place	4.10
Subtotal	16.00
Special Use	
Central-Clemson Recreation Center	4.30
Subtotal	4.30
Grand Total	254.00

Figure 25: CPRD System Inventory

3.2.1 Park Land and Trails

Clemson’s level of service for park land and trails aligns with industry medians for agencies of similar size and scope (**Table 1**). At the development of this report, additional park land and trail mileage is being considered for expansion.

Metric	Clemson	All Cities	Less Than 20,000 Population Served	1,501-2,500 Population Per Square Mile	10-19 Parks Maintained
Residents per Park	1,257	2,000	1,225	2,200	2,200
Acres of Park Land per 1,000 Residents	13.5	11.5	13.0	12.3	10.1
Miles of Trail*	6.4**	16	4	18	8

*Trail miles are a combination of paved and unpaved.

**There are also an addition 1.5 miles of trails available outside of park miles.

Table 1: CPRD Park Land and Trails Benchmark



3.2.2 Outdoor Facilities

The percentages in **Table 2** below represent the percentage of agencies that offer a given type of outdoor facility/amenity based on the benchmark characteristic. The numbers in **Table 3** represent the related population-based LOS metric (i.e., 1 facility/amenity for every X number of people). Based on its population size, Clemson typically has a lower level of service for outdoor facilities than industry medians. When examining outdoor amenities offered by agencies of similar size and scope, facilities for future consideration may include youth diamond fields, basketball courts, pickleball courts (currently being constructed as of this plan's development and slated to be ready by December 2024), and youth rectangular fields.

Metric	Clemson	All Cities	Less Than 20,000 Population Served	1,501-2,500 Population Per Square Mile	10-19 Parks Maintained
Baseball Diamond (Adult)	Yes	59%	49%	59%	50%
Baseball Diamond (Youth)	Yes	83%	78%	85%	80%
Basketball Courts	Yes	91%	85%	92%	86%
Community Gardens	Yes	57%	39%	58%	41%
Cricket Fields	-	15%	2%	16%	10%
Dog Parks	Yes	77%	48%	76%	60%
Field Hockey Fields	-	3%	3%	7%	3%
Football Fields	-	39%	25%	42%	29%
Lacrosse Fields	-	11%	4%	15%	5%
Multi-Purpose Fields (Natural)	Yes	71%	58%	68%	70%
Multi-Purpose Fields (Synthetic)	-	23%	6%	24%	15%
Multiuse Courts	-	51%	42%	48%	45%
Outdoor Ice Rink	-	19%	23%	19%	14%
Outdoor Pickleball Courts	-	32%	18%	38%	29%
Outdoor Swimming Pool	-	60%	36%	58%	38%
Outdoor Tennis Courts	Yes	81%	67%	82%	71%
Overlay Fields	-	7%	6%	10%	5%
Playgrounds	Yes	95%	95%	97%	97%
Shelters	Yes	-	-	-	-
Skate Park	Yes	49%	26%	53%	41%
Soccer Fields (Adult)	-	47%	34%	51%	40%
Soccer Fields (Youth)	Yes	55%	51%	58%	46%
Softball Diamond (Adult)	Yes	71%	51%	69%	60%
Softball Diamond (Youth)	Yes	68%	65%	65%	57%
Sprayground/Splashpad	-	-	-	-	-

Table 2: CPRD Outdoor Facilities Prevalence Benchmark



Metric	Clemson LOS	All Cities	Less Than 20,000 Population Served	1,501-2,500 Population Per Square Mile	10-19 Parks Maintained
Baseball Diamond (Adult)	9,400	20,300	7,600	18,200	16,500
Baseball Diamond (Youth)	9,400	6,600	3,100	7,000	6,000
Basketball Courts	12,600	7,000	3,700	7,600	8,000
Community Gardens	18,900	30,300	8,200	39,000	22,000
Cricket Fields	-	105,500	-	112,800	71,700
Dog Parks	18,900	40,600	11,100	44,000	28,900
Field Hockey Fields	-	38,000	18,000	18,000	15,000
Football Fields	-	29,000	8,600	30,700	17,600
Lacrosse Fields	-	37,800	9,800	19,400	33,000
Multi-Purpose Fields (Natural)	6,300	9,100	3,900	8,800	8,800
Multi-Purpose Fields (Synthetic)	-	43,200	9,500	31,000	26,500
Multiuse Courts	-	16,800	5,100	17,200	14,800
Outdoor Ice Rink	-	15,800	8,000	20,100	12,200
Outdoor Pickleball Courts	-	13,300	3,300	12,400	9,500
Outdoor Swimming Pool	-	36,600	9,700	38,700	19,000
Outdoor Tennis Courts	2,700	5,400	2,800	6,000	5,200
Overlay Fields	-	16,600	8,700	20,700	7,400
Playgrounds	2,400	3,300	2,000	3,500	3,800
Shelters	3,100	-	-	-	-
Skate Park	18,900	57,200	10,700	54,100	25,700
Soccer Fields (Adult)	-	14,000	7,000	12,700	11,500
Soccer Fields (Youth)	18,900	7,300	3,600	6,500	7,300
Softball Diamond (Adult)	9,400	13,600	5,800	13,800	12,000
Softball Diamond (Youth)	18,900	12,000	5,100	13,700	7,800
Sprayground/Splashpad	-	-	-	-	-

Table 3: CPRD Outdoor Facilities Population-Based LOS Benchmark



3.2.3 Indoor Facilities

The percentages in **Table 4** below represent the percentage of agencies that offer a given type of indoor facility/amenity based on the benchmark characteristic. The numbers in **Table 5** represent the related population-based LOS metric (i.e., 1 facility/amenity for every X number of people). Clemson offers one recreation center that is operated in conjunction with the City of Central. The Central-Clemson Recreation Center sits on four acres and includes an aquatics area, fitness and wellness area, and gymnasium space. More study is warranted to understand the utility of the Central-Clemson Recreation Center based on its location, proximity, and access for Clemson residents.

Metric	Clemson	All Cities	Less Than 20,000 Population Served	1,501-2,500 Population Per Square Mile	10-19 Parks Maintained
Aquatics Centers	-	33%	16%	31%	31%
Arenas	-	8%	4%	12%	4%
Community Centers	-	62%	52%	64%	56%
Indoor Ice Rinks	-	13%	7%	14%	5%
Nature Centers	-	29%	11%	35%	21%
Performance Amphitheaters	-	45%	16%	45%	32%
Recreation Centers (including gyms)	Yes	69%	47%	70%	50%
Senior Centers	-	50%	22%	48%	32%
Stadiums	-	22%	13%	24%	14%
Teen Centers	-	15%	7%	10%	12%

Table 4: CPRD Indoor Facilities Prevalence Benchmark

Metric	Clemson LOS	All Cities	Less Than 20,000 Population Served	1,501-2,500 Population Per Square Mile	10-19 Parks Maintained
Aquatics Centers	-	56,100	11,700	53,600	37,400
Arenas	-	78,300	5,500	91,000	96,000
Community Centers	-	27,500	8,800	34,000	23,200
Indoor Ice Rinks	-	43,200	8,000	60,700	17,400
Nature Centers	-	99,800	10,600	101,500	48,300
Performance Amphitheaters	-	58,700	11,100	59,400	33,900
Recreation Centers (including gyms)	18,900	33,500	9,700	32,400	22,200
Senior Centers	-	65,400	14,000	73,300	28,300
Stadiums	-	68,300	9,300	72,100	27,900
Teen Centers	-	59,700	14,600	58,200	23,300

Table 5: CPRD Indoor Facilities Population-Based LOS Benchmark



3.2.4 General Programming

Clemson’s recreation programming primarily focuses on athletics, camps, community events, senior programming, and activities based out of the Central-Clemson Recreation Center. In terms of potential programming to add, health and wellness education, fitness enhancement classes, and racquet sports are offered by a large percentage of agencies of similar size and scope.

The percentages in **Table 6** below represent the percentage of agencies that offer this type of recreation programming based on the benchmark characteristic.

Metric	Clemson	All Cities	Less Than 20,000 Population Served	1,501-2,500 Population Per Square Mile	10-19 Parks Maintained
Aquatics	☒	77%	53%	75%	59%
Cultural Crafts	☐	64%	40%	73%	57%
eSports/eGaming	☐	25%	12%	26%	15%
Fitness Enhancement Classes	☐	85%	64%	87%	76%
Golf	☐	52%	22%	63%	34%
Health and Wellness Education	☐	82%	64%	84%	75%
Individual Sports	☒	81%	64%	79%	73%
Martial Arts	☐	61%	35%	58%	49%
Natural and Cultural History	☐	65%	34%	72%	57%
Performing Arts	☐	66%	39%	71%	57%
Racquet Sports	☐	76%	60%	75%	62%
Running/Cycling Races	☐	51%	40%	56%	43%
Safety Training	☐	72%	63%	75%	64%
Social Recreation Events	☒	91%	82%	94%	83%
Team Sports	☒	92%	82%	89%	82%
Themed Special Events	☒	92%	82%	94%	86%
Trips and Tours	☐	61%	41%	61%	53%
Visual Arts	☐	64%	39%	66%	54%

Table 6: CPRD General Programming Benchmark



3.2.5 Targeted Programs

As mentioned in the previous section, Clemson offers programs geared toward seniors and summer/break camps. Four program areas should be considered based on benchmark comparisons including after school programs, programs for people with disabilities, specific teen programs, and STEM programs. Again, public engagement should validate any potential programmatic expansion.

Metric	Clemson	All Cities	Less Than 20,000 Population Served	1,501-2,500 Population Per Square Mile	10-19 Parks Maintained
After School Programs	☐	55%	45%	61%	43%
Before School Programs	☐	15%	16%	15%	13%
Full Daycare	☐	6%	5%	4%	4%
Preschool	☐	28%	24%	35%	30%
Programs for People with Disabilities	☐	65%	34%	65%	55%
Specific Senior Programs	☒	82%	61%	84%	72%
Specific Teen Programs	☐	68%	43%	78%	60%
STEM Programs	☐	57%	42%	66%	48%
Summer Camp	☒	81%	60%	88%	74%

Table 7: CPRD Targeted Programming Benchmark

3.3 Staffing

Clemson is understaffed compared to agencies of similar size and scope, both in terms of total full-time equivalents (FTEs) available and FTEs per 10,000 residents.

Metric	Clemson	All Cities	Less Than 20,000 Population Served	1,501-2,500 Population Per Square Mile	10-19 Parks Maintained
Full-Time Equivalents (FTEs)	10	60	32	74	29
FTEs per 10,000 Residents	5.3	10.3	10.7	9.9	8.6

Table 8: CPRD Staffing Benchmark



3.3.1 Budget Metrics

Clemson operates on a \$1.9M budget, spanning four different accounts including 12-Mile Recreation Area's budget. This figure tends to align with agencies of similar population size, but not of those that have a similar population density or maintain a similar number of parks. Additionally, Clemson aligns with the majority of budget metrics benchmarked against industry medians except for operating expenditures per FTE.

Metric	Clemson	All Cities	Less Than 20,000 Population Served	1,501-2,500 Population Per Square Mile	10-19 Parks Maintained
Annual Operating Expenditures	\$1.9M	\$6.5M	\$1.2M	\$7M	\$3.2M
Operating Expenditures per Capita	\$100	\$108	\$121	\$96	\$92
Operating Expenditures per Acre	\$7,400	\$8,200	\$7,500	\$6,400	\$7,300
Operating Expenditures per FTE	\$188,660	\$105,400	\$102,100	\$100,700	\$107,000
Revenues per Capita	\$19	\$22	\$31	\$22	\$22
Revenue as a Percentage of Operating Expenditures (Cost Recovery)	19%	20%	26%	22%	22%

Table 9: CPRD Budget Metrics Benchmark

3.3.2 Distribution of Operating Expenditures

When examining the distribution of operating expenditures, Clemson spends less on personal services and more on capital expenses (not included in a separate Capital Improvement Plan) than agencies of similar size and scope.

Metric	Clemson	All Cities	Less Than 20,000 Population Served	1,501-2,500 Population Per Square Mile	10-19 Parks Maintained
Personal Services	46%	56%	51%	55%	54%
Operating Expenses	34%	37%	41%	37%	36%
Capital Expense (Not In CIP)	14%	5%	6%	5%	8%
Other	6%	2%	2%	3%	2%

Table 10: CPRD Distribution of Operating Expenditures Benchmark



3.3.3 Sources of Operating Expenditures

In terms of sources for operating expenditures, Clemson relies more on the general fund than benchmark statistics; however, the general fund is supplemented by other dedicated taxes and earned/generated income.

Metric	Clemson	All Cities	Less Than 20,000 Population Served	1,501-2,500 Population Per Square Mile	10-19 Parks Maintained
General Fund Tax Support	71%	67%	62%	60%	63%
Earned/Generated Income	19%	19%	25%	23%	21%
Dedicated Levies	5%	5%	7%	8%	8%
Other Dedicated Taxes	-	4%	1%	4%	2%
Grants	-	2%	3%	1%	2%
Sponsorships	-	1%	1%	1%	1%
Other	5%	2%	1%	3%	3%

Table 11: CPRD Sources of Operating Expenditures Benchmark

3.3.4 Capital Budget

The median statistic for capital improvement spending is \$11 million over a five-year period for all cities. Based on capital expense actuals and projections from 2020-2024, Clemson has expended \$2 million on improving the park system. It should be noted, additional funds have been available and are projected to be available in the future due to funds transfers and additional capital funding options.

Metric	Clemson	All Cities	Less Than 20,000 Population Served	1,501-2,500 Population Per Square Mile	10-19 Parks Maintained
Five-Year Capital Budget Spending	\$2M	\$11M	\$2M	\$11M	\$4M

Table 12: CPRD Capital Budget Benchmark

3.4 Discussion and Implications

3.4.1 More Consistent Capital Funding

Although Clemson has had capital monies available for its park system, it does not appear to be consistent of how it is expended. More consistently using external capital dollars (outside of the general budget) can help alleviate the pressure to use general fund monies for capital expenditures. Additionally, a more formal capital improvement plan (CIP) program is warranted that identifies asset/facility lifecycles, replacement schedules, current replacement values, and priority.



3.4.2 Retaining Earned Income

Budget metrics show Clemson generates approximately 19% of its budget through earned income; however, the metric can be misleading. All funds generated by the department are returned to the General Fund and are used to offset next year's budget. Most agencies are moving toward a consistent General Fund tax support amount with earned/generated income being retained by the department *in addition to* the baseline tax support amount. This helps to incentivize earned income opportunities and allows the department to be more entrepreneurial in its approach to delivering programs and services.

3.4.3 Increase Staffing

Based on benchmark statistics, Clemson is understaffed for its park system and community size. With system expansion being a possibility, it will be important to identify a baseline staffing standard so additional park land and facilities do not automatically lower the standard of care (or level of service) provided by the department due to staffing constraints. Additionally, the ability to retain earned income can assist with increasing staff when a department is able to help support itself through revenue generating opportunities.

3.4.4 Indoor Recreation Space Needs More Study

With Clemson's population approaching 20,000 residents, it is becoming closer to national metrics for an indoor recreation center level of service. The Central-Clemson Recreation Center does currently serve residents, but it also serves Central residents and is not geographically located well for Clemson residents. With more a more limited recreation program portfolio and indoor space not geographically located well for Clemson residents, further investigation is warranted to understand if the department (and community) needs a new dedicated indoor recreation space.

3.5 Recreation Programs and Services

3.5.1 Athletics

CPRD offers sports in each season throughout the year. With a focus on recreational sports, making lifelong memories, improving skills, and providing positive outcomes are the priority. In all, over 2,300 athletic teams participated in CPRD sport programs in 2023. The following athletic offerings are provided:

- Spring
 - T-ball
 - Youth baseball
 - Softball (youth and adult)
 - Soccer
 - Volleyball
- Summer
 - Tennis clinics
- Fall
 - Youth baseball
 - Softball
 - Soccer
 - Volleyball (youth and adult)
 - Cross country
- Winter
 - Basketball (youth and adult)



3.5.2 Camps

Spring Break

Spring Break Camp is a one-week offering that utilizes two full-time, 10 part-time, and 40 volunteer staff. In 2023, 100 campers participated during the week.

Summer

Summer Day Camp is a 6-week camp that utilizes two full-time and 33 part-time staff. In 2023, 350 campers participated throughout the summer. An additional several hundred campers participated in summer sports camps as well.

3.5.3 Events and Programs

There were 49 events scheduled for 2023 which resulted in over 13,000 people participating. Events and programs include: community garage sales, CAAAM collaboration events, senior luncheons, senior trips, breakfast with Santa, picnic in the park, mobile recreation, movies in the park, and other holiday themed community events.



3.5.4 Program Expansion

Currently, indoor recreation space is limited which hinders CPRD's ability to expand recreation programs. The ability to expand recreation programming is influenced largely by the ability for additional space and staffing levels. More investigation is warranted to understand the need for indoor recreation space.



Chapter 4 - Community Engagement

4.1 Stakeholder Interviews and Focus Groups

Zec Eight Insights conducted stakeholder interviews and focus groups throughout the fall 2023 months. Meetings were held virtually via Zoom or general phone conversations or in person at CPRD headquarters in Nettles Park. Invited and engaged stakeholders included: Park Board members, City Council members, CPRD staff, CAAAM staff, athletics organizations, Central-Clemson Recreation Center staff, Clemson University representatives, conservation groups, civic groups, special interest groups, and representatives of the Green Crescent Trail.

Talking with vested stakeholders allowed the consultant to understand overarching goals and objectives for the *Parks and Recreation Master Plan* while also providing key context to the planning process. The following key themes were derived from the stakeholder interview and focus group process. Of note, the themes are not presented in any order of magnitude or importance; rather, these represent a comprehensive listing of the most salient ideas.

4.1.1 Key Themes

More trail connections. Stakeholders strongly support the efforts that created the Green Crescent Trail and have noticed the impact it has had on the community. As a result, and in an effort to reduce fragmentation throughout the park system, stakeholders desire to see more trail connections and pathways. They mention the desire to see less reliance on vehicular travel and more promotion of alternative transportation methods and human-powered options. Additionally, more trails and pathways can lead to more running and bicycling events as an added bonus.

Enhance the “Town and Gown” relationship. All stakeholders understand the importance of Clemson University to the community. An interesting indirect effect the university has on city services is through its approach to community or public use of university facilities. As community or public use has decreased over time, more pressure is being put on the CPRD park system. Although it is not an inherently negative notion to have people using facilities it is more about the existing level of service, demand on facilities, availability of facilities, and associated maintenance levels to take care of the park system. Therefore, stakeholders desire to see a more connected and unified approach to recreation facility use, pathway development, program and event promotion and awareness, and overall long-range planning to fully address community needs.

Lake Hartwell may be an underutilized resource. Stakeholders note one of the CPRD’s greatest strengths, or assets, is Lake Hartwell and the natural outdoor recreation space available to the community. Abernathy Park, Mountain View Park, and the newly acquired Twelve Mile Recreation Area are all adjacent to the lake and offer scenic views, picnicking, and water access. As many municipalities across the country are looking toward their water resources to activate their communities, the same can be said of Clemson. More opportunities exist for water sports, boating, canoeing/kayaking, blueways, boat launches (both motorized and non-motorized), boardwalks and pathways, and event/gathering spaces. These opportunities can come in the form of either leader-led programs and/or self-directed opportunities and experiences.

Indoor recreation space is lacking. Stakeholders appreciate what the Central-Clemson Recreation Center provides to the community, but they are generally underwhelmed with the availability of publicly accessible indoor recreation space within Clemson. They note the need for true four-season spaces and



the ability to expand recreational offerings. Based on stakeholder feedback, indoor recreation space needs span a wide spectrum of activity topics such as arts, camps, sports/athletics (both for games and practices), rental spaces, and the like.

Address lagging staffing levels. Stakeholders appreciate their dedicated staff and acknowledge how personable they are and how great the relationships are among staff and various stakeholder groups. They also acknowledge how well the staff are doing at their existing capacities, but know what the existing staff can do is constrained by available personnel and resources. They desire to see more assistance with maintaining the park system and with expanding community programs, events, and service offerings.

More family programming. With the success of community events, stakeholders see an increased focus on family programming as the next big step for CPRD services. More parent/child offerings, specialized camps, and community festivals and events were all mentioned as growth areas. Additionally, continuing to focus on providing recreation programming for all ages and abilities was noted.

Seek to incorporate diverse funding sources. Stakeholders would like to see alternative funding mechanisms be included to fund the system. Specific options mentioned included: fees and charges, revenue sharing, grants, impact fees, sponsorships and naming rights, philanthropy and planned giving opportunities, Friends Group and/or dedicated foundation, joint ventures/opportunities with Clemson University, South Carolina Delegation Appropriations, South Carolina Conservation Bank, Water Recreation Funds, and millage increase dedicated to parks and recreation.

4.2 Public Input Opportunities

Three public input opportunities were offered throughout the planning process and generated interactions with over 500 individuals:

- 1) Statistically valid community survey (327 people).
- 2) Online community survey (177 people).
- 3) Virtual public meeting (23 people).

4.2.1 Statistically Valid Community Survey

Methodology

ETC Institute mailed a survey packet to a random sample of households in Clemson. Each survey packet contained a cover letter, a copy of the survey, and a postage-paid return envelope. Residents who received the survey were given the option of returning the survey by mail or completing it online at ClemsonParkSurvey.org.

After the surveys were mailed, ETC Institute followed up with residents to encourage participation. To prevent people who were not residents of Clemson from participating, everyone who completed the survey online was required to enter their home address prior to submitting the survey. ETC Institute then matched the addresses that were entered online with the addresses that were originally selected for the random sample. If the address from a survey completed online did not match one of the addresses selected for the sample, the online survey was not included in the final database for this report.

The goal was to collect a minimum of 300 completed surveys from residents. The goal was met with 327 completed surveys collected. The overall results for the sample of 327 households has a precision of at least ± 5.3 at the 95% level of confidence. The full survey report can be found in the **Appendix**.



Key Findings

Clemson Recreation and Parks Facilities

Parks Use Overview. Ninety percent (90%) of respondents said that someone in their household had visited any of the City of Clemson parks or recreation facilities in the past year. Most of those respondents (83%) rated the overall quality of those parks as either “good” (63%) or “excellent” (20%). Most respondents (63%) say they live within a 10-minute walk from a park. Of those who do not live within a 10-minute walk, the largest percentage (40%) said it would take 25 minutes or longer to walk to the nearest park from their home. Most respondents (55%) have access to a pedestrian route to safely access the closest park from their home. However, 56% say that the pedestrian route needs improvement or that they don’t have a pedestrian route (44%).

Parks and Facilities Use. Respondents were provided with a list of 14 Clemson Parks and Recreation sites and asked to indicate which ones their household had visited over the past year. The sites most often visited by respondents were W.C Nettles Park (59%), Central-Clemson Recreation Center (48%), and Larry W. Abernathy Waterfront Park (30%). Respondents most often travel to parks and recreation areas via personal vehicle (89%), walking (54%), or bicycle (19%).

Recreation Programs Participation

Participation Overview. Forty-one percent (41%) of respondents report participating in recreation programs offered by Clemson Parks and Recreation Department in the past year. Of those respondents who participated, the highest percentage (71%) report participating in 1-3 programs followed by 4-6 programs (23%). Most respondents (94%) rated these programs as either “good” (48%) or “excellent” (48%).

Barriers to Participation. Respondents were asked to select all the reasons that prevent their household from using recreation programs offered by the city. Most often respondents said they do not know what is offered/available (29%), not interested/too busy (22%), or what they desire is not offered (14%).

Other Major Findings

Services Satisfaction. Respondents were provided with a list of 11 services provided by the City of Clemson Parks and Recreation Department and asked to rate their level of satisfaction with each. Respondents were most satisfied (rating “satisfied” or “very satisfied”) with how close parks are location to their home (71%), the maintenance of parks (66%), and the number of parks (65%). The three services respondents think should receive the most emphasis from city leaders over the next five years are the maintenance of parks (35%), availability of information about programs/facilities (24%), and the quality of programs for adults (23%). This question was further analyzed in section 5 of this report, the importance-satisfaction analysis.

Communication Methods. Respondents most often report learning about programs and services offered by the City of Clemson via word of mouth (39%), social media (39%), and email blasts/newsletters (33%). Respondents would most prefer to receive communication via email blasts/newsletters (44%), social media (33%), or the city department or website (23%).

Funding Allocation. Respondents were told to allocate a hypothetical \$100 for various parks and recreation categories. Respondents provided the greatest amount (on average) of funding towards developing new trails and greenways (\$31.02) and improvements or maintenance of existing parks, trails, and facilities (\$30.55).



Benefits of Parks and Recreation. Most respondents (75%) said they were either “satisfied” (41%) or “very satisfied” (34%) with the overall value their household receives from the City of Clemson Parks and Recreation Department. Respondents were provided with a list of 12 potential benefits of parks, trails, recreation facilities, programs, and services of Clemson and asked to rate their agreement with each statement. Respondents most often agreed (rating “agree” or “strongly agree”) that parks and recreation provide outdoor recreation (96%), makes the city a more desirable place to live (94%), and improves physical health/fitness (94%) The three most important benefits of parks and recreation to respondents are improves physical health and fitness (57%), preserving open space and the environment (39%), and makes the city a more desirable place to live (30%).

Parks and Recreation Facilities/Amenities Needs and Priorities

Amenity/Facility Needs: Respondents were asked to identify if their household had a need for 33 facilities/amenities and to rate how well their needs for each were currently being met. Based on this analysis, ETC Institute was able to estimate the number of households in the community that had the greatest “unmet” need for various facilities/amenities.

The three amenities/facilities with the highest percentage of households that have an unmet need:

1. Paved connectivity trails for bikes and pedestrians – 4,481 households
2. Unpaved hiking trails within parks – 3,963 households
3. Splash pads/interactive water play or features – 3,932 households

The estimated number of households that have unmet needs for each of the 33 facilities/amenities assessed is shown in **Figure 26**.

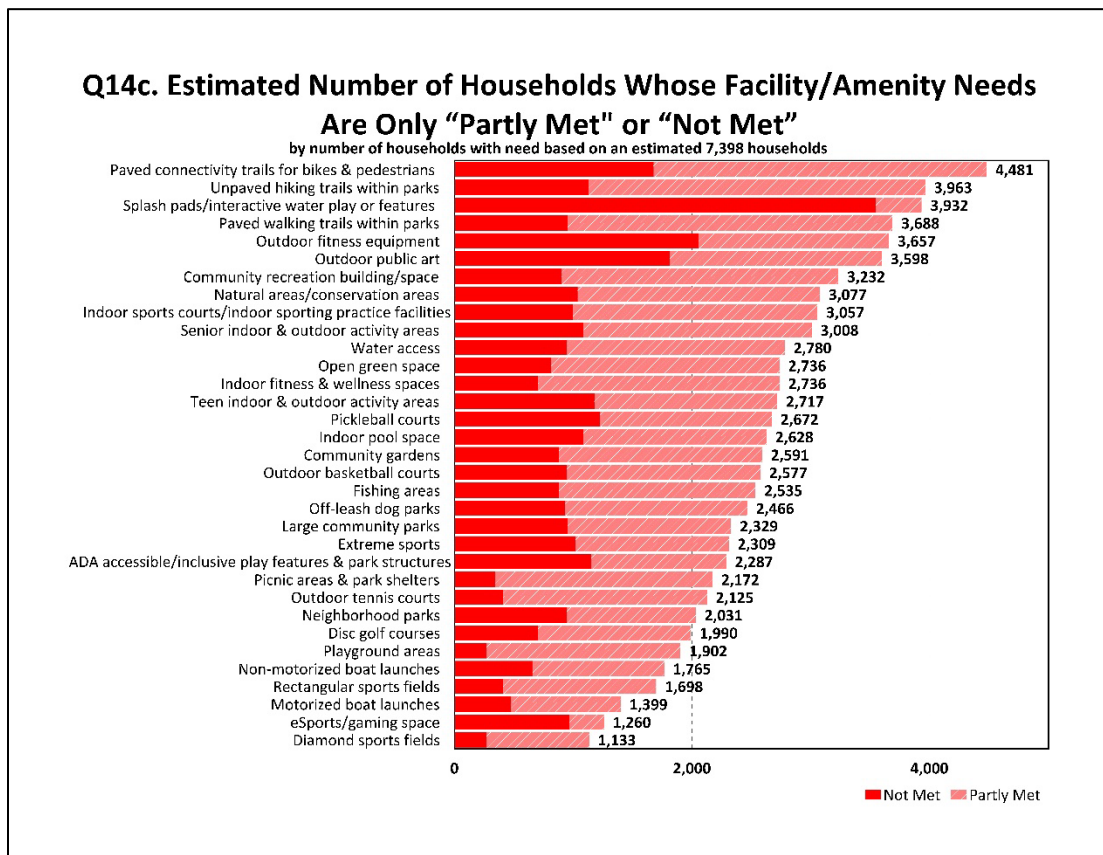


Figure 26: Number of Households with Given Facility/Amenity Needs



Amenities/Facilities Importance: In addition to assessing the needs for each amenity/facility, ETC Institute also assessed the importance that residents placed on each item. Based on the sum of respondents' top four choices, these were the four amenities/facilities ranked most important to residents:

1. Neighborhood parks (31%)
2. Natural areas/conservation areas (30%)
3. Paved connectivity trails for bikes and pedestrians (26%)
4. Unpaved hiking trails within parks (21%)

The percentage of residents who selected each amenity/facility as one of their top four choices is shown in the **Figure 27**.

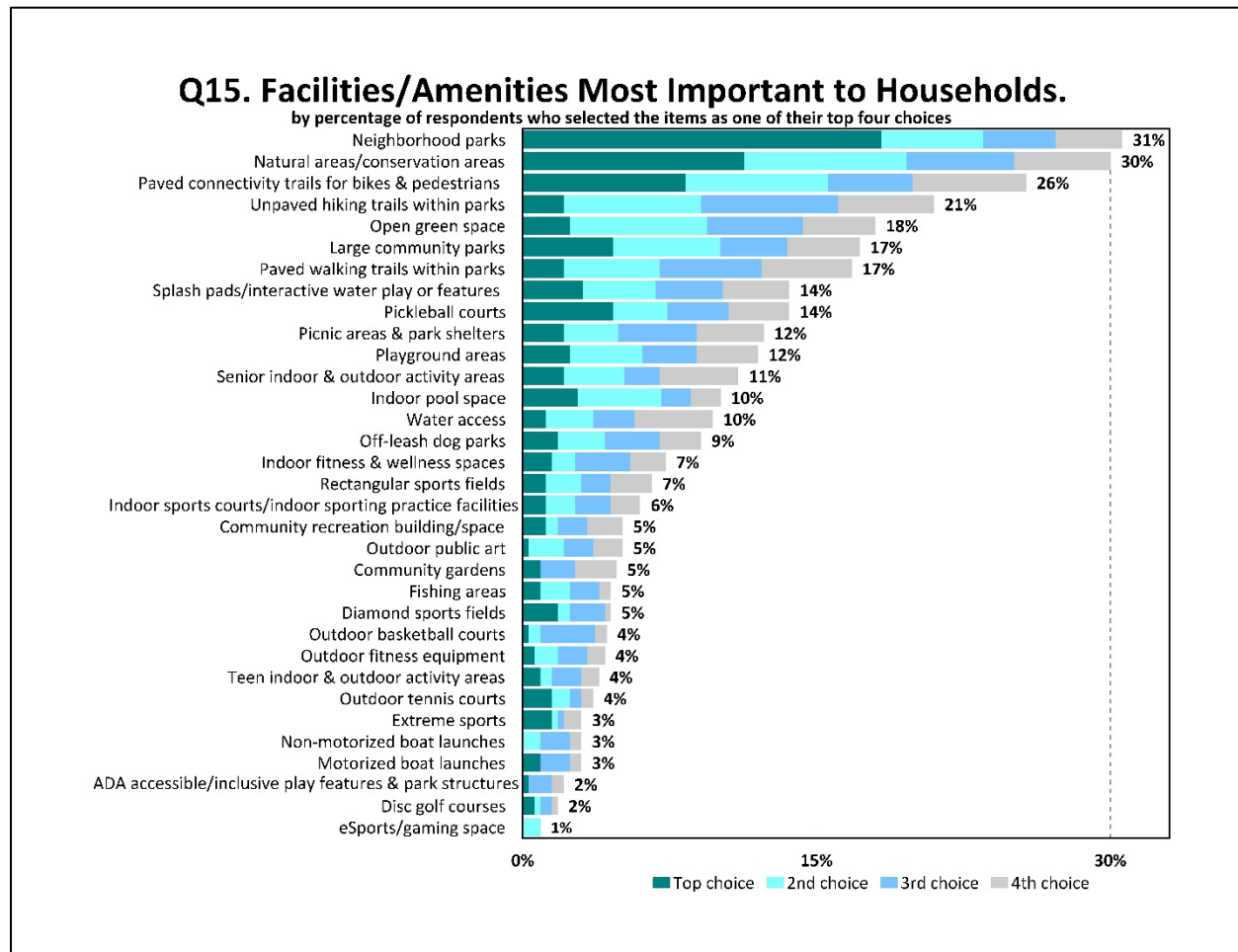


Figure 27: Facilities/Amenities Most Important to Households



Priorities for Facility Investments: The **Priority Investment Rating (PIR)** was developed by ETC Institute to provide organizations with an objective tool for evaluating the priority that should be placed on recreation and parks investments. The Priority Investment Rating (PIR) equally weighs (1) the importance that residents place on amenities/facilities and (2) how many residents have unmet needs for the amenity/facility.

Based the Priority Investment Rating (PIR), the following amenities/facilities were rated as high priorities for investment:

1. Paved connectivity trails for bikes & pedestrians (PIR= 184)
2. Natural areas/conservation areas (PIR= 166.7)
3. Unpaved hiking trails within parks (PIR= 157.1)
4. Neighborhood parks (PIR= 145.3)
5. Paved walking trails within parks (PIR= 137.2)
6. Splash pads/interactive water play or features (PIR= 132.2)
7. Open green space (PIR= 119.9)
8. Large community parks (PIR= 108.2)
9. Pickleball courts (PIR= 104.1)
10. Senior indoor & outdoor activity areas (PIR= 103.1)

Figure 28 shows the Priority Investment Rating for each of the 33 facilities/parks assessed on the survey.

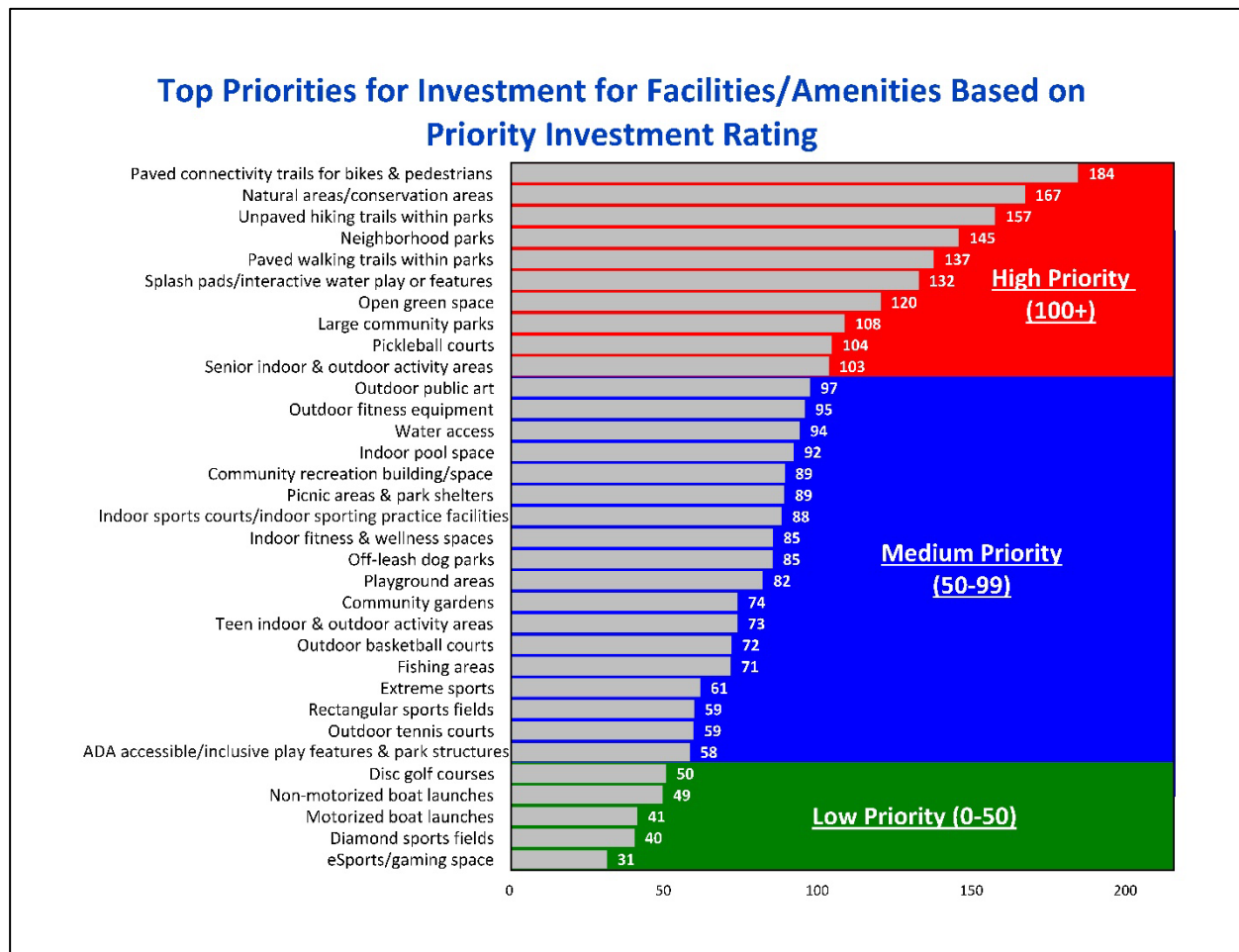


Figure 28: Facilities/Amenities PIR



Recreation Program/Activity Needs and Priorities

Activity/Program Needs: Respondents were asked to identify if their household had a need for 24 programs/activities and to rate how well their needs for each were currently being met. Based on this analysis, ETC Institute was able to estimate the number of households in the community that had the greatest “unmet” need for various activities/programs.

The three programs with the highest percentage of households that have an unmet need:

1. Special events – 3,688 households
2. Nature programs/environmental education – 3,416 households
3. Water-based recreation programs – 3,259 households

The estimated number of households that have unmet needs for each of the 24 programs assessed is shown in **Figure 29**.

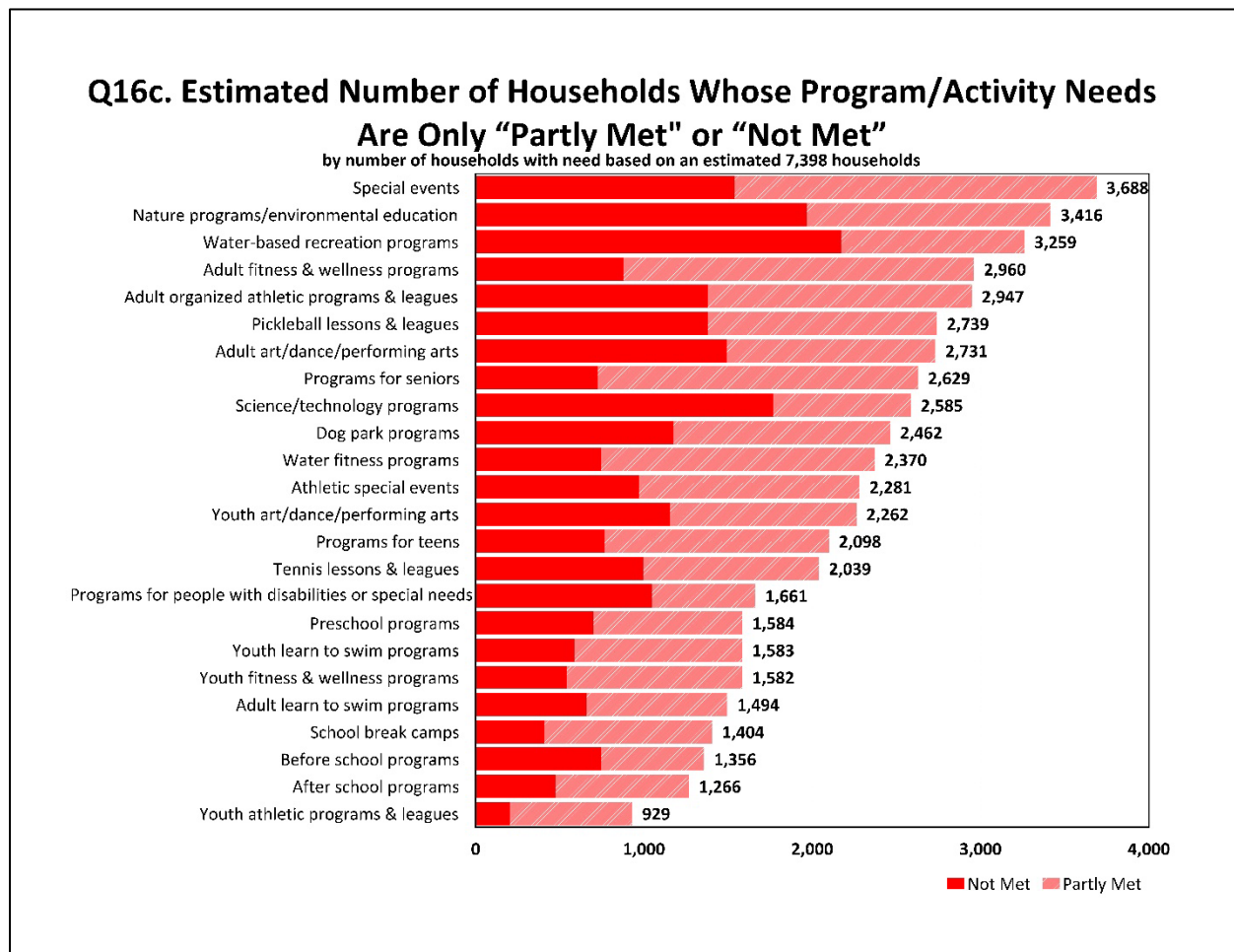


Figure 29: Number of Households with Given Program/Activity Needs



Programs Importance: In addition to assessing the needs for each program, ETC Institute also assessed the importance that residents placed on each item. Based on the sum of respondents' top four choices, these were the four programs ranked most important to residents:

1. Special events (33%)
2. Adult continuing education programs (29%)
3. Nature programs/environmental education 18%)
4. Programs for seniors (17%)

The percentage of residents who selected each program as one of their top four choices is shown in Figure 30.

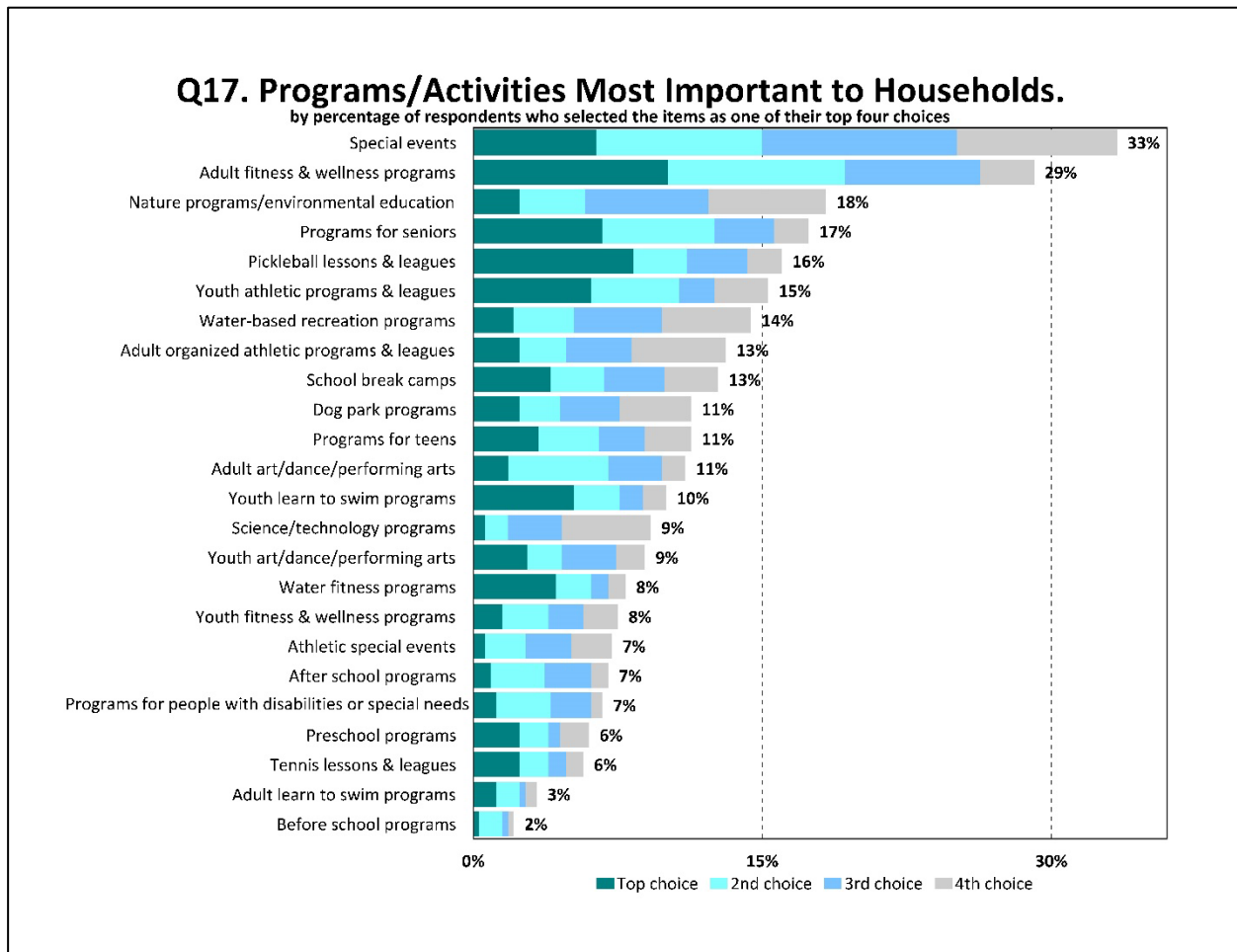


Figure 30: Programs/Activities Most Important to Households



Priorities for Activity/Program Investments: The **Priority Investment Rating (PIR)** was developed by ETC Institute to provide organizations with an objective tool for evaluating the priority that should be placed on recreation and parks investments. The Priority Investment Rating (PIR) equally weighs (1) the importance that residents place on programs and (2) how many residents have unmet needs for the activity/program.

Based the Priority Investment Rating (PIR), the following programs were rated as high priorities for investment:

1. Special events (PIR=200)
2. Adult fitness and wellness programs (PIR=167)
3. Nature programs/environmental education (PIR=147)
4. Water-based recreation programs (PIR=132)
5. Programs for seniors (PIR=123)
6. Pickleball lessons and leagues (PIR=122)
7. Adult organized athletic programs and leagues (PIR=119)
8. Adult art/dance/performing arts (PIR=107)
9. Dog park programs (PIR=101)

Figure 31 shows the Priority Investment Rating for each of the 24 activities/programs assessed on the survey.

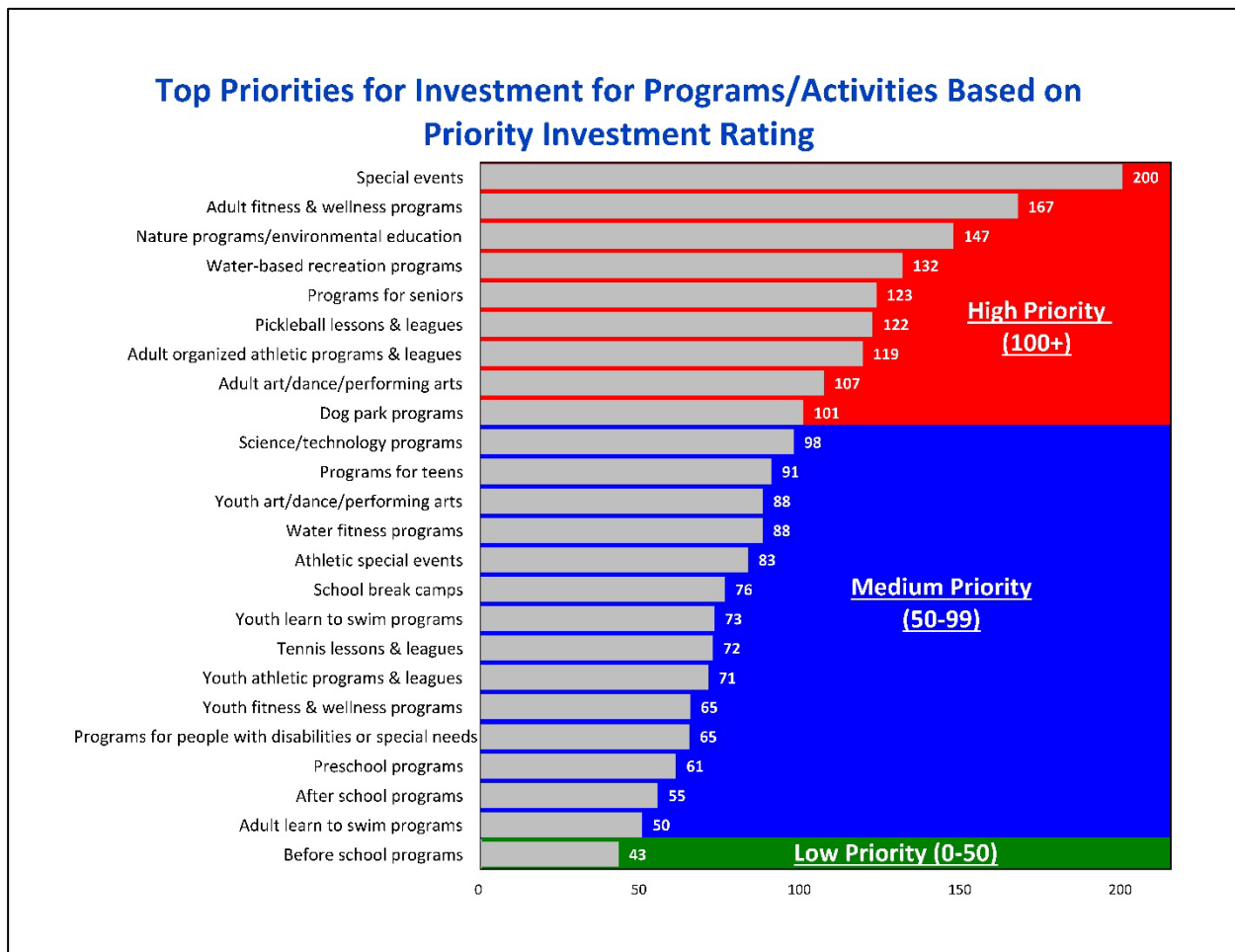


Figure 31: Programs/Activities PIR



4.2.2 Online Survey

An online survey was launched to solicit general public feedback about parks and recreation services in Clemson. The survey was open from mid-January to March 2024. The survey consisted of 29 questions (including demographic questions) and took users an average of ten minutes to complete. A total of 177 responses were recorded, consisting of 65% residents and 35% non-residents. Non-residents were allowed to participate in the survey because of the regional draw CPRD programs, events, and services have. The survey was advertised in person, on social media, and during the virtual public meeting. Survey results can be found in the **Appendix**.

4.2.3 Public Meeting

A virtual public meeting was held on March 7, 2024 from 7-8pm via Zoom. Advertisements were distributed via social media (**Figure 33**). A total of 23 participants joined the meeting throughout the hour. The meeting format included a presentation by Zec Eight Insights, live polling, and then a discussion of next steps.

Live polling consisted of seven questions and provided meeting participants with an interactive way to give feedback and input for the planning process. The questions asked were:

1. Did anything surprise you or do you have any additional input based on what you just heard? **Open-ended response.**
2. What programs would you like the City of Clemson to offer (either more of or in general)? **Word cloud response.**
3. What facilities or amenities would you like the City of Clemson to offer (either more of or in general)? **Word cloud response.**
4. What should be the focus of the next five years? **Ranking scale response.**
5. Anything else you can think of? **Open-ended response.**
6. Do you think we can achieve your vision? **Rating scale response.**
7. Why did you rate that way? **Open-ended response.**

The following section presents the interactive polling results (**Figures 34-47**).

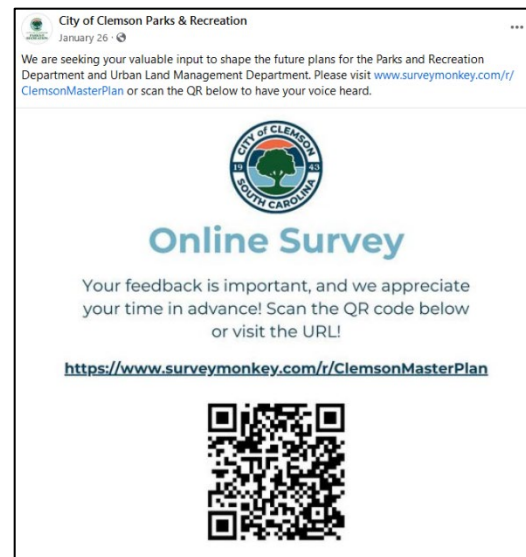


Figure 32: Online Survey Notification

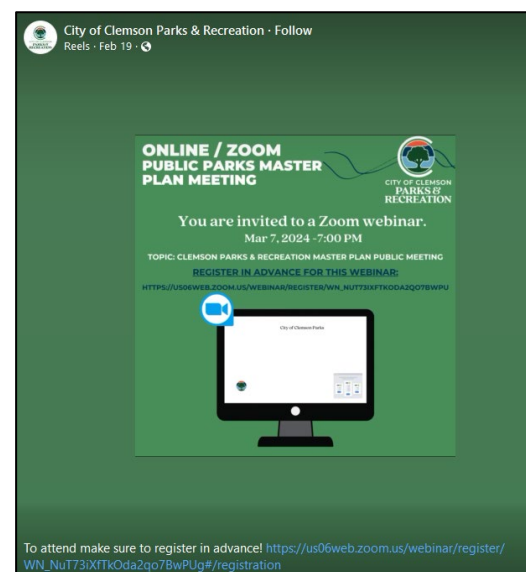


Figure 33: Public Meeting Notification



Question #1

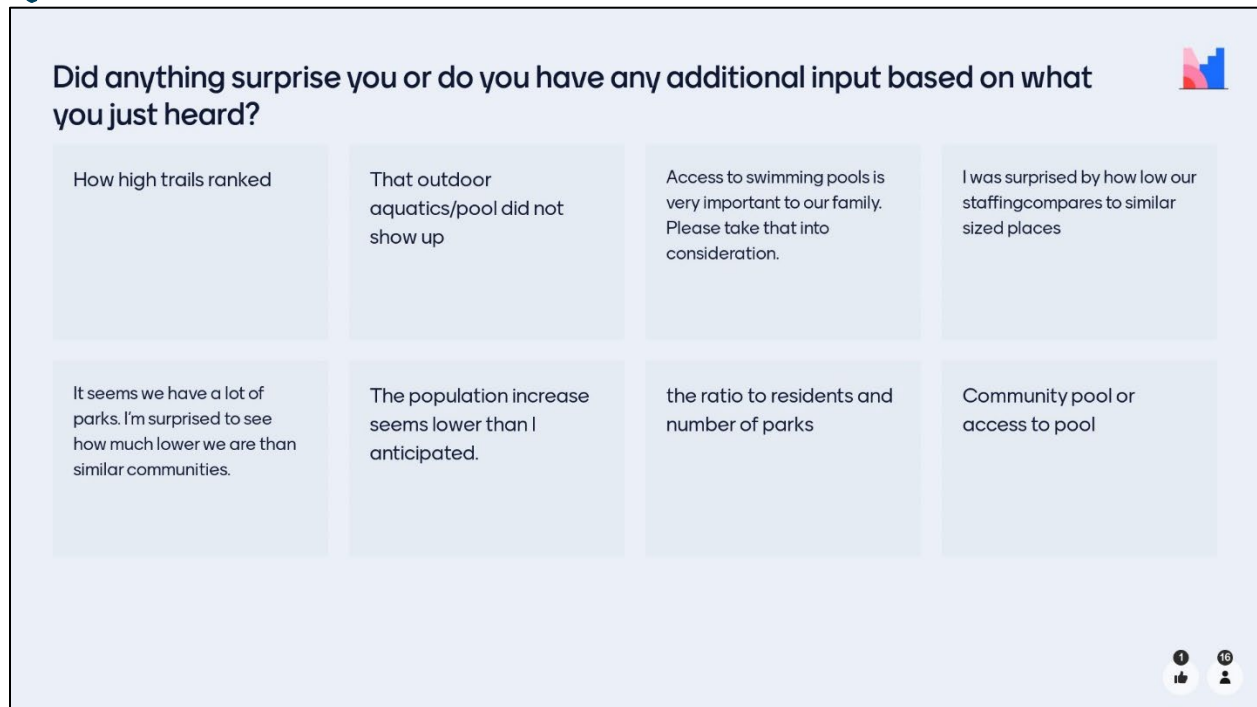


Figure 34: Virtual Public Meeting Question 1 Results Part I

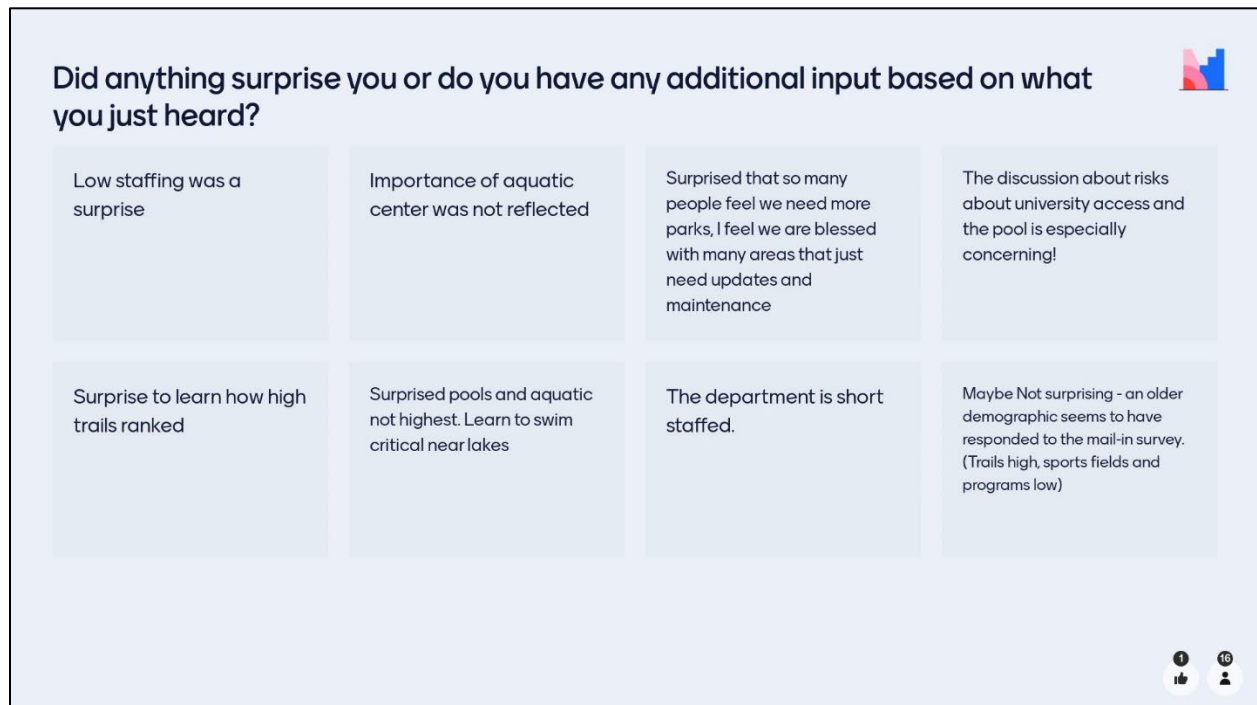


Figure 35: Virtual Public Meeting Question 1 Results Part II

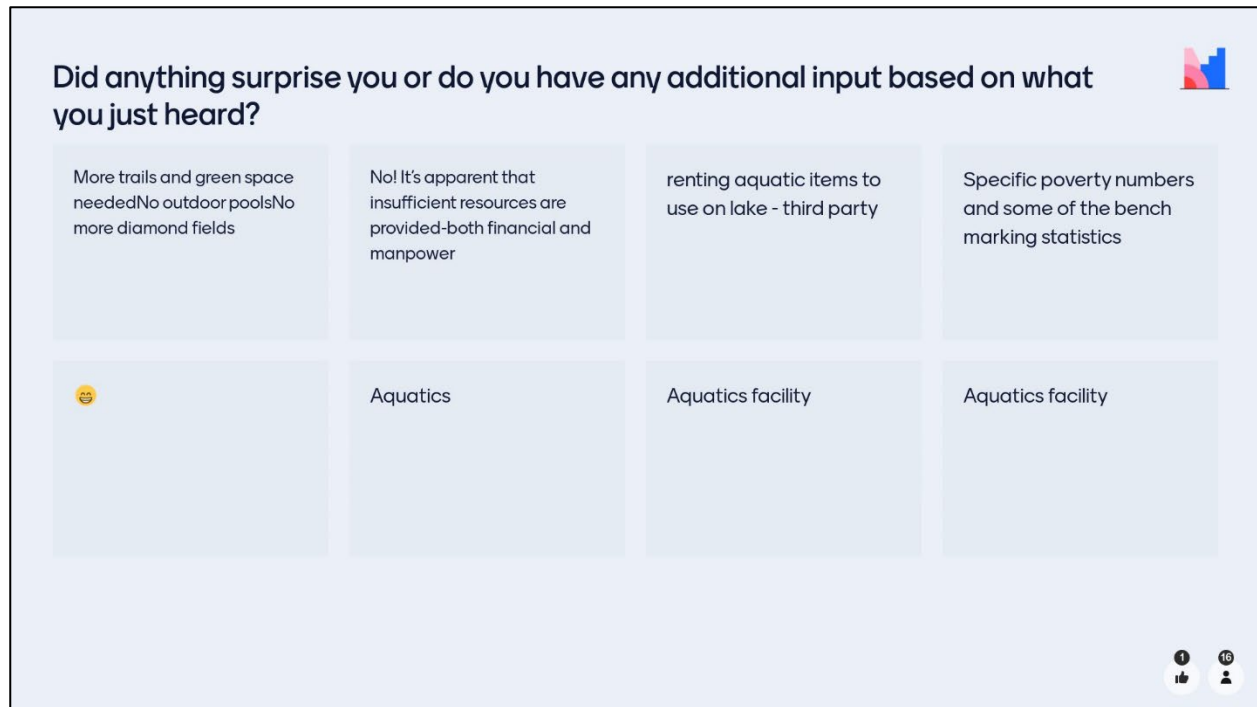


Figure 36: Virtual Public Meeting Question 1 Results Part III

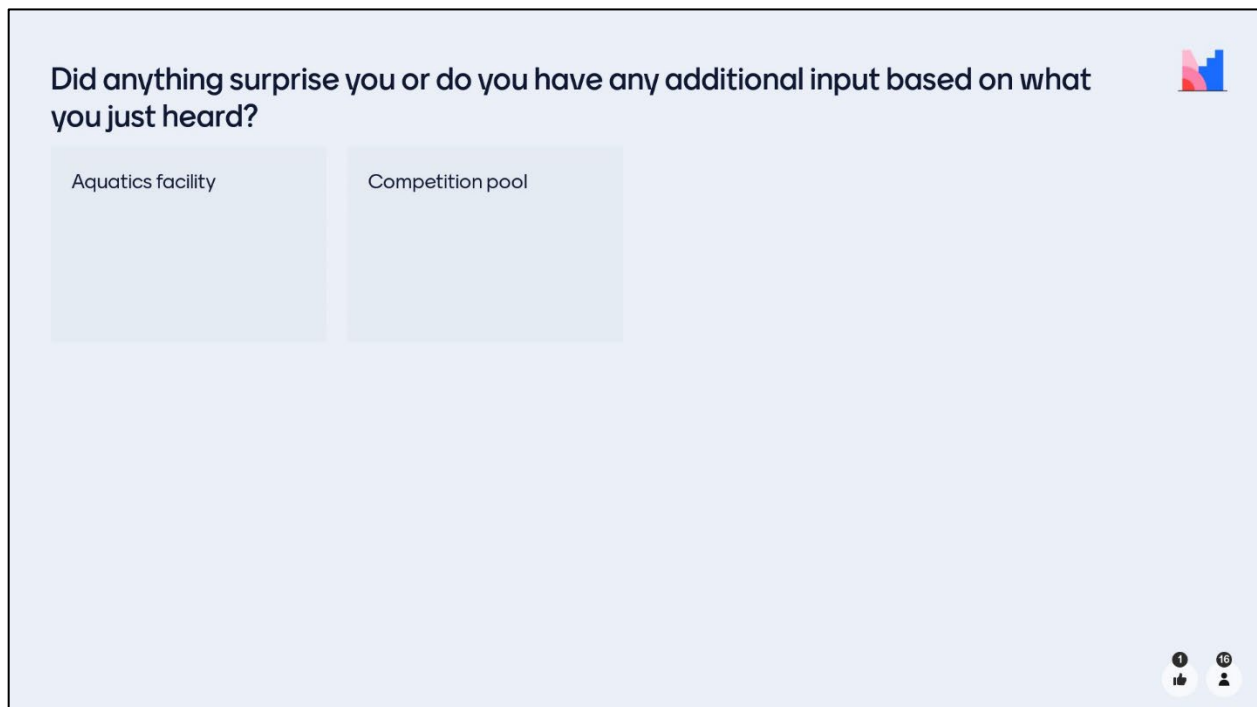


Figure 37: Virtual Public Meeting Question 1 Results Part IV



Question #2



Figure 38: Virtual Public Meeting Question 2 Results

Question #3

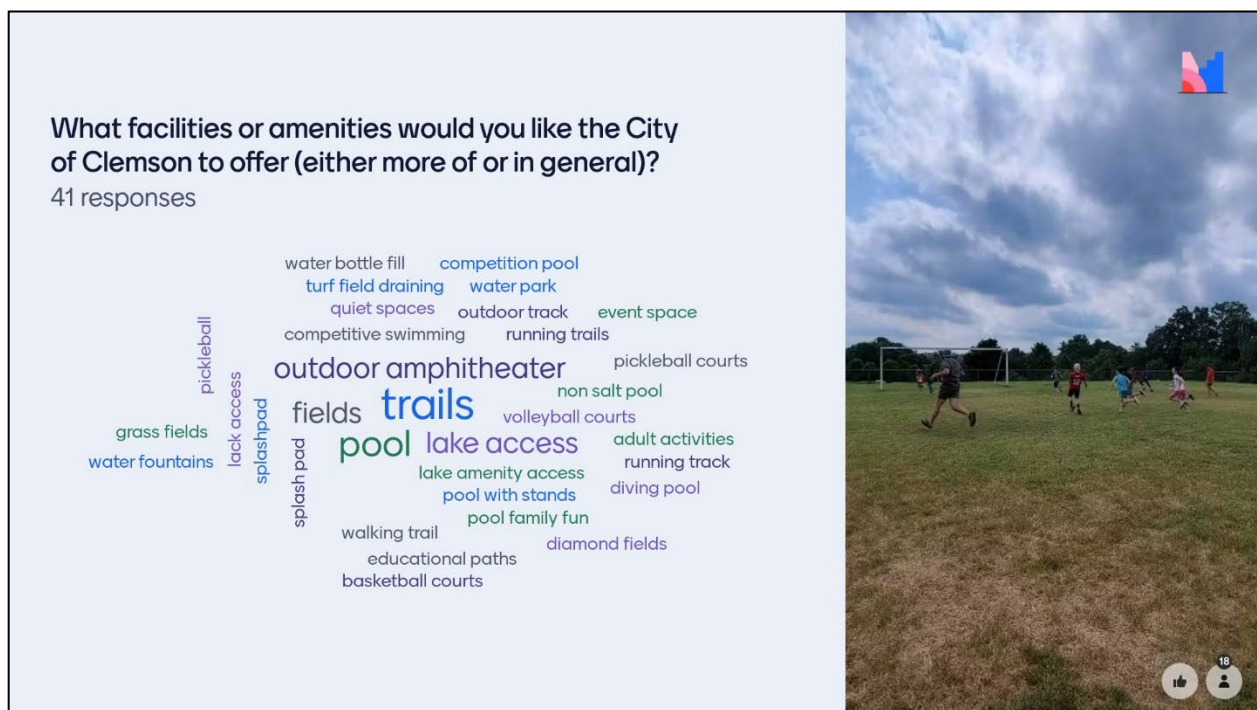


Figure 39: Virtual Public Meeting Question 3 Results



Question #4

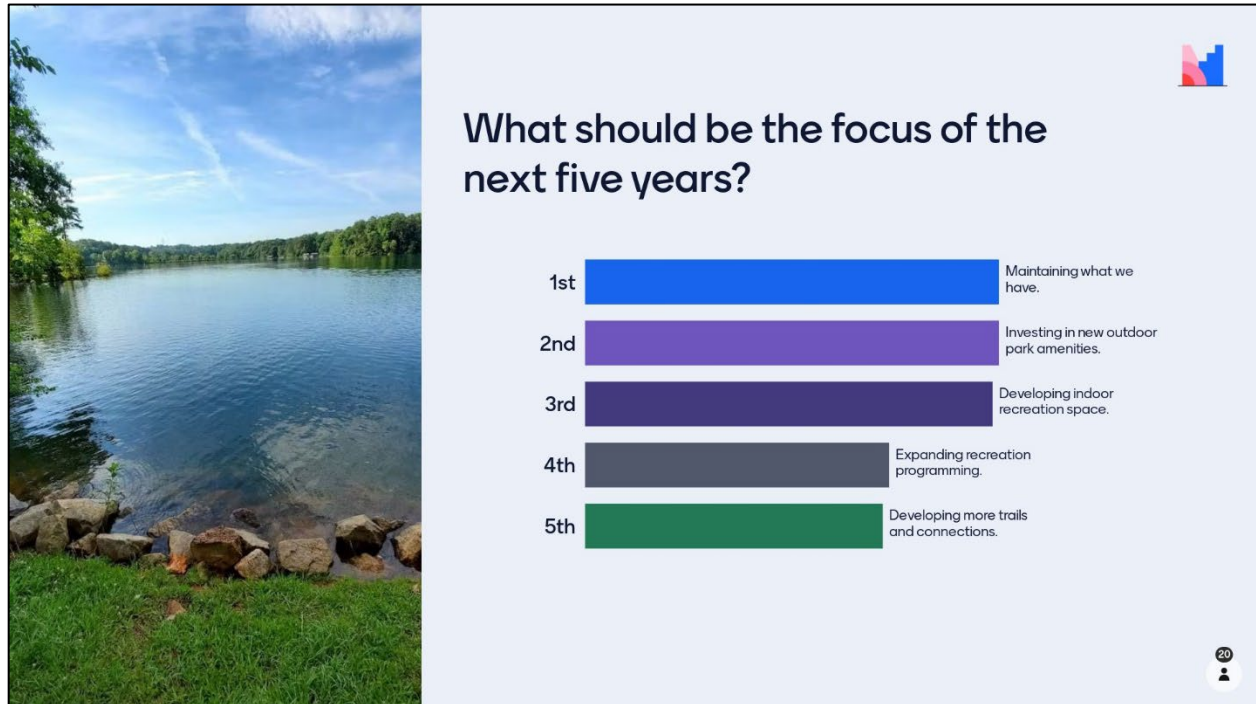


Figure 40: Virtual Public Meeting Question 4 Results

Question #5

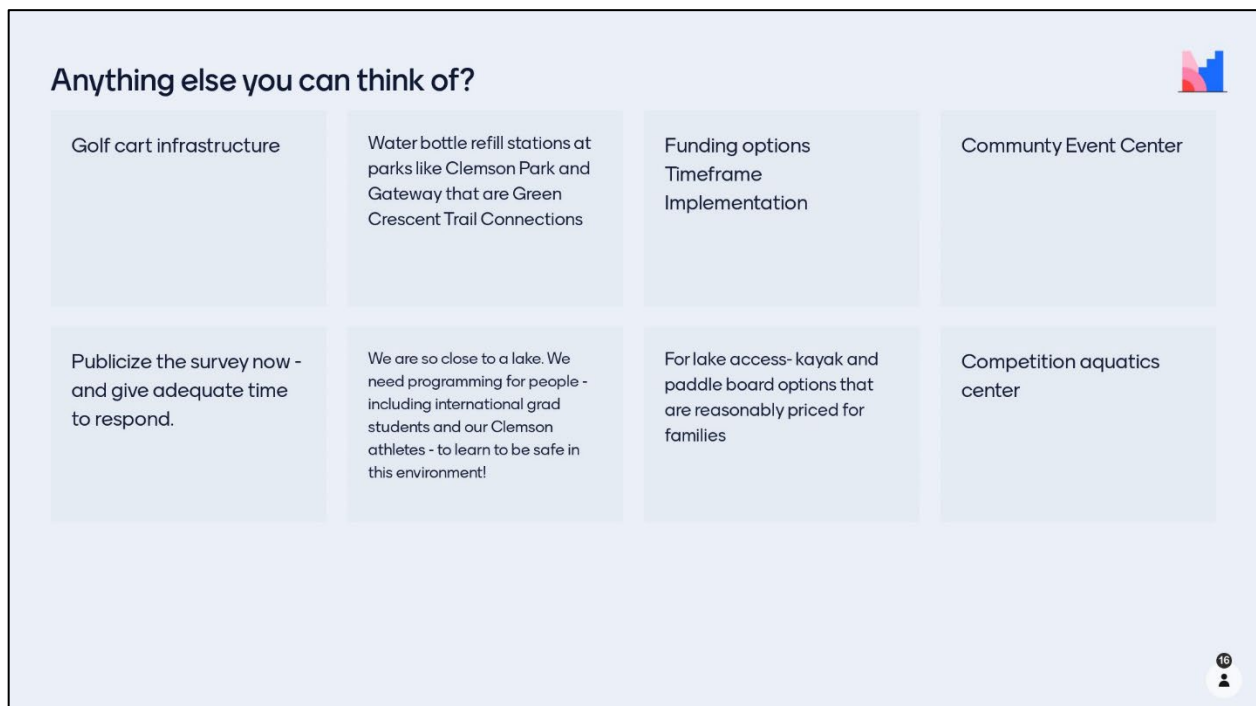


Figure 41: Virtual Public Meeting Question 5 Results Part I



Figure 42: Virtual Public Meeting Question 5 Results Part II

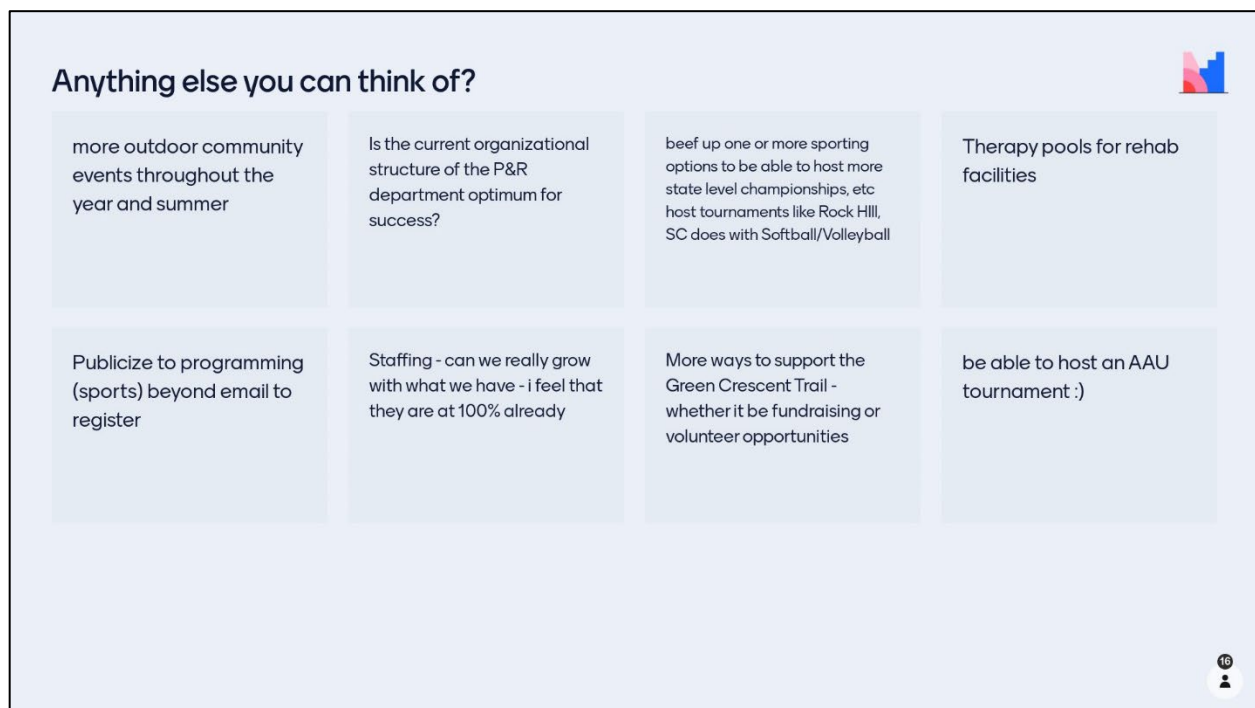


Figure 43: Virtual Public Meeting Question 5 Results Part III



Figure 44: Virtual Public Meeting Question 5 Results Part IV

Question #6

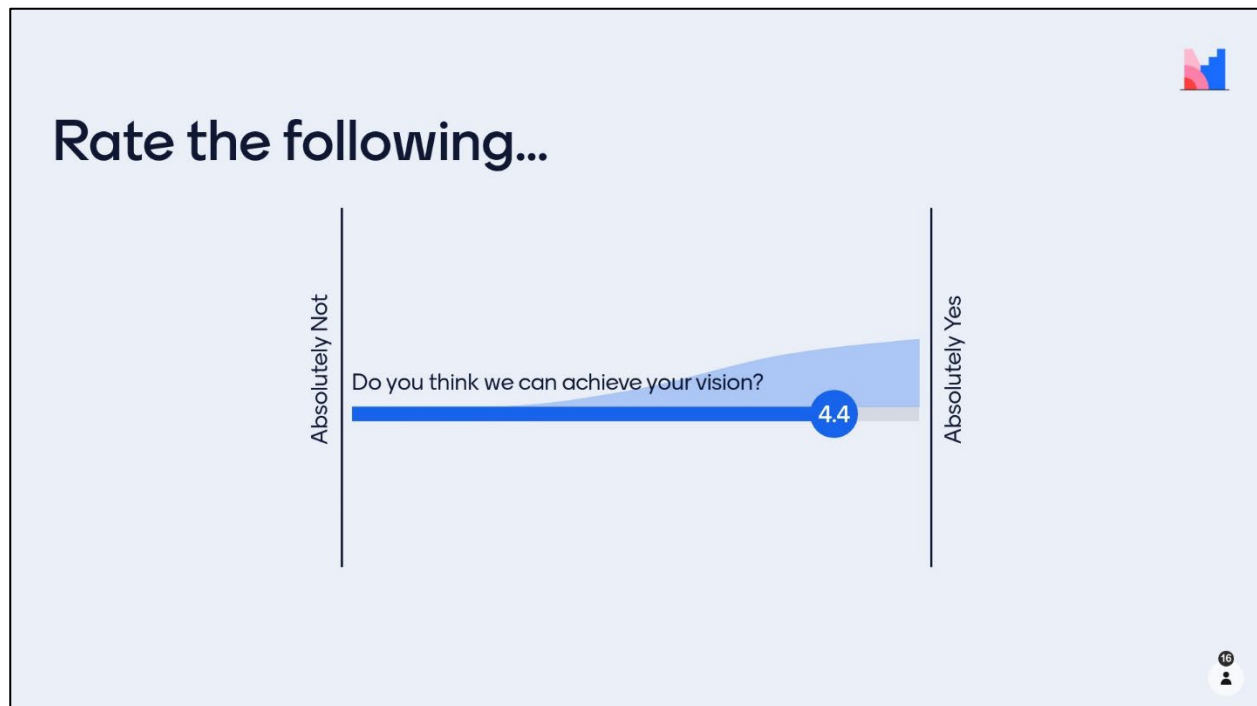


Figure 45: Virtual Public Meeting Question 6 Results



Question #7

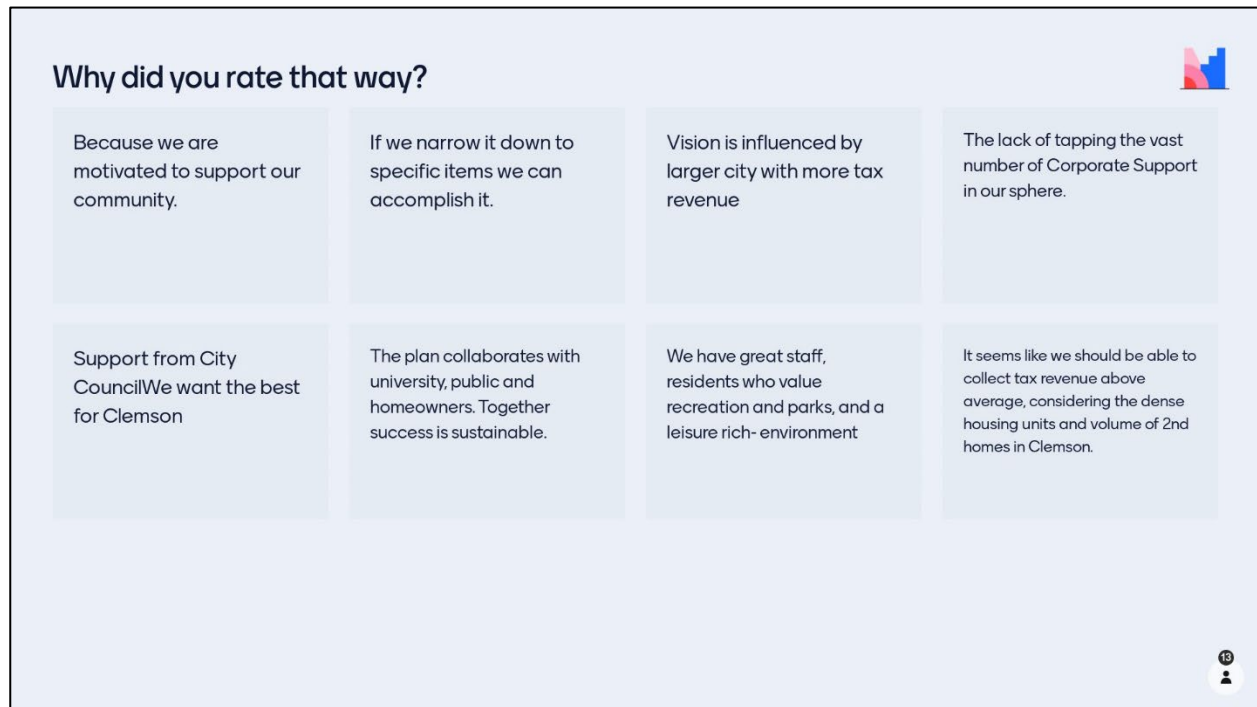


Figure 46: Virtual Public Meeting Question 7 Results Part I

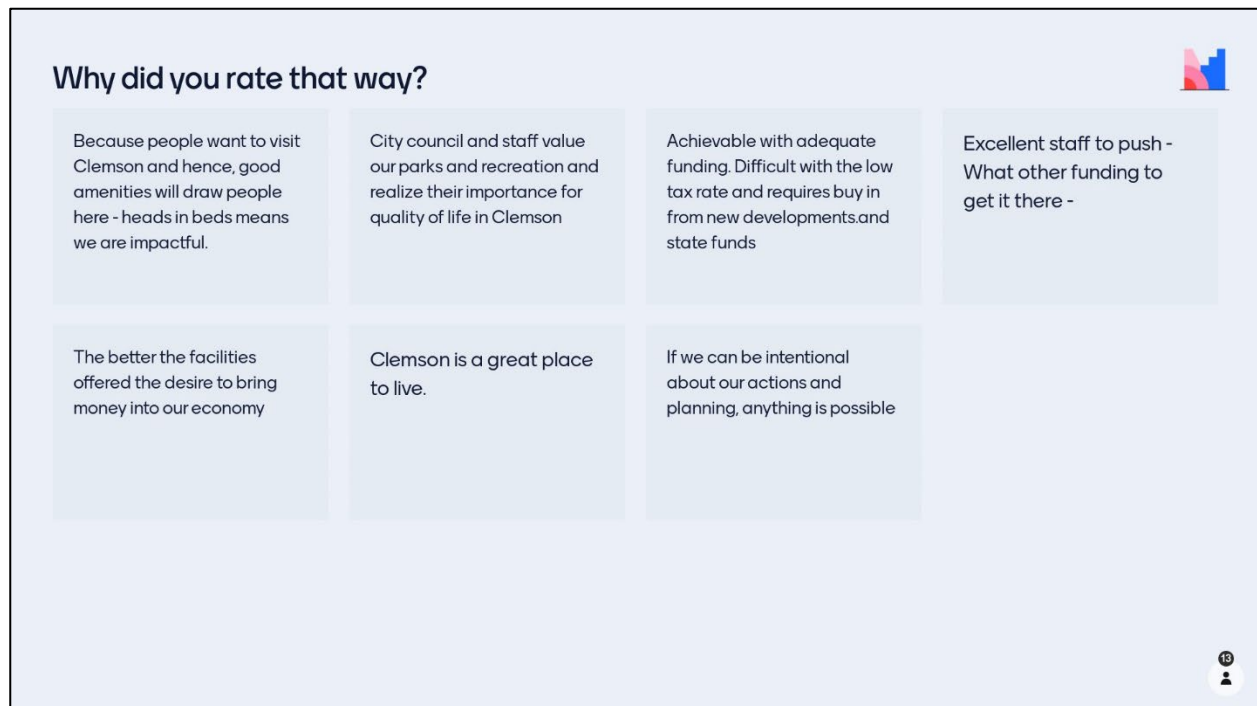


Figure 47: Virtual Public Meeting Question 7 Results Part II



Chapter 5 - Needs Assessment

5.1 Introduction

A needs assessment determines “gaps” between current conditions and desired conditions. An important tenet of a needs assessment is the accurate measurement of desired conditions so needs, or gaps, can be appropriately identified. A distinction must be made between “wants” and “needs.” A community may want or desire a specific amenity, program, or experience, but determining the actual need may manifest a bit different from the stated want based on many factors including, but not limited to: economic realities, physical land restrictions or constraints, system growth based on phasing, and the like.

5.2 Identified Needs

The *Parks and Recreation Master Plan* included a multi-pronged approach to its creation, including societal research, industry benchmarks, existing supply, public feedback, and consultant analysis and opinion. As a result, the following sections outline and discuss key needs for Clemson over the next 5-10 years. Of note, the needs listed below are not presented in a priority order.

5.2.1 Enhancing Outdoor Recreation

The Clemson park system contains several sites with Lake Hartwell access, tree canopies, trails, and the like. Given the University’s ability to provide outdoor recreation programming (via Leisure Skills courses) and enhanced opportunities (via Clemson Outdoor Recreation and Education), it makes sense to leverage access to Lake Hartwell along with facilitating increased outdoor recreation opportunities and availability for residents and students alike.

Ideas for enhancing outdoor recreation include pursuing self-rental kiosks for canoes/kayaks, adding infrastructure that facilitates more drop-in based water activities, and establishing design standards/master plan for both Twelve Mile Recreation Area and Mountain View Park based on either non-motorized or motorized watercraft launches (distinguishing uses between the two park sites).

5.2.2 Identifying the Clemson University Relationship

Based on discussions with stakeholders, Clemson University plans for increased student populations, a widening campus footprint, and recreation facilities to support them. Public access to these facilities is not guaranteed as part of the University’s growth strategy. Therefore, an increased student population with a finite amount of access to recreation facilities will continue to increase local park use. As a result, a stronger connection between city and university growth is warranted.

Specific actions to take related to this relationship include continuing to leverage the use of Parks, Recreation, and Tourism Management (PRTM) and Forestry students; working with Clemson University to plan for public access to facilities and defining each other’s roles and responsibilities; ensuring a CPRD representative serves in an advisory role capacity for Clemson University plans; seeking formal memorandums of understanding or agreements with Clemson University for joint programming, staffing, and/or sponsorship opportunities; and pursuing the addition of a Friends of the Park organization.

5.2.3 Indoor Recreation Space is a Premium

Having dedicated indoor recreation space is of utmost importance to a growing recreation department. Indoor recreation space provides a guaranteed space regardless of weather conditions. Additionally, it opens up opportunities for more types of programs, services, and rentals. Currently, the Central-Clemson Recreation Center is the main dedicated indoor space available for Clemson residents; however, there are



several challenges to the site including, but not limited to: crowding, parking, physical distance/location from Clemson population, pool size, storage availability, and staffing.

As of the development of this *Parks and Recreation Master Plan*, a feasibility study is being conducted for new dedicated indoor recreation space which will be a large part of addressing this challenge. Action items to consider in addition include formalizing the operating agreement with the Central-Clemson Recreation Center and revisiting the Central-Clemson Recreation Center Committee structure (purpose and scope).

5.2.4 Design Standards and Branding

No two parks should be exactly alike within a park system; however, commonality should exist in terms of design standards and overall branding. These components reinforce system awareness while simultaneously reassuring users continued intentionality and system growth is being planned for.

Action items to consider include new entrance signage and branding, wayfinding signage, developing a sign inventory, creating a system design pattern book, incorporating crime prevention through environmental design (CPTED) standards, and celebrating and promoting individual park history into the site's design and/or signage.

5.2.5 ADA Improvements Along with Overall Accessibility and Access

Many Clemson residents report not being able to walk to their nearest park/greenspace. Additionally, park sites are not along public transportation routes making access readily available. This creates a challenge of local park use (along with having limited parking at various park sites). Accessibility challenges also exist in terms of physical ADA improvements. The system is mindful of ADA improvements for new infrastructure, but more can be done related to existing infrastructure.

Specific action items to address accessibility and access challenges include conducting a park system self-audit and inventory, ensuring ADA requirements are taken into consideration for all new infrastructure improvements, and pursue a project opportunity for Clemson University (perhaps) to look at overall walkability of the park system and identify barriers and solutions to park system access.

5.2.6 Twelve Mile Activation

With the newly acquired park site, more opportunities exist for recreation activities, but more operations and maintenance support is required, both from a physical property management perspective as is and for increasing site activation. Additionally, more capital improvement projects and monies must be identified.

Site improvements to consider include developing a walking trail, determine best functionality between day use and overnight camping opportunities, redesigning the site's point with a shelter/pavilion area to take advantage of the scenic surroundings, creating a boardwalk similar to Abernathy Park, and creating an overall site master plan. In addition to infrastructure improvements, a formalized strategy needs to be established that allows the site to retain earned income to help support the vast infrastructure.

5.2.7 Internal Investments

The park system has grown since its creation, but staffing levels have not increased commensurate to the responsibilities and requirements of the system. As a result, maintenance levels may be lower than desired and required. Appropriate maintenance levels are necessary to ensure assets and facilities achieve expected lifecycles and recreation use is maintained and/or increased. Maintenance activities



have a direct relationship to both the integrity of infrastructure and recreation programming. The existing staffing structure would also benefit from a succession or continuity plan within the next 10 years.

In terms of functionality, there is no real ability for the existing staffing structure to focus on natural areas or truly grow the system's maintenance operations. Additional functions are being done by existing staff that also include landscape reviews, tree ordinance compliance, urban canopy monitoring, pre-construction meetings, and the like which takes time away from maintaining the park system. Developing a Maintenance Management Plan will be an important planning process to undertake to establish maintenance work activities, frequencies, and/or zones.

5.2.8 Level of Service

Traditionally, level of service (LOS) relates to the number of amenities, facilities, park acreage, etc. per 1,000 residents, but that metric has broadened over time. Still, when looking at Clemson's LOS metrics, there are challenges associated with external factors that affect the department's LOS metrics beyond mere population. Those challenges include floodplains, increased usership/visitation, inefficient indoor recreation space, and not owning all of its park sites (e.g., Dawson Park).

To improve the system's level of service, an acknowledgment should be made for lease sites (Dawson Park, Abernathy Park, Twelve Mile Recreation Area, and Mountain View Park) as these are not guaranteed to be in the CPRD for perpetuity, existing sports fields and park amenities need to be moved out of floodplains to increase usability, a 10-minute walk level of service goal should be adopted and worked toward, and CPRD should work with new housing developments to create needed local parks and infrastructure/features.

5.2.9 Natural Resources and Urban Forestry

There are infrastructure challenges within the system that relate to the natural environment as well as the built environment. Identifying, monitoring, and addressing invasive species is paramount for a well-functioning urban forestry plan. Additionally, tree assessments, pruning schedules, watering, plantings, and associated tasks all work in tandem to provide a healthy urban tree canopy. As the system grows and expands, attention to natural resource management is equally important to recreation programming and capital investments for recreation infrastructure.

Of note, there is a recently completed Canopy Mapping Study and the City established a baseline of 48% canopy coverage (80% is on private property). All trees removed from public lands are to be replaced the following fall.

To advance natural resources and urban forestry within the CPRD system, an Urban Forest Master Plan should be created; more intentional landscapes such as meadows, pollinator gardens, and bioswales should be incorporated; an arboriculture risk assessment and maintenance function needs to be added to the staffing structure; and an increased focus on conserving open space and land needs to be enhanced.

5.2.10 More Consistent Capital Funding

Although Clemson has had capital monies available for its park system, it does not appear to be consistent of how it is expended. More consistently using external capital dollars (outside of the general budget) can help alleviate the pressure to use general fund monies for capital expenditures. Additionally, a more formal capital improvement plan (CIP) program is warranted that identifies asset/facility lifecycles, replacement schedules, current replacement values, and priority.



A formal CIP program should be created and adopted. In terms of funding, impact fees and hospitality tax revenues should be examined for the ability to be dedicated capital funding sources.

5.2.11 Retaining Earned Income

Budget metrics show Clemson generates approximately 19% of its budget through earned income; however, the metric can be misleading. All funds generated by the department are returned to the General Fund and are used to offset next year's budget. Most agencies are moving toward a consistent General Fund tax support amount with earned/generated income being retained by the department *in addition to* the baseline tax support amount. This helps to incentivize earned income opportunities and allows the department to be more entrepreneurial in its approach to delivering programs and services.

Beyond being able to retain earned income at Twelve Mile Recreation Area, a larger mechanism should be created that allows the department to retain earned income which will serve as an incentive to increase cost recovery.

5.2.12 Balancing Sports and Athletics

It is evident athletics can be a large community asset and regional draw based on Market Potential Index (MPI) scores. Facility improvements such as formalizing fields and enhancing support amenities will be critical. Formalizing fields refers to redesigning spaces for their intended use. For example, making more dedicated rectangular fields instead of sharing spaces with diamond fields. Support amenities typically refer to spectator seating, shade, restrooms, walking paths, activities/play structures for multiple generations, parking, concessions, and lighting. Additionally, the balance between recreational and competitive/travel sports must be identified and have an earned income revenue strategy/philosophy that yields the desired outcome(s). What is the relationship with local high schools and colleges? What is the "feeder system?"

CPRD should continue to utilize the feeder system model put forth by volleyball and basketball programs. Additionally, the Nettles Park Master Plan needs to be implemented as more multi-purpose fields are needed along with support amenities such as restrooms.

5.2.13 Investing in Technology

Both staff and residents agree the recreation program registration process can and should be improved. A recreation software system would make the process more user-friendly while simultaneously enhancing the department's capabilities to monitor, evaluate, and analyze user and facility data. Additionally, a more robust work order management system should be utilized that is appropriate for asset management within a park system. This system should allow for integration with work order management, amenity/facility warranties, financial planning, and customized reporting. Currently, the department is utilizing MyCivic for work order management planning; more focus on this system should be given to leverage its full potential for the department.

To keep up with industry best practices, useful technology needs to be utilized. Supported by public engagement findings, a new recreation software system needs to be considered. This will assist with program registrations, data management, and mobile capabilities. In terms of park maintenance, MyCivic should be explored for potential enhancements for true asset management capabilities.



5.2.14 Funding Parks and Recreation

Based on existing funding sources utilized for parks and recreation services and facilities, the following funding mechanisms should be considered for the system:

- South Carolina Delegation Appropriations
- South Carolina Conservation Bank
- Water Recreation Funds
- Millage increase for parks and recreation specifically
- Non-resident fees
- Revenue sharing – vendors for events and programs
- Impact fees
- Grants
- Sponsorships
- Naming rights
- Philanthropy and/or Foundation
- Friends Group(s)
- Pickens County Recreation Funding (we have to ask for it).
- Hospitality Tax
- SCPARD funds
- Non-reverting funds/accounts

5.2.15 Identified System Needs

Considering the existing system inventory, public engagement findings, and benchmarking comparisons, the following programmatic and facility/amenity needs are identified:

- Programs
 - Special and community events
 - Outdoor recreation
 - Nature programming
 - Water-based activities
 - Family programming
 - Senior programming
 - Inclusive programming
 - Athletics
 - Performing arts
 - Aquatics (expansion of this programming area must occur via partnerships)
- Facilities
 - Green Crescent Trail expansion (and more trails/pathways in general)
 - Natural areas
 - Splashpad (currently being planned for Clemson Park)
 - Pickleball (currently being established)
 - Amphitheater
 - Parking
 - Outdoor gathering spaces/venues
 - Additional indoor space (Arts Center, CAAAM, etc.)
 - Public art
 - Water access



Chapter 6 - Capital Improvement Plan

6.1 Framework

There are different capital improvement projects an agency can implement; therefore, it is important to use a framework that helps make budget decisions that are sustainable over time. Funding is not always sufficient to take care of all existing assets and build/acquire new parkland, facilities, and amenities. A three-tiered Capital Improvement Plan (CIP) is created to acknowledge fiscal realities and to help balance priorities and their associated expenditures:

- **Critical Projects.** These projects prioritize spending within existing budget targets. The intention of this category is to refocus and make the most of existing resources with the primary goal being to maintain services. The actions associated with these projects address deferred maintenance, accessibility issues, and other critical needs at existing facilities and is funded through existing tax dollars. In a multi-year CIP program, these projects are typically prioritized for years 1 and 2; however, they can be spread out over years 1 through 5 due to the expense.
- **Sustainable Projects.** These projects describe the extra services or capital improvements that should be undertaken when additional funding is available. This includes strategically enhancing existing programs, beginning new alternative programs, adding new positions, or making other strategic changes that would require additional operational or capital funding. It is imperative to evaluate and analyze potential sources of additional revenue, including but not limited to capital bond funding, dedicated levies, partnerships, program income, grants, and/or new funding sources for these capital projects. In a multi-year CIP program, these projects are typically prioritized for years 3 through 5.
- **Visionary Projects.** These projects represent the complete set of services and facilities desired by the community. It is fiscally unconstrained but can help provide policy guidance by illustrating the ultimate goals of the community and by providing a long-range look to address future needs and deficiencies. Typically, visionary projects are related to closing gaps identified by LOS metrics and specific park site enhancements derived from the community needs assessment process. Funding for visionary projects can be derived from partnerships, private investments, new tax dollars or bonds, additional dedicated funding sources, and more. In a multi-year CIP program, these projects are typically prioritized for year 5 and beyond.



6.2 Critical Projects

There are 11 *critical* projects currently identified within the CPRD system. These projects total an estimated ~\$1 million and relate to deferred maintenance, lifecycle replacements, drainage, painting, and site usability (Table 13).

Critical Projects			
Location/Park	Classification	Description	Estimated Cost
Ashley Dearing Park	Neighborhood Park	Clean and repaint buildings at playground and evaluate roofing	\$5,000
Catherine Smith Plaza	Pocket Park/Urban Plaza	Repair/replace/repurpose leaking fountain	\$25,000
Dawson Park	Neighborhood Park	Replace backstop wall and fencing and replace dugout roofing	\$15,000
Earle Anderson Park	Pocket Park/Urban Plaza	Replace playground and surfacing	\$250,000
Larry W. Abernathy Waterfront Park	Community Park	Replace rails and pickets on boardwalk	\$10,000
Tottie's Place	Greenspace/Natural Area	Finish park construction started in 2014 by adding steps from the lower sidewalk up to the south bridge	\$7,500
Twelve Mile Recreation Area	Regional Park	Address insufficient ADA infrastructure throughout the park	\$300,000
Twelve Mile Recreation Area	Regional Park	Repaint lines in all parking areas	\$5,000
W.C. Nettles Park	Community Park	Add drainage and knee wall to Stone Field to prevent dirt washing into parking lot	\$15,000
W.C. Nettles Park	Community Park	Upper concessions/bathrooms: Replace rot, clean, and paint	\$200,000
W.C. Nettles Park	Community Park	Add a shelter/restroom facility between tennis courts & lower field	\$250,000
Total			\$1,082,500

Table 13: Capital Improvement Plan (CIP) – Critical Projects



6.3 Sustainable Projects

There are 9 *sustainable* projects currently identified within the CPRD system. These projects total an estimated ~\$1.5 million and relate to site redesigns, reconfigurations, and supporting amenity updates/upgrades (Table 14).

Sustainable Projects			
Location/Park	Classification	Description	Estimated Cost
Ashley Dearing Park	Neighborhood Park	Redesign existing playground surround with retaining wall, new fencing, and new surfacing	\$75,000
Dawson Park	Neighborhood Park	Replace existing retaining wall and stairs	\$10,000
Earle Anderson Park	Neighborhood Park	Replace older picnic tables to match the rest of the park system	\$5,000
Jaycee Park	Community Park	Replace playground safety surface	\$15,000
Larry W. Abernathy Waterfront Park	Neighborhood Park	Renovate or replace pavilion and bathrooms with more sustainable model	\$300,000
Mountain View Park	Neighborhood Park	Reconfigure boat ramp to include an exit road back to the parking lot	\$50,000
Twelve Mile Recreation Area	Regional Park	Replace aged out playgrounds and add safety surface	\$350,000
W.C. Nettles Park	Community Park	Replace all field lighting with LED light system	\$750,000
W.C. Nettles Park	Community Park	Replace all water fountains with bottle filling stations throughout the park system (Nettles, AD, Clemson, Dawson)	\$7,500
Total			\$1,562,500

Table 14: Capital Improvement Plan (CIP) – Sustainable Projects



6.4 Visionary Projects

There are 5 *visionary* projects currently identified within the CPRD system. These projects total an estimated ~\$900,000 and relate to new amenities (**Table 15**).

Visionary Projects			
Location/Park	Classification	Description	Estimated Cost
Ashley Dearing Park	Neighborhood Park	Turn current baseball field into a destination playground area	\$250,000
Berkeley Orchard	Greenspace/Natural Area	Develop conceptual plan for trails, meadows, and orchards	\$45,000
Clemson Park	Neighborhood Park	Add a playground with more play features	\$250,000
W.C. Nettles Park	Community Park	Add 12u baseball field	\$350,000
W.C. Nettles Park	Community Park	Add a netting system to protect bystanders from foul balls on upper three youth fields	\$15,000
Total			\$910,000

Table 15: Capital Improvement Plan (CIP) – Visionary Projects





Chapter 7 - Implementation Plan

7.1 Purpose

The *Parks and Recreation Master Plan* contains an assortment of data findings, challenges, priorities, and opportunities. To make everything actionable, it is critical to have an Implementation Plan. The Implementation Plan is useful for creating annual work plans and continually updating elected officials, staff, and the public on implementation status. The Implementation Plan assists with achieving goals and objectives over the next five years.

The Implementation Plan outlines a three-tiered priority approach (A, B, and C), but as realities dictate, it may become necessary to deprioritize or emphasize given actions as resources and opportunities present themselves. Therefore, the implementation plan should be viewed as a framework in which CPRD can work within, add to/modify during this plan's lifecycle, and re-assess according to related resources, policy directives, and any other factor(s) that may influence implementation sequencing and focus.

7.2 Organization

The Implementation Plan is presented in a series of strategies and tactics organized into two main categories: operations and experiences (**Tables 16 and 17**).

Operations is defined in this context by the mechanisms used to ensure the Clemson parks and recreation system is available, maintained, and sustained. Operations is further delineated into governance and business. Governance relates to organizational structure, management, staffing, and personnel-related matters concerning the parks system. Business encompasses dedicated funding sources, cost recovery philosophies, revenue strategies, partnerships, fundraising, and other general organizational philosophies.

Experiences is defined in this context by the user/visitor experience available within the Clemson parks and recreation system. Programs can be leader-led, self-directed, drop-in, rental, and/or ticketed experiences. Facilities refer to the site amenities, furnishings, built environment, and natural resources located throughout the system.





7.3 Strategies and Tactics

Operations			
Governance			
Strategic Action		Status	Priority
G1.	Grow and formalize the Friends of the Park through collaboration with CU to offer enhanced community services.	☐ Not Started ☐ In Progress ☐ Completed	B
G2.	Formalize the Central-Clemson Recreation Center operating agreement.	☐ Not Started ☐ In Progress ☐ Completed	B
G3.	Revisit the Central-Clemson Recreation Center Committee structure and purpose.	☐ Not Started ☐ In Progress ☐ Completed	B
G4.	Establish a staffing standard per acre of parkland maintained commensurate with industry best practices of 1 FTE per 20 acres.	☐ Not Started ☐ In Progress ☐ Completed	A
G5.	Develop a <i>Maintenance Management Plan</i> for the park system.	☐ Not Started ☐ In Progress ☐ Completed	B
G6.	Increase natural area and park maintenance functional staffing (including arboriculture risk assessments).	☐ Not Started ☐ In Progress ☐ Completed	A
G7.	Research, acquire, and implement a new recreation software program for ease of registrations, data tracking, and scheduling.	☐ Not Started ☐ In Progress ☐ Completed	A
G8.	Enhance the use of MyCivic as an asset management and/or work order management system.	☐ Not Started ☐ In Progress ☐ Completed	C
G9.	As a long-term strategy, investigate the feasibility of transitioning to a park district since CPRD acts like one with its relationship with Central and the fact the city is more of a regional service provider.	☐ Not Started ☐ In Progress ☐ Completed	C
Business			
Strategic Action		Status	Priority
B1.	Continue to utilize PRTM and Forestry students in various capacities throughout the park system.	☐ Not Started ☐ In Progress ☐ Completed	A
B2.	Work with CU to discuss public access to facilities.	☐ Not Started ☐ In Progress ☐ Completed	B
B3.	Ensure a CPRD representative serves in an advisory capacity for CU planning processes that relate to community residents.	☐ Not Started ☐ In Progress ☐ Completed	B



B4.	Identify more ways to have CU sponsor activities, events, and programs.	☐ Not Started ☐ In Progress ☐ Completed	B
B5.	Establish mechanism that allows the department to retain earned income to be reinvested back into infrastructure and/or programming, particularly at Twelve Mile Recreation Area due to its revenue generating capabilities and vast infrastructure needs.	☐ Not Started ☐ In Progress ☐ Completed	A
B6.	Adopt a 10-minute walk level of service goal.	☐ Not Started ☐ In Progress ☐ Completed	B
B7.	Utilize residential developments as a way to increase the number of neighborhood parks.	☐ Not Started ☐ In Progress ☐ Completed	B
B8.	Adopt and implement a formal five-year capital improvement program (CIP).	☐ Not Started ☐ In Progress ☐ Completed	A
B9.	Pursue potential dedicated funding sources for capital improvements such as impact fees and hospitality tax.	☐ Not Started ☐ In Progress ☐ Completed	A
B10.	Pursue new, and expand existing, funding mechanisms such as South Carolina Delegation Appropriations, South Carolina Conservation Bank, Water Recreation Funds, millage increases for parks and recreation specifically, non-resident fees, revenue sharing, impact fees, grants, sponsorships, naming rights, philanthropy/planned giving (via a Foundation), Pickens County Recreation Funding, Hospitality Tax, SCPARD funds, and non-reverting funds/accounts use.	☐ Not Started ☐ In Progress ☐ Completed	B
B11.	Continue to focus on enhancing communication channels between City leadership and CPRD/City departments.	☐ Not Started ☐ In Progress ☐ Completed	A

Table 16: Implementation Plan – Operations Strategies and Tactics



Experiences			
Facilities			
Strategic Action		Status	Priority
F1.	Develop a <i>Twelve Mile Recreation Area Site Master Plan</i> , including public and stakeholder engagement.	☐ Not Started ☐ In Progress ☐ Completed	A
F2.	Consider adding self-rental watercraft kiosks to waterfront parks sites.	☐ Not Started ☐ In Progress ☐ Completed	B
F3.	Establish site use distinction between Twelve Mile Recreation Area and Mountain View Park.	☐ Not Started ☐ In Progress ☐ Completed	C
F4.	Complete indoor recreation center feasibility study and advance facility design.	☐ Not Started ☐ In Progress ☐ Completed	A
F5.	Complete a sign inventory for the park system.	☐ Not Started ☐ In Progress ☐ Completed	A
F6.	Update signage and wayfinding throughout the system.	☐ Not Started ☐ In Progress ☐ Completed	A
F7.	Develop a system design pattern book.	☐ Not Started ☐ In Progress ☐ Completed	B
F8.	Adopt and incorporate crime prevention through environmental design (CPTED) standards into site improvements and all new developments.	☐ Not Started ☐ In Progress ☐ Completed	B
F9.	Conduct a park system walkability status study that identifies current conditions, barriers, and solutions to park access.	☐ Not Started ☐ In Progress ☐ Completed	A
F10.	Conduct a system ADA self-audit and inventory.	☐ Not Started ☐ In Progress ☐ Completed	A
F11.	Move park infrastructure and facilities out of floodplains, especially at Nettles Park to reduce reliance on floodplain facilities and to reduce reactive maintenance due to flooding/washouts.	☐ Not Started ☐ In Progress ☐ Completed	A
F12.	Develop an <i>Urban Forest Master Plan</i> .	☐ Not Started ☐ In Progress ☐ Completed	A
F13.	Develop a <i>Green Infrastructure Plan</i> .	☐ Not Started ☐ In Progress ☐ Completed	A



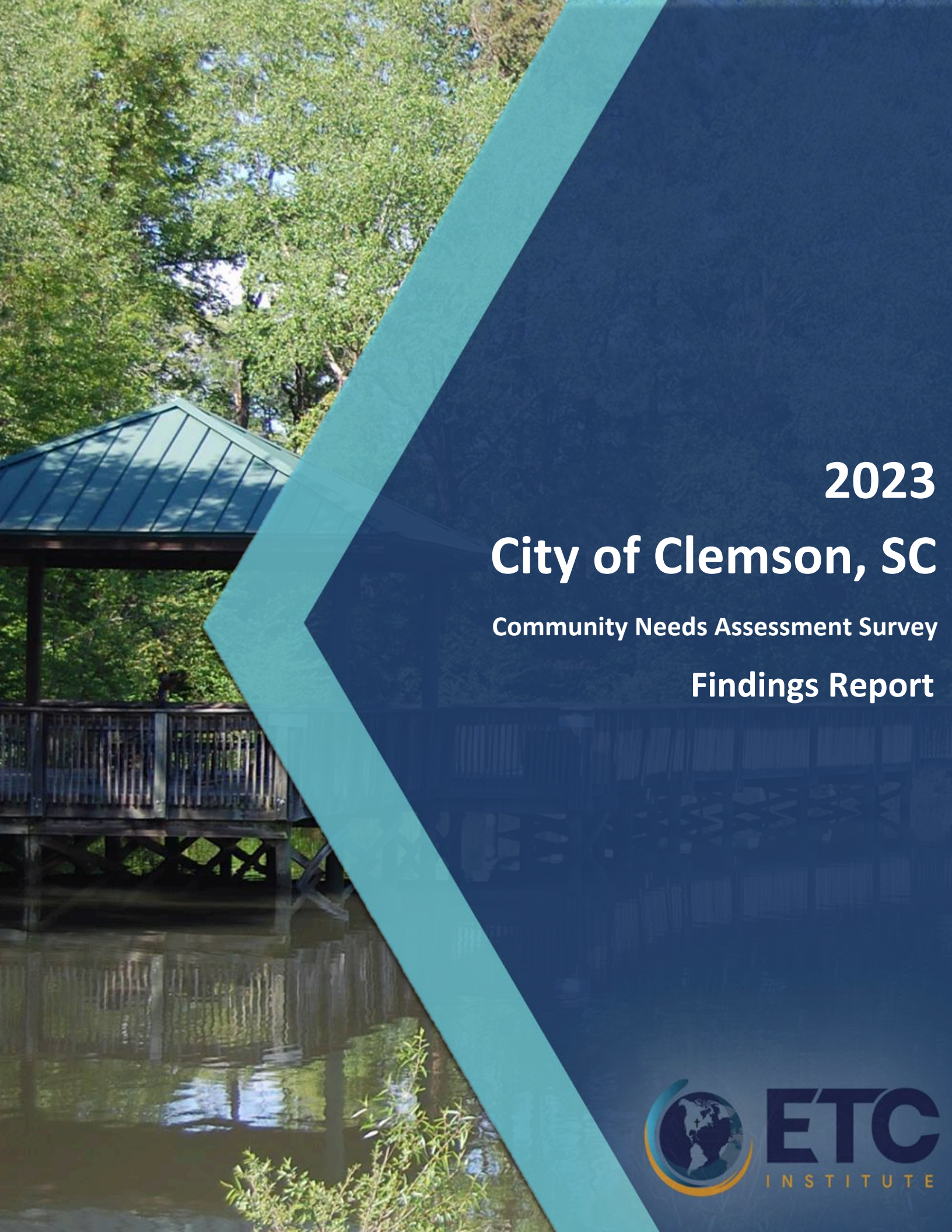
F14.	Move toward more intentional landscapes such as meadows, pollinator gardens, and bioswales.	☐ Not Started ☐ In Progress ☐ Completed	A
F15.	Implement the <i>Nettles Park Site Master Plan</i> .	☐ Not Started ☐ In Progress ☐ Completed	A
Programs			
Strategic Action		Status	Priority
P1.	Add more inclusive recreation programming opportunities and elevate the awareness of existing inclusive programming opportunities.	☐ Not Started ☐ In Progress ☐ Completed	A
P2.	Continue to enhance social gathering opportunities, community events, and family programming.	☐ Not Started ☐ In Progress ☐ Completed	A
P3.	Identify new programs that leverage the system's outdoor recreation opportunities (both land and water).	☐ Not Started ☐ In Progress ☐ Completed	A
P4.	Identify new nature-based programs such as nature programming at Berkeley Orchard, nature walks, pruning/arboriculture demonstrations, and naturalist talks at community gardens.	☐ Not Started ☐ In Progress ☐ Completed	B
P5.	Seek to add performing arts activities and experiences to the programming portfolio.	☐ Not Started ☐ In Progress ☐ Completed	A
P6.	Work with partners to expand aquatic programming, as appropriate and/or as resources become available.	☐ Not Started ☐ In Progress ☐ Completed	C
P7.	Continue to identify facilitative and/or collaborative programming opportunities that do not have major capital infrastructure implications.	☐ Not Started ☐ In Progress ☐ Completed	B
P8.	Utilize non-reverting funds to enhance staffing capacity and earned revenue opportunities.	☐ Not Started ☐ In Progress ☐ Completed	A

Table 17: Implementation Plan – Experiences Strategies and Tactics



Chapter 8 - Appendix: Statistically Valid and Online Surveys

The following pages contain the full results for the two survey instruments utilized during the planning process: the statistically valid community needs assessment survey and the anecdotal online survey.



2023 City of Clemson, SC

Community Needs Assessment Survey
Findings Report



ETC
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Executive Summary

2023 City of Clemson, SC

Community Needs Assessment Survey

Executive Summary

Overview

ETC Institute administered a community needs assessment survey for the city of Clemson, South Carolina during the months of fall 2023. The survey will help determine park and recreation priorities for the city.

Methodology

ETC Institute mailed a survey packet to a random sample of households in Clemson. Each survey packet contained a cover letter, a copy of the survey, and a postage-paid return envelope. Residents who received the survey were given the option of returning the survey by mail or completing it online at *ClemsonParkSurvey.org*.

After the surveys were mailed, ETC Institute followed up with residents to encourage participation. To prevent people who were not residents of Clemson from participating, everyone who completed the survey online was required to enter their home address prior to submitting the survey. ETC Institute then matched the addresses that were entered online with the addresses that were originally selected for the random sample. If the address from a survey completed online did not match one of the addresses selected for the sample, the online survey was not included in the final database for this report.

The goal was to collect a minimum of 300 completed surveys from residents. The goal was met with 327 completed surveys collected. The overall results for the sample of 327 households has a precision of at least ± 5.3 at the 95% level of confidence.

This report contains the following:

- Charts showing the overall results of the survey (Section 2)
- Priority Investment Rating (PIR) that identifies priorities for facilities and programs (Section 3)
- Benchmarks comparing data from Clemson to national averages (Section 4)
- An Importance-Satisfaction analysis for services provided by Clemson Parks and Recreation Department (Section 5)
- Tabular data showing the overall results for all questions on the survey (Section 6)
- Answers to open-ended questions (Section 7)
- A copy of the cover letter and survey instrument (Section 8)

The major findings of the survey are summarized in the following pages.

Clemson Recreation and Parks Facilities

Parks Use Overview. Ninety percent (90%) of respondents said that someone in their household had visited any of the City of Clemson parks or recreation facilities in the past year. Most of those respondents (83%) rated the overall quality of those parks as either “good” (63%) or “excellent” (20%). Most respondents (63%) say they live within a 10-minute walk from a park. Of those who do not live within a 10-minute walk, the largest percentage (40%) said it would take 25 minutes or longer to walk to the nearest park from their home. Most respondents (55%) have access to a pedestrian route to safely access the closest park from their home. However, 56% say that the pedestrian route needs improvement or that they don’t have a pedestrian route (44%).

Parks and Facilities Use. Respondents were provided with a list of 14 Clemson Parks and Recreation sites and asked to indicate which ones their household had visited over the past year. The sites most often visited by respondents were W.C Nettles Park (59%), Central-Clemson Recreation Center (48%), and Larry W. Abernathy Waterfront Park (30%). Respondents most often travel to parks and recreation areas via personal vehicle (89%), walking (54%), or bicycle (19%).

Recreation Programs Participation

Participation Overview. Forty-one percent (41%) of respondents report participating in recreation programs offered by Clemson Parks and Recreation Department in the past year. Of those respondents who participated, the highest percentage (71%) report participating in 1-3 programs followed by 4-6 programs (23%). Most respondents (94%) rated these programs as either “good” (48%) or “excellent” (48%).

Barriers to Participation. Respondents were asked to select all the reasons that prevent their household from using recreation programs offered by the city. Most often respondents said they do not know what is offered/available (29%), not interested/too busy (22%), or what they desire is not offered (14%).

Other Major Findings

Services Satisfaction. Respondents were provided with a list of 11 services provided by the City of Clemson Parks and Recreation Department and asked to rate their level of satisfaction with each. Respondents were most satisfied (rating “satisfied” or “very satisfied”) with how close parks are location to their home (71%), the maintenance of parks (66%), and the number of parks (65%). The three services respondents think should receive the most emphasis from city leaders over the next five years are the maintenance of parks (35%), availability of information about programs/facilities (24%), and the quality of programs for adults (23%). This question was further analyzed in section 5 of this report, the importance-satisfaction analysis.

Communication Methods. Respondents most often report learning about programs and services offered by the City of Clemson via word of mouth (39%), social media (39%), and email blasts/newsletters (33%). Respondents would most prefer to receive communication via email blasts/newsletters (44%), social media (33%), or the city department or website (23%).

Funding Allocation. Respondents were told to allocate a hypothetical \$100 for various parks and recreation categories. Respondents provided the greatest amount (on average) of funding towards developing new trails and greenways (\$31.02) and improvements or maintenance of exiting parks, trails, and facilities (\$30.55).

Benefits of Parks and Recreation. Most respondents (75%) said they were either “satisfied” (41%) or “very satisfied” (34%) with the overall value their household receives from the City of Clemson Parks and Recreation Department. Respondents were provided with a list of 12 potential benefits of parks, trails, recreation facilities, programs, and services of Clemson and asked to rate their agreement with each statement. Respondents most often agreed (rating “agree” or “strongly agree”) that parks and recreation provides outdoor recreation (96%), makes the city a more desirable place to live (94%), and improves physical health/fitness (94%). The three most important benefits of parks and recreation to respondents are improves physical health and fitness (57%), preserving open space and the environment (39%), and makes the city a more desirable place to live (30%).

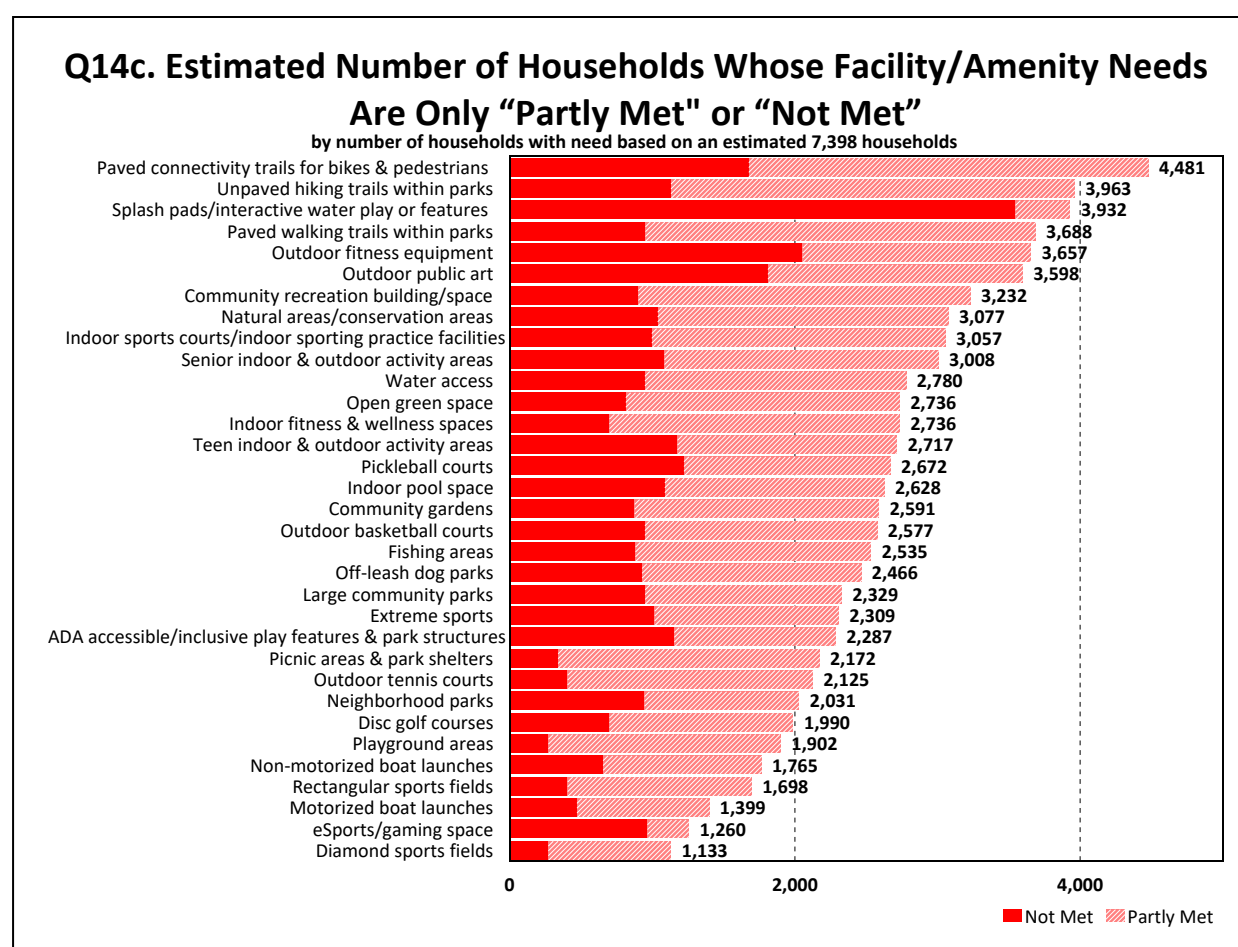
Parks and Recreation Facilities/Amenities Needs and Priorities

Amenity/Facility Needs: Respondents were asked to identify if their household had a need for 33 facilities/amenities and to rate how well their needs for each were currently being met. Based on this analysis, ETC Institute was able to estimate the number of households in the community that had the greatest “unmet” need for various facilities/amenities.

The three amenities/facilities with the highest percentage of households that have an unmet need:

1. Paved connectivity trails for bikes and pedestrians – 4,481 households
2. Unpaved hiking trails within parks – 3,963 households
3. Splash pads/interactive water play or features – 3,932 households

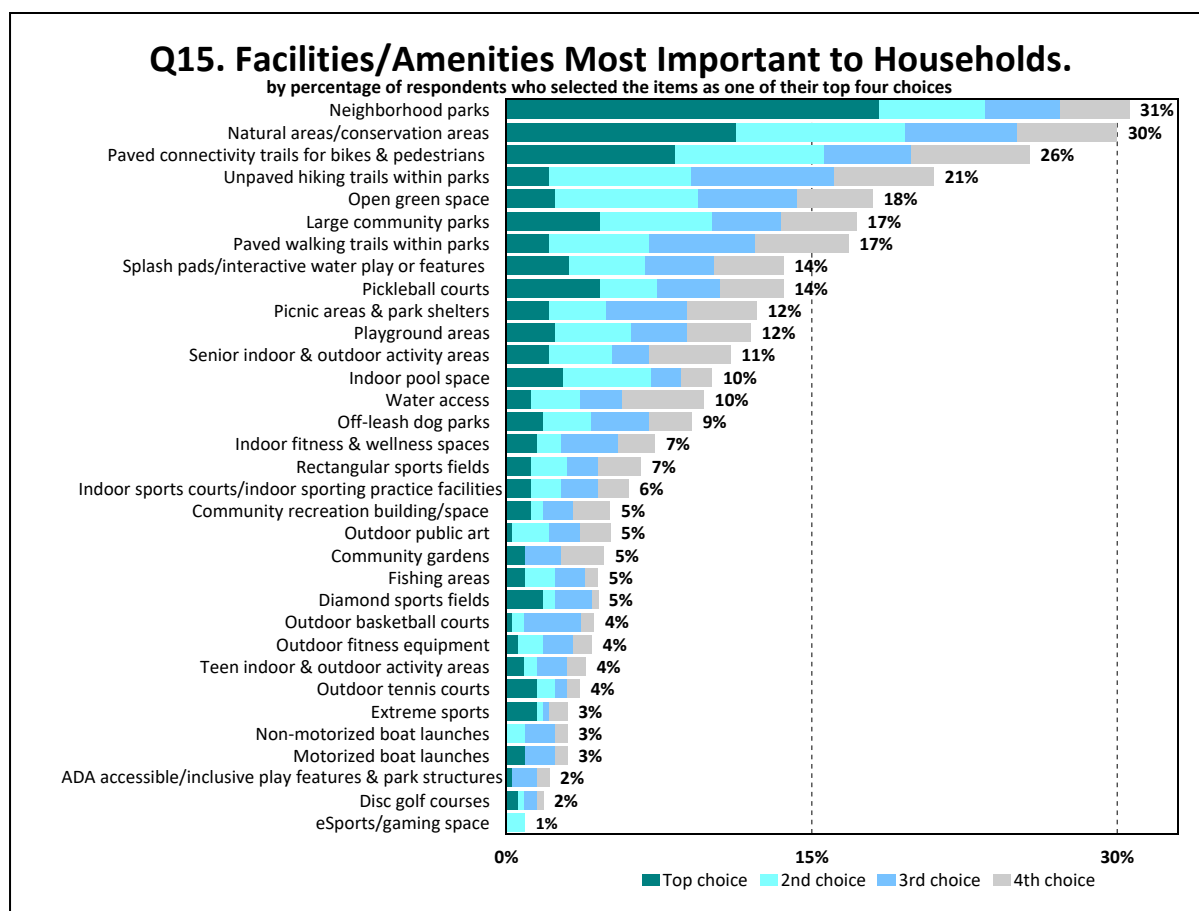
The estimated number of households that have unmet needs for each of the 33 facilities/amenities assessed is shown in the chart below.



Amenities/Facilities Importance: In addition to assessing the needs for each amenity/facility, ETC Institute also assessed the importance that residents placed on each item. Based on the sum of respondents' top four choices, these were the four amenities/facilities ranked most important to residents:

1. Neighborhood parks (31%)
2. Natural areas/conservation areas (30%)
3. Paved connectivity trails for bikes and pedestrians (26%)
4. Unpaved hiking trails within parks (21%)

The percentage of residents who selected each amenity/facility as one of their top four choices is shown in the chart below.

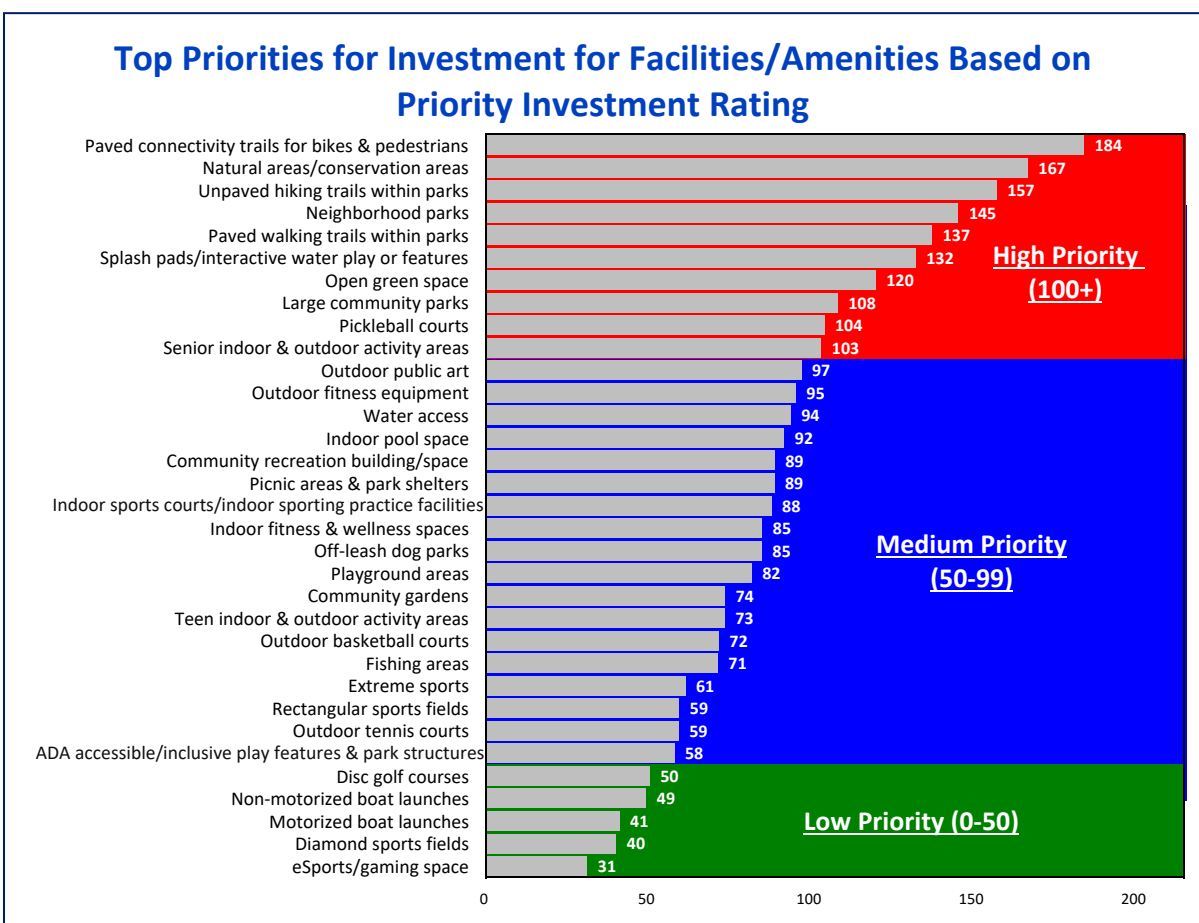


Priorities for Facility Investments: The **Priority Investment Rating (PIR)** was developed by ETC Institute to provide organizations with an objective tool for evaluating the priority that should be placed on recreation and parks investments. The Priority Investment Rating (PIR) equally weighs (1) the importance that residents place on amenities/facilities and (2) how many residents have unmet needs for the amenity/facility. [Details regarding the methodology for this analysis are provided in Section 3 of this report.]

Based the Priority Investment Rating (PIR), the following amenities/facilities were rated as high priorities for investment:

- Paved connectivity trails for bikes & pedestrians (PIR= 184)
- Natural areas/conservation areas (PIR= 166.7)
- Unpaved hiking trails within parks (PIR= 157.1)
- Neighborhood parks (PIR= 145.3)
- Paved walking trails within parks (PIR= 137.2)
- Splash pads/interactive water play or features (PIR= 132.2)
- Open green space (PIR= 119.9)
- Large community parks (PIR= 108.2)
- Pickleball courts (PIR= 104.1)
- Senior indoor & outdoor activity areas (PIR= 103.1)

The chart below shows the Priority Investment Rating for each of the 33 facilities/parks assessed on the survey.



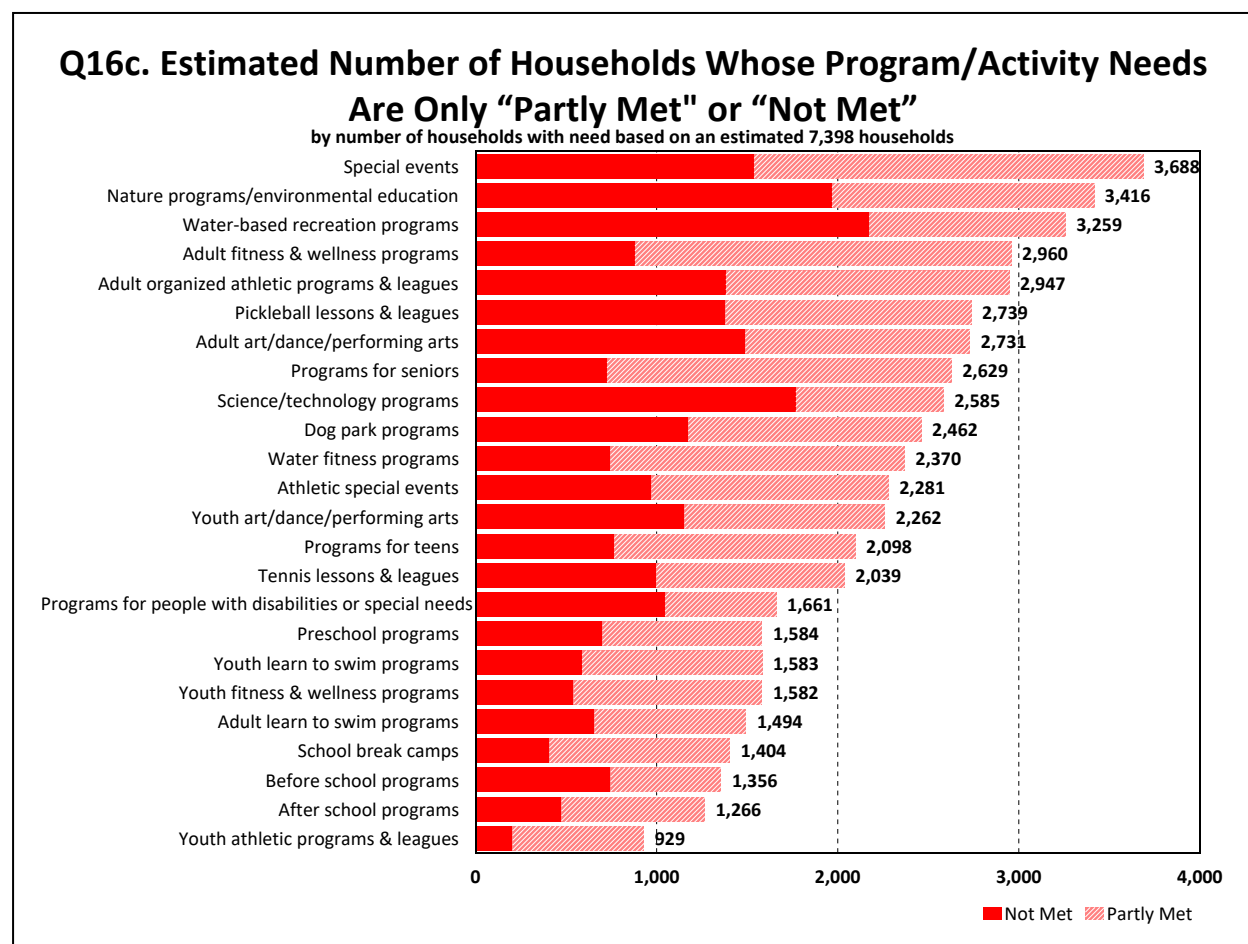
Recreation Program/Activity Needs and Priorities

Activity/Program Needs: Respondents were asked to identify if their household had a need for 24 programs/activities and to rate how well their needs for each were currently being met. Based on this analysis, ETC Institute was able to estimate the number of households in the community that had the greatest “unmet” need for various activities/programs.

The three programs with the highest percentage of households that have an unmet need:

1. Special events – 3,688 households
2. Nature programs/environmental education – 3,416 households
3. Water-based recreation programs – 3,259 households

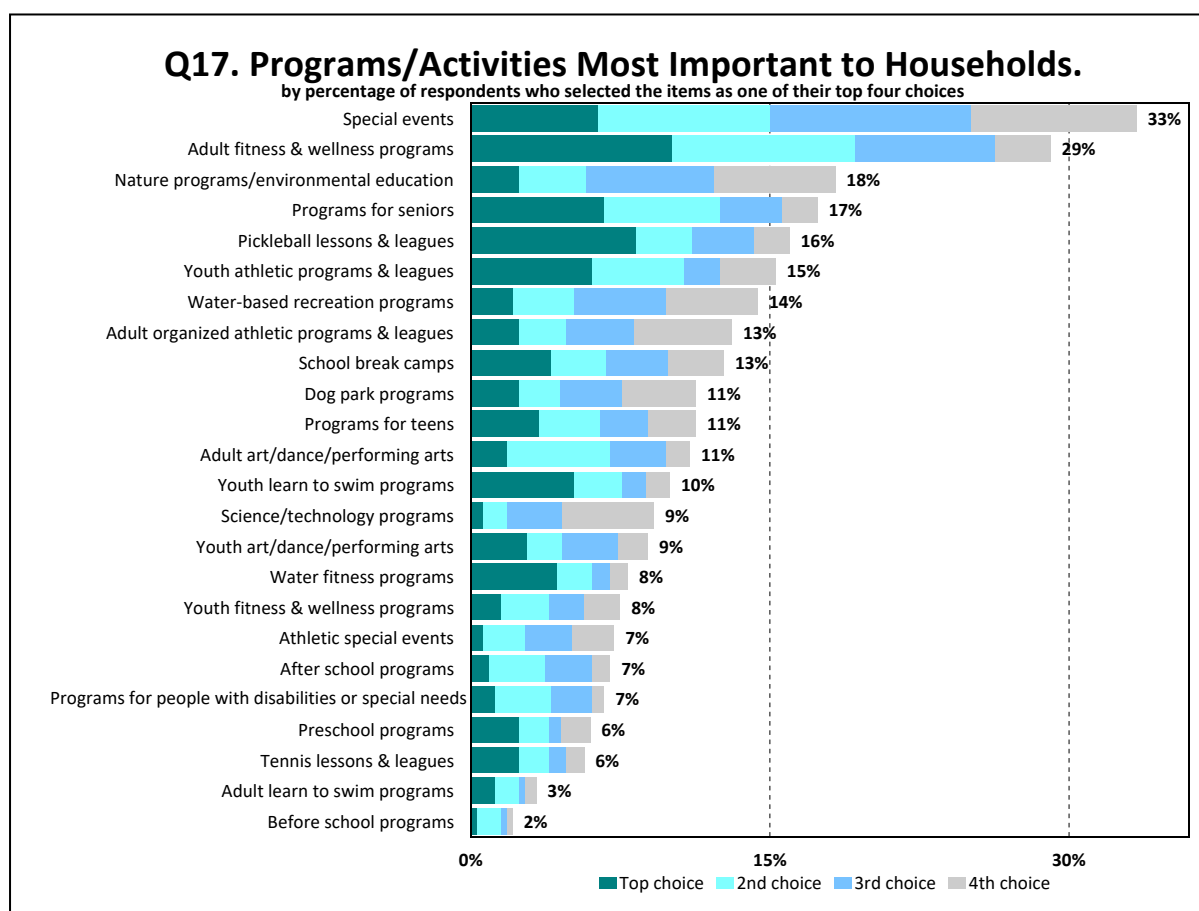
The estimated number of households that have unmet needs for each of the 24 programs assessed is shown in the chart below.



Programs Importance: In addition to assessing the needs for each program, ETC Institute also assessed the importance that residents placed on each item. Based on the sum of respondents' top four choices, these were the four programs ranked most important to residents:

1. Special events (33%)
2. Adult continuing education programs (29%)
3. Nature programs/environmental education (18%)
4. Programs for seniors (17%)

The percentage of residents who selected each program as one of their top four choices is shown in the chart below.

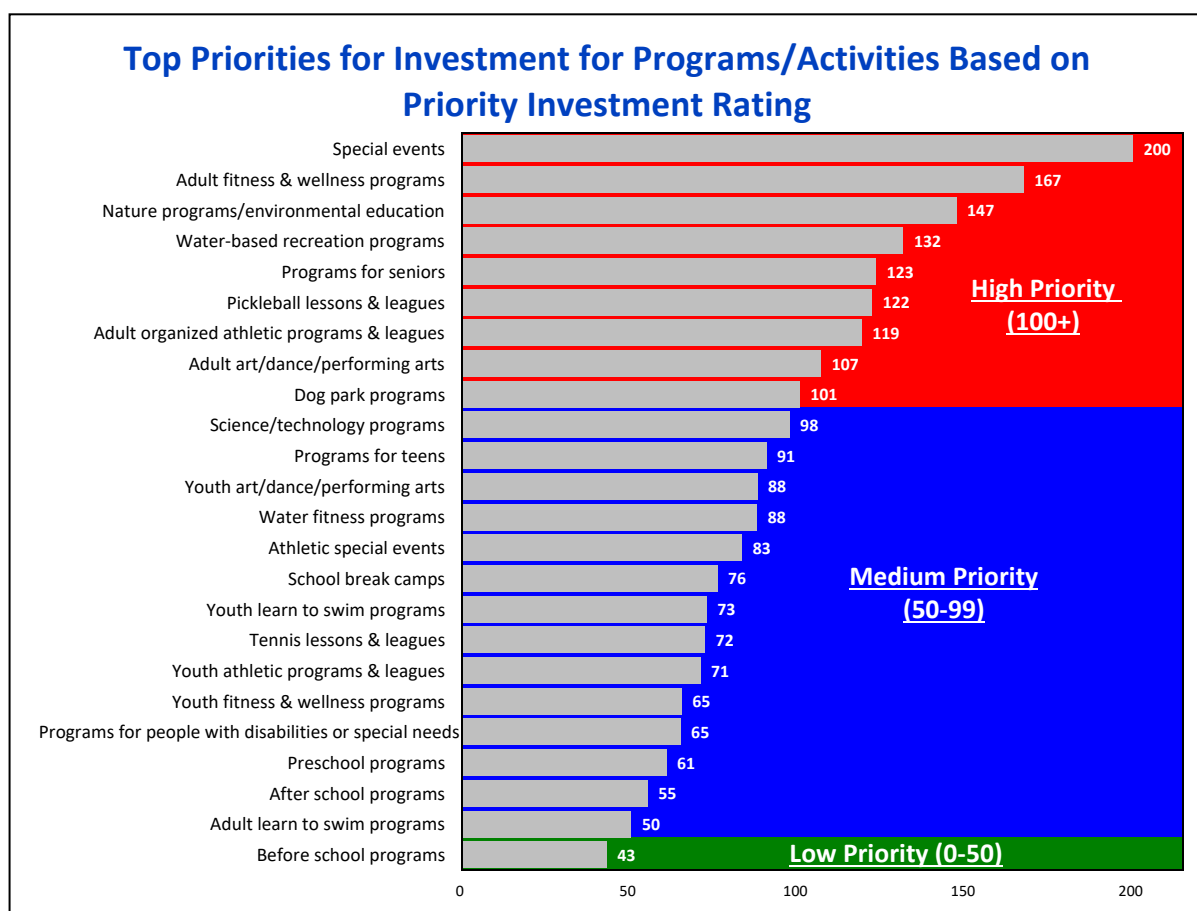


Priorities for Activity/Program Investments: The **Priority Investment Rating (PIR)** was developed by ETC Institute to provide organizations with an objective tool for evaluating the priority that should be placed on recreation and parks investments. The Priority Investment Rating (PIR) equally weighs (1) the importance that residents place on programs and (2) how many residents have unmet needs for the activity/program. [Details regarding the methodology for this analysis are provided in Section 3 of this report.]

Based the Priority Investment Rating (PIR), the following programs were rated as high priorities for investment:

- Special events (PIR=200)
- Adult fitness and wellness programs (PIR=167)
- Nature programs/environmental education (PIR=147)
- Water-based recreation programs (PIR=132)
- Programs for seniors (PIR=123)
- Pickleball lessons and leagues (PIR=122)
- Adult organized athletic programs and leagues (PIR=119)
- Adult art/dance/performing arts (PIR=107)
- Dog park programs (PIR=101)

The chart below shows the Priority Investment Rating for each of the 24 activities/programs assessed on the survey.

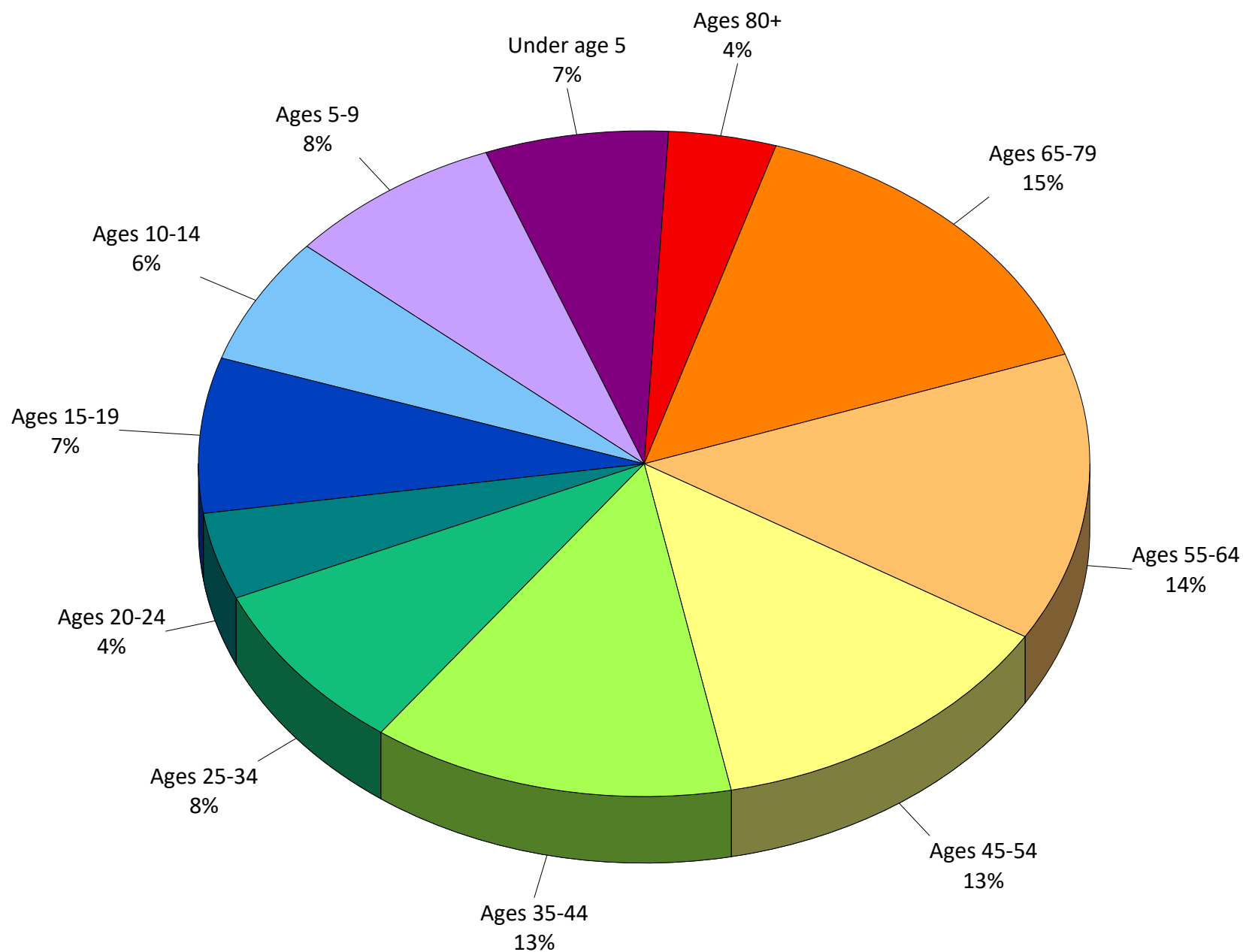




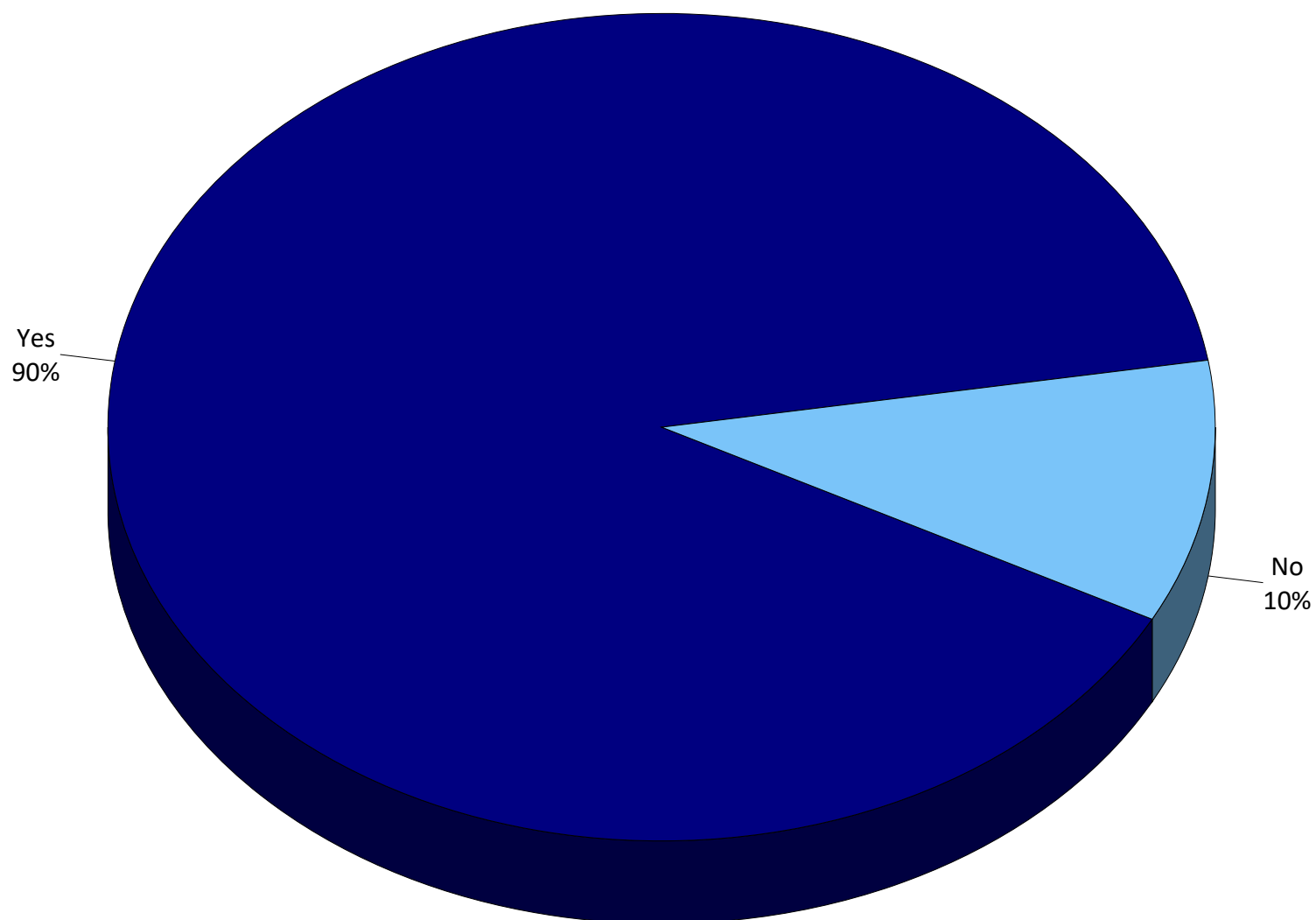
Charts & Graphs

Q1. Counting yourself, how many people in your household are...

by percentage of persons in household

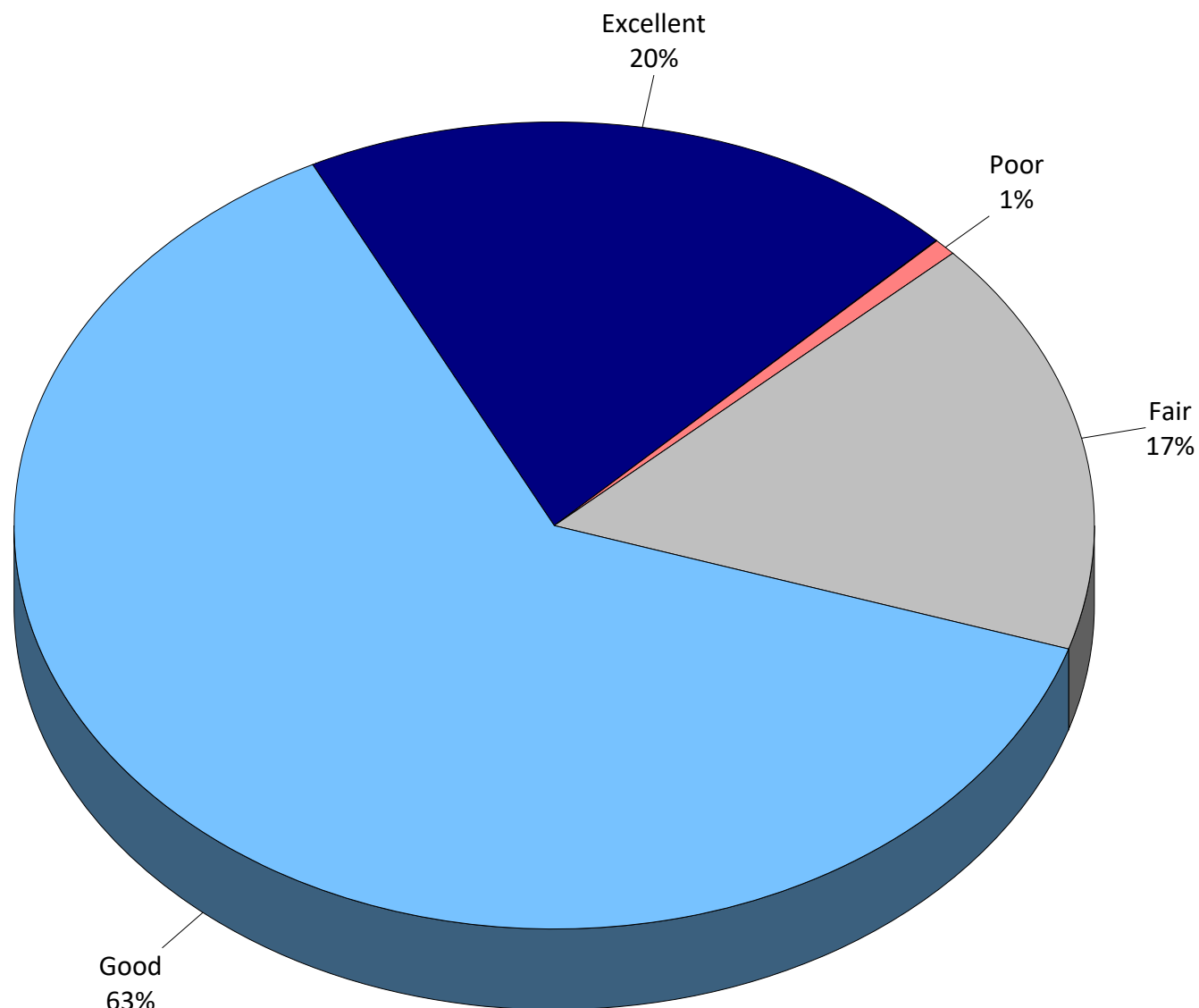


Q2. Have you/your household visited any of the City of Clemson parks or recreation facilities during the past 12 months?
by percentage of respondents



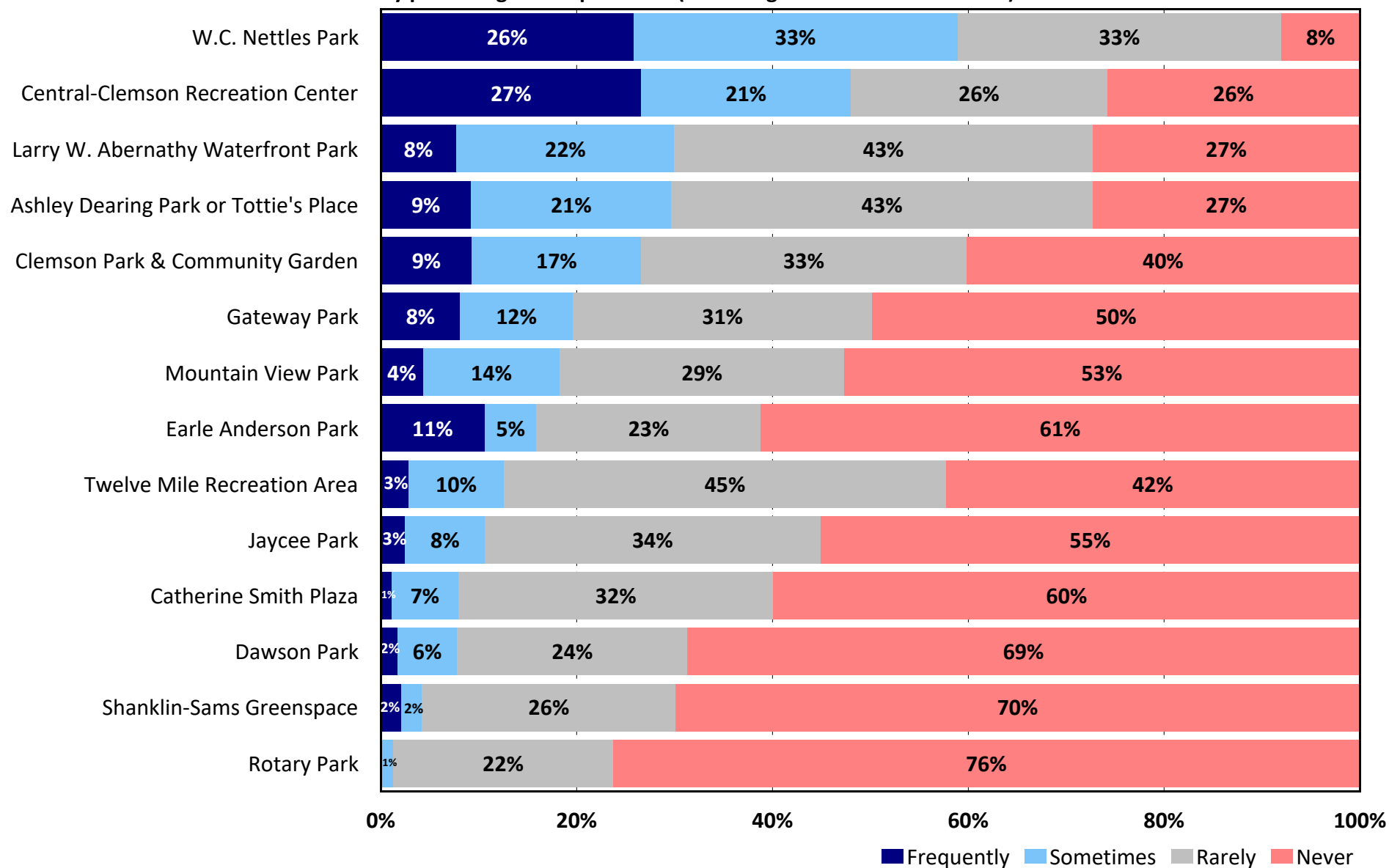
Q2a. Overall, how would you rate the physical condition of the City of Clemson parks you have visited?

by percentage of respondents (excluding "not provided")

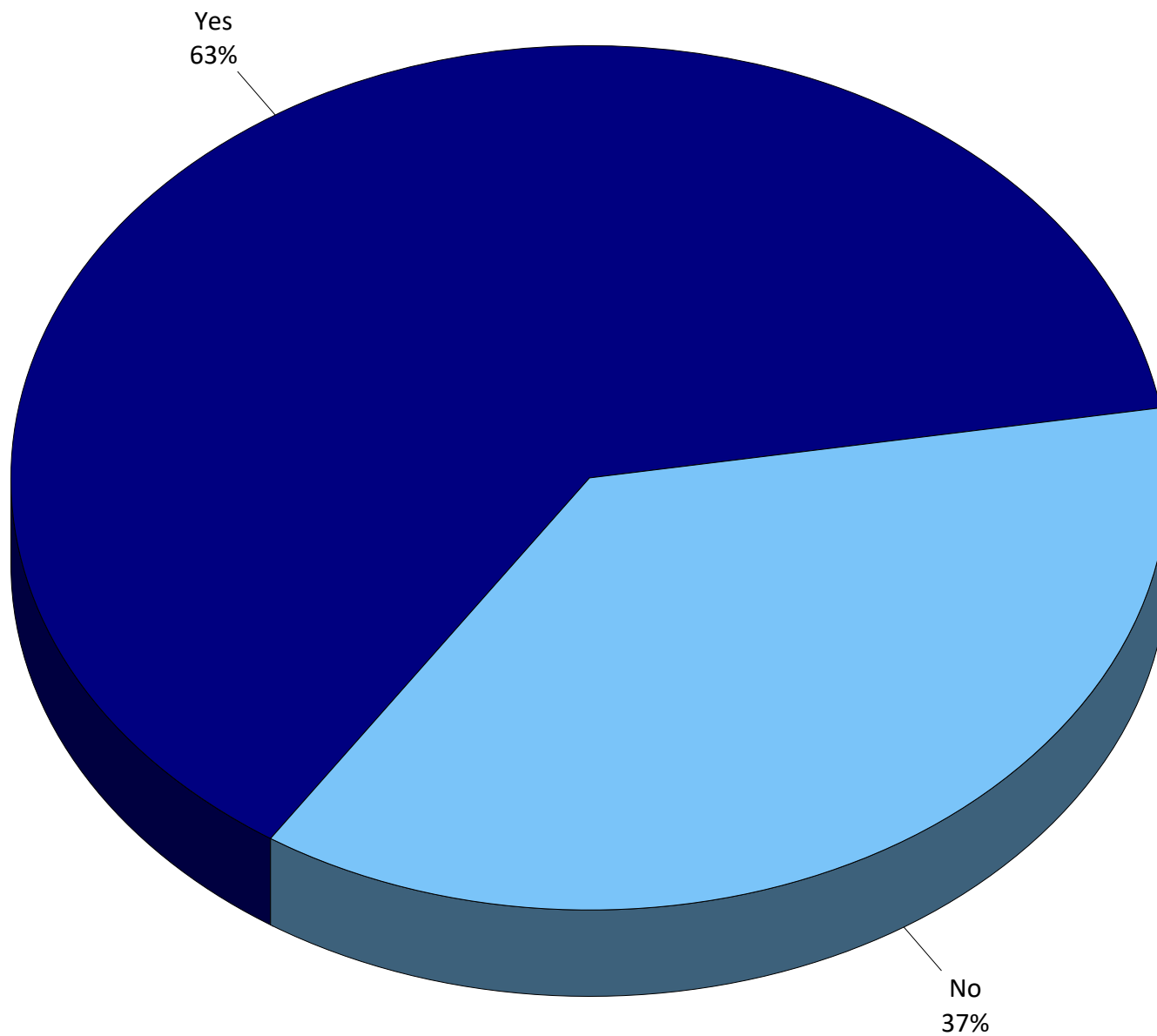


Q2b. In the last 12 months, how often have you used the following parks and recreation facilities provided by the City of Clemson Parks and Recreation department?

by percentage of respondents (excluding "did not know existed")

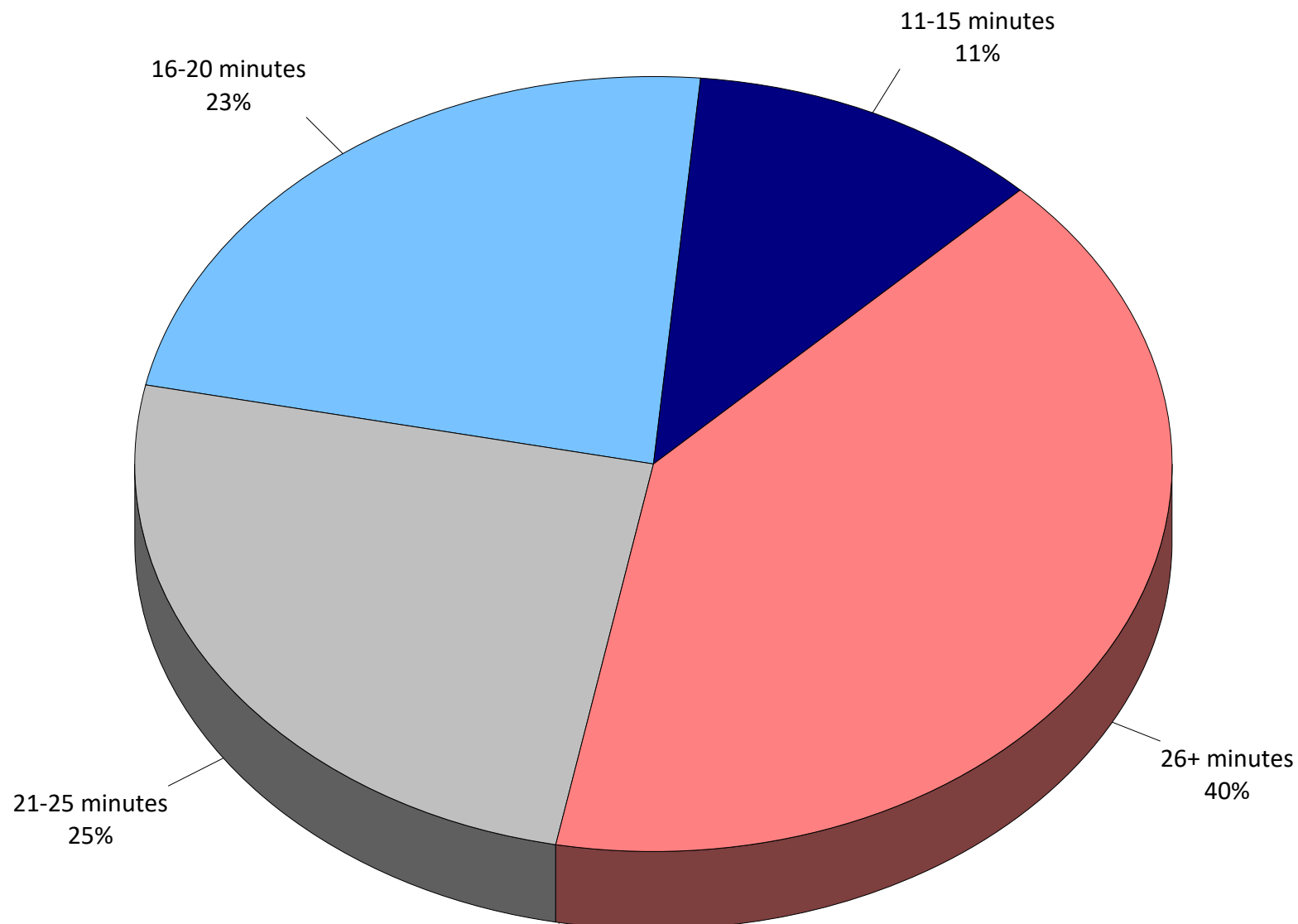


Q3. Do you live within a 10-minute walk from a park?
by percentage of respondents (excluding "not provided")



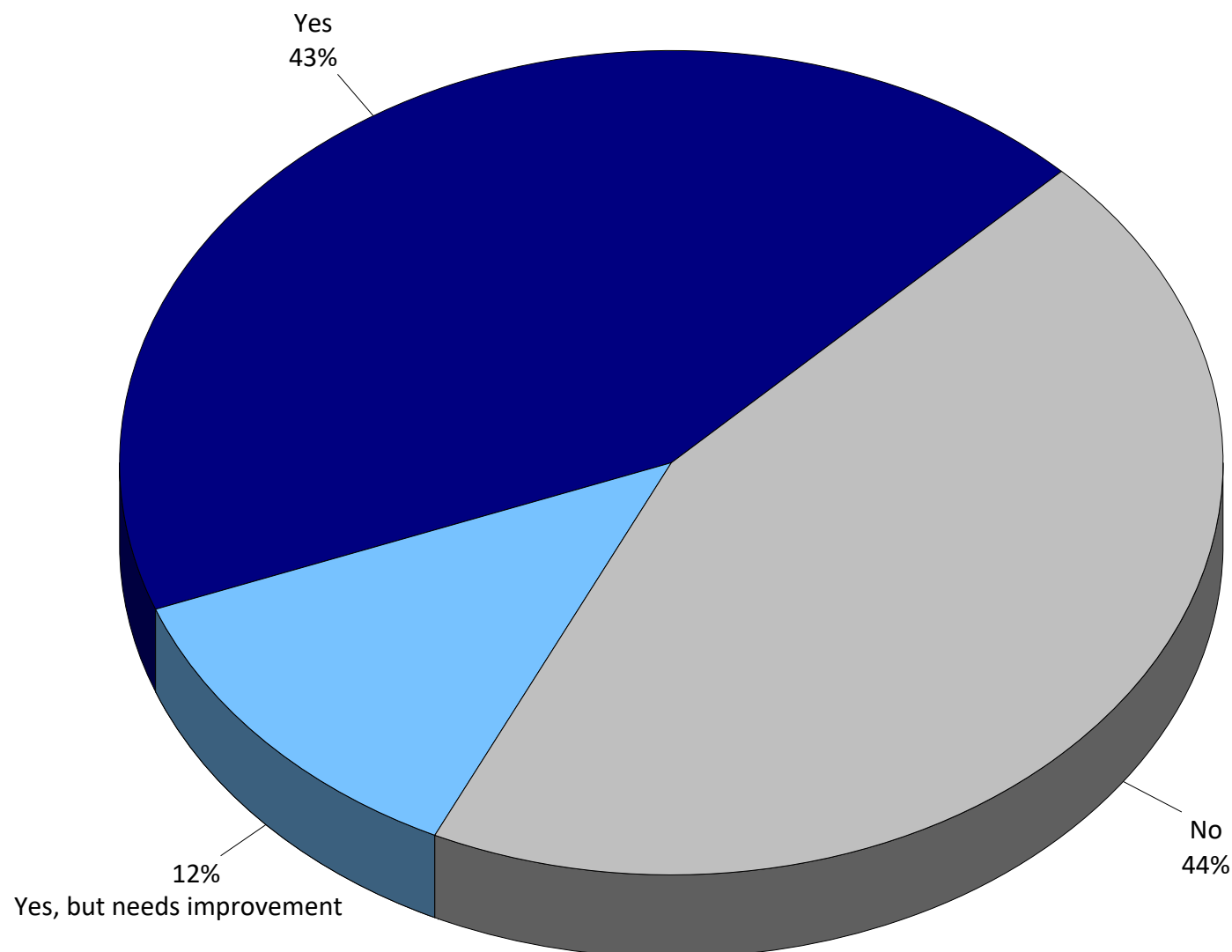
Q3b. Approximately how long would it take for you to walk to the nearest park from your home?

by percentage of respondents (excluding "not provided")



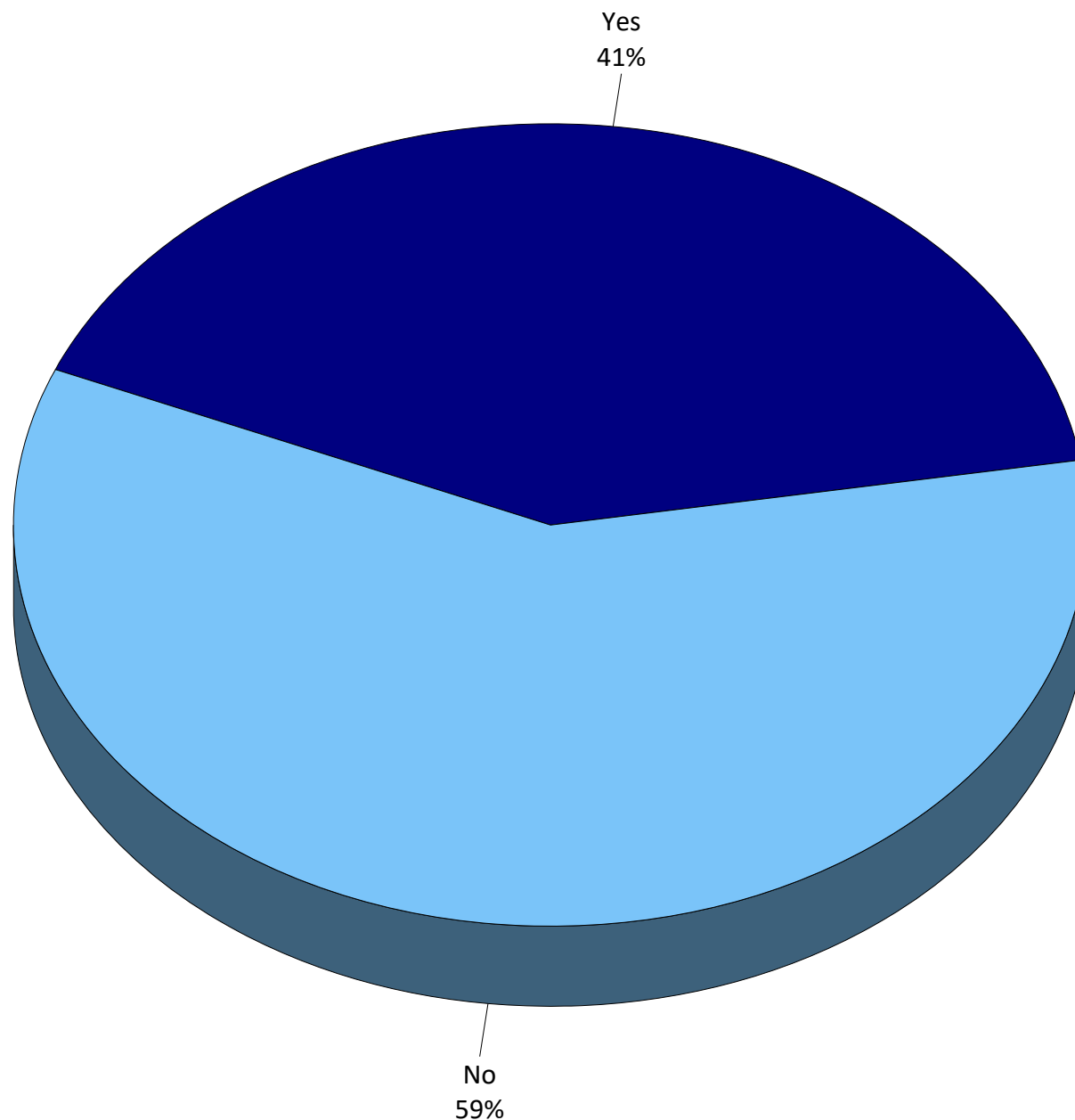
Q4. Do you have a pedestrian route (trails, sidewalks) to safely access the closest park from your home?

by percentage of respondents (excluding "not provided")



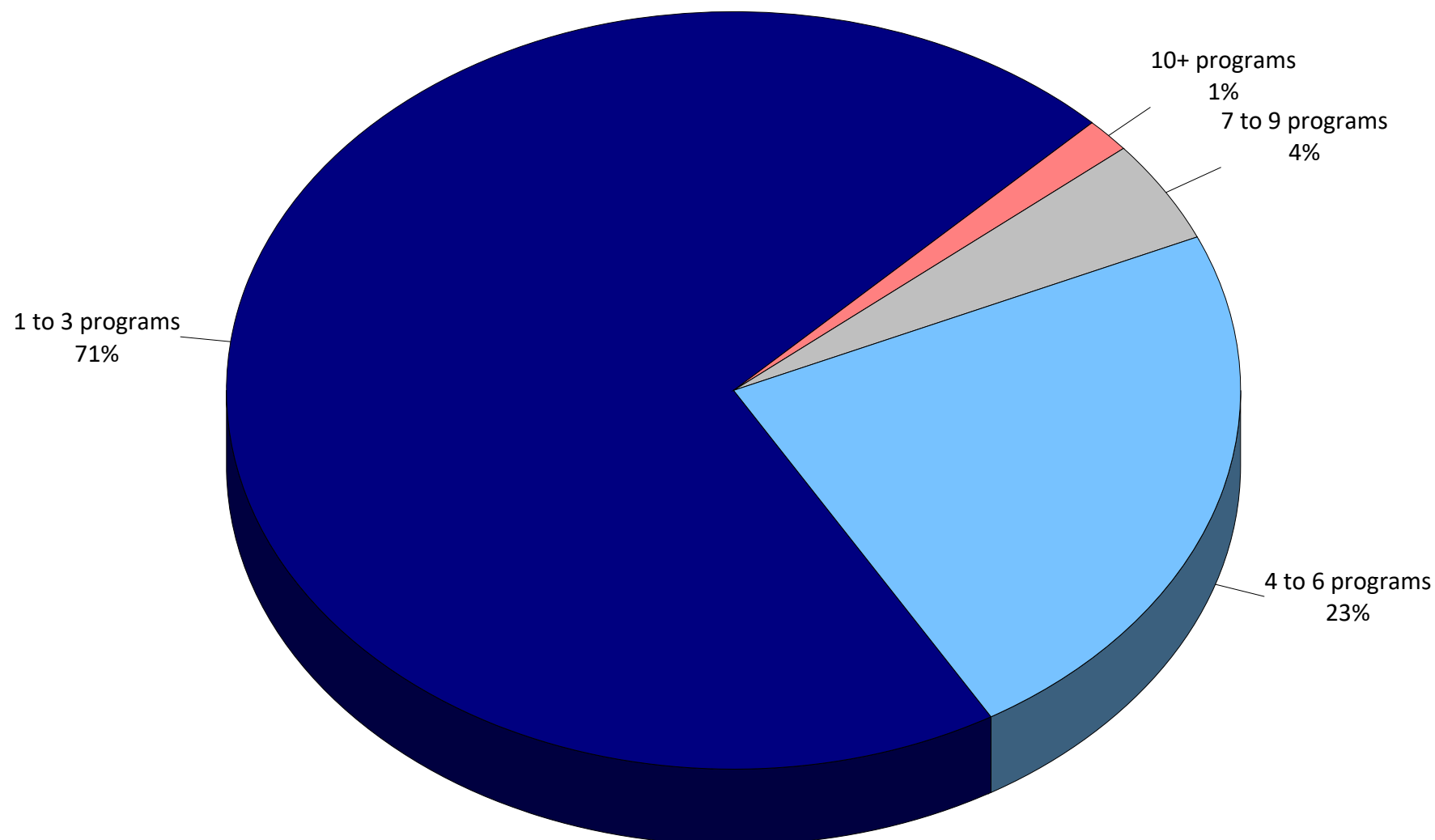
Q5. Have you/your household participated in any recreation programs offered by the City of Clemson Parks and Recreation Department during the past 12 months?

by percentage of respondents (excluding "not provided")



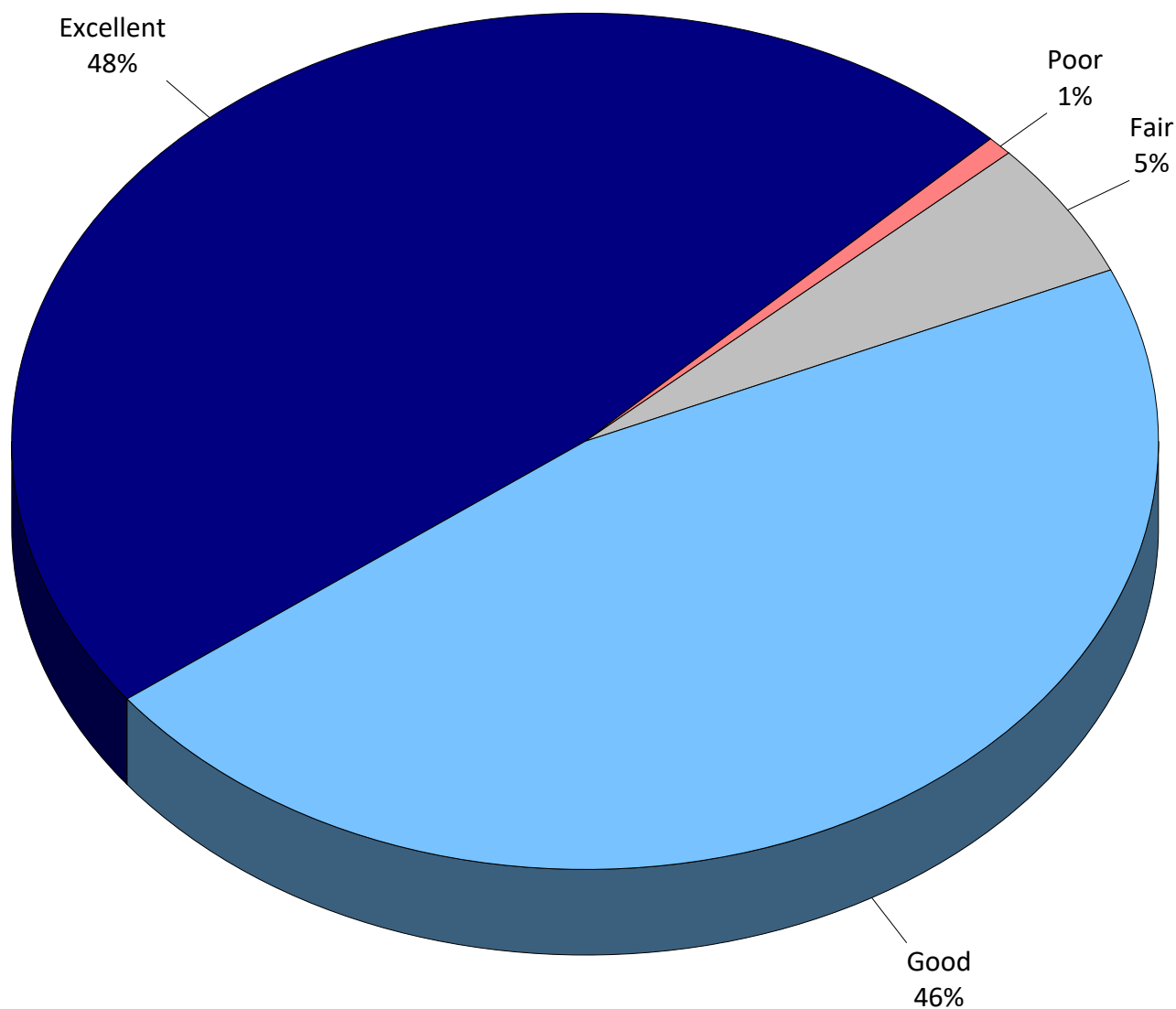
Q5a. How many different recreation programs have you/your household have participated in over the last 12 months?

by percentage of respondents (excluding "not provided")



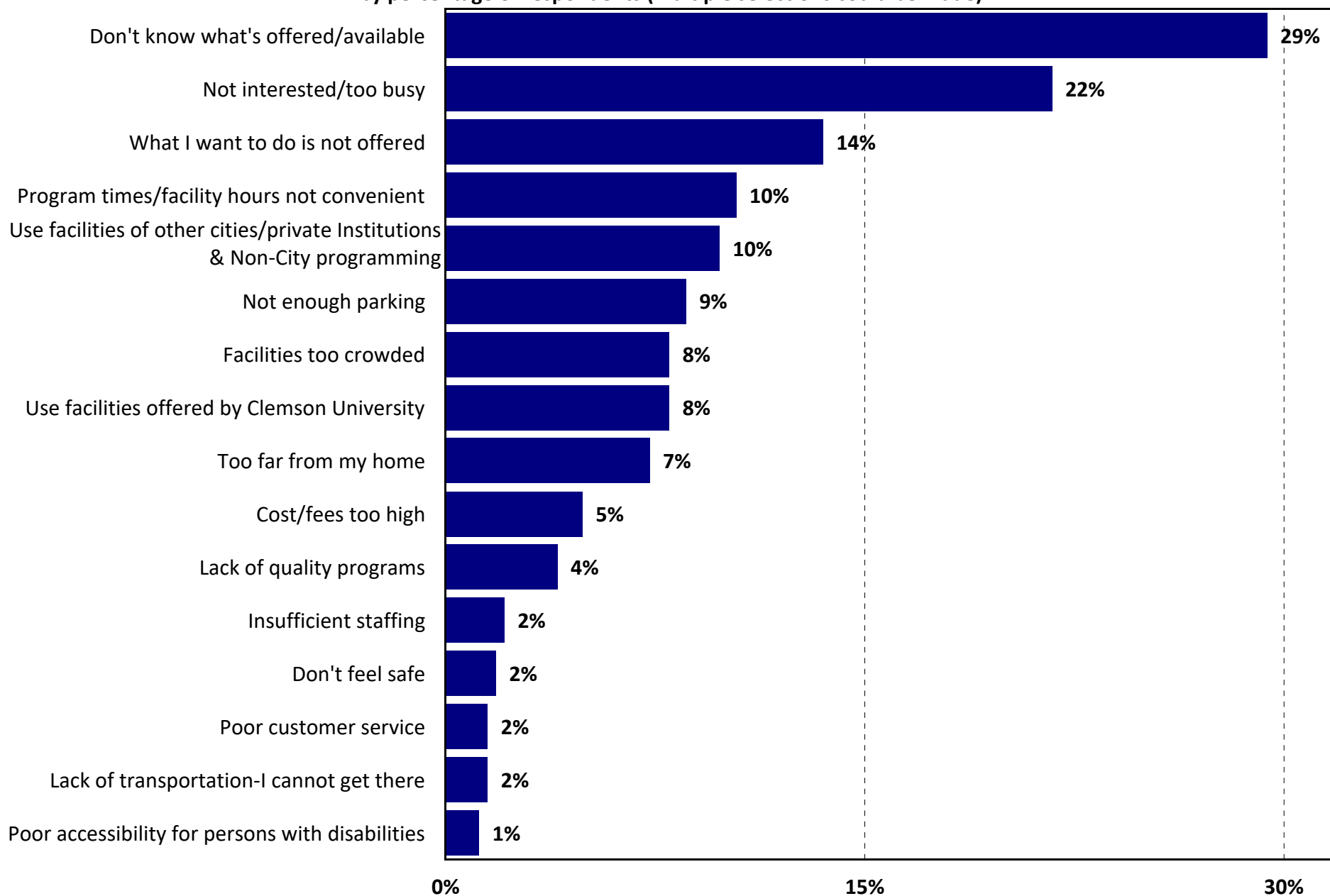
Q5b. Overall, how would you rate the quality of the City of Clemson Parks and Recreation Department programs you participated in?

by percentage of respondents (excluding "not provided")



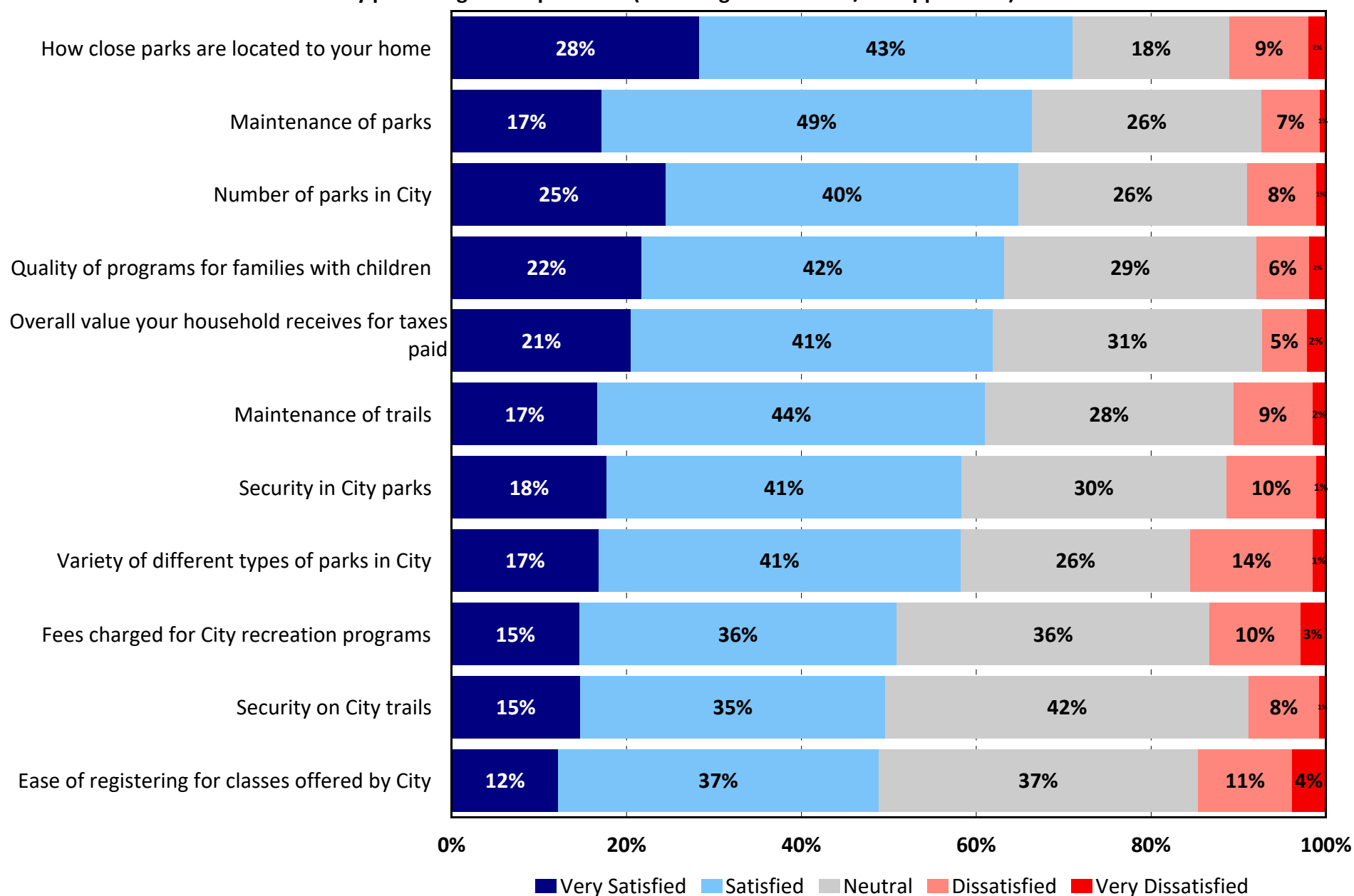
Q6. Which of the following reasons prevent you/your household from using recreation programs offered by the city?

by percentage of respondents (multiple selections could be made)



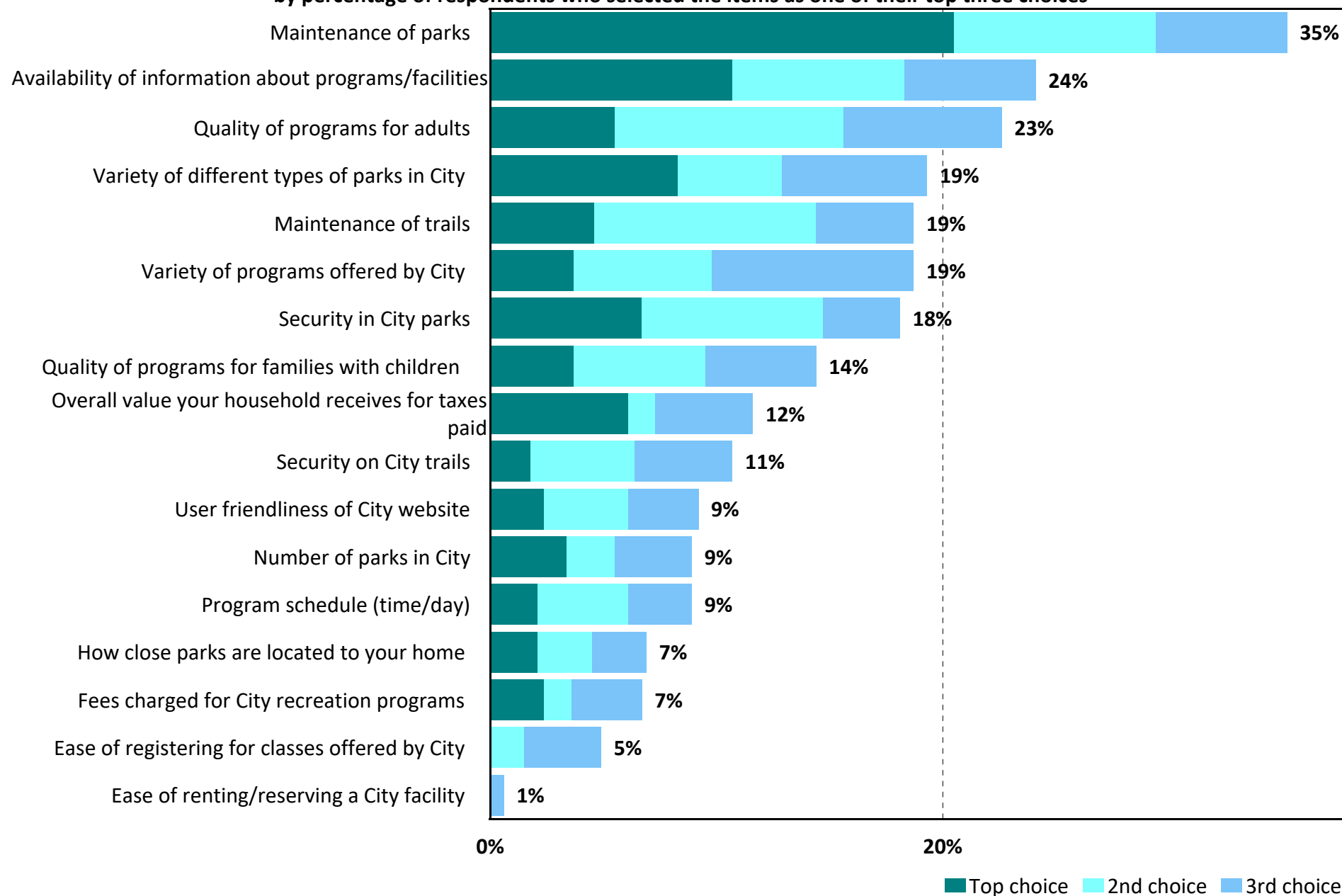
Q7. Please rate your satisfaction with the following recreation, parks, and cultural services provided by the City of Clemson Parks and Recreation Department.

by percentage of respondents (excluding "don't know/not applicable")



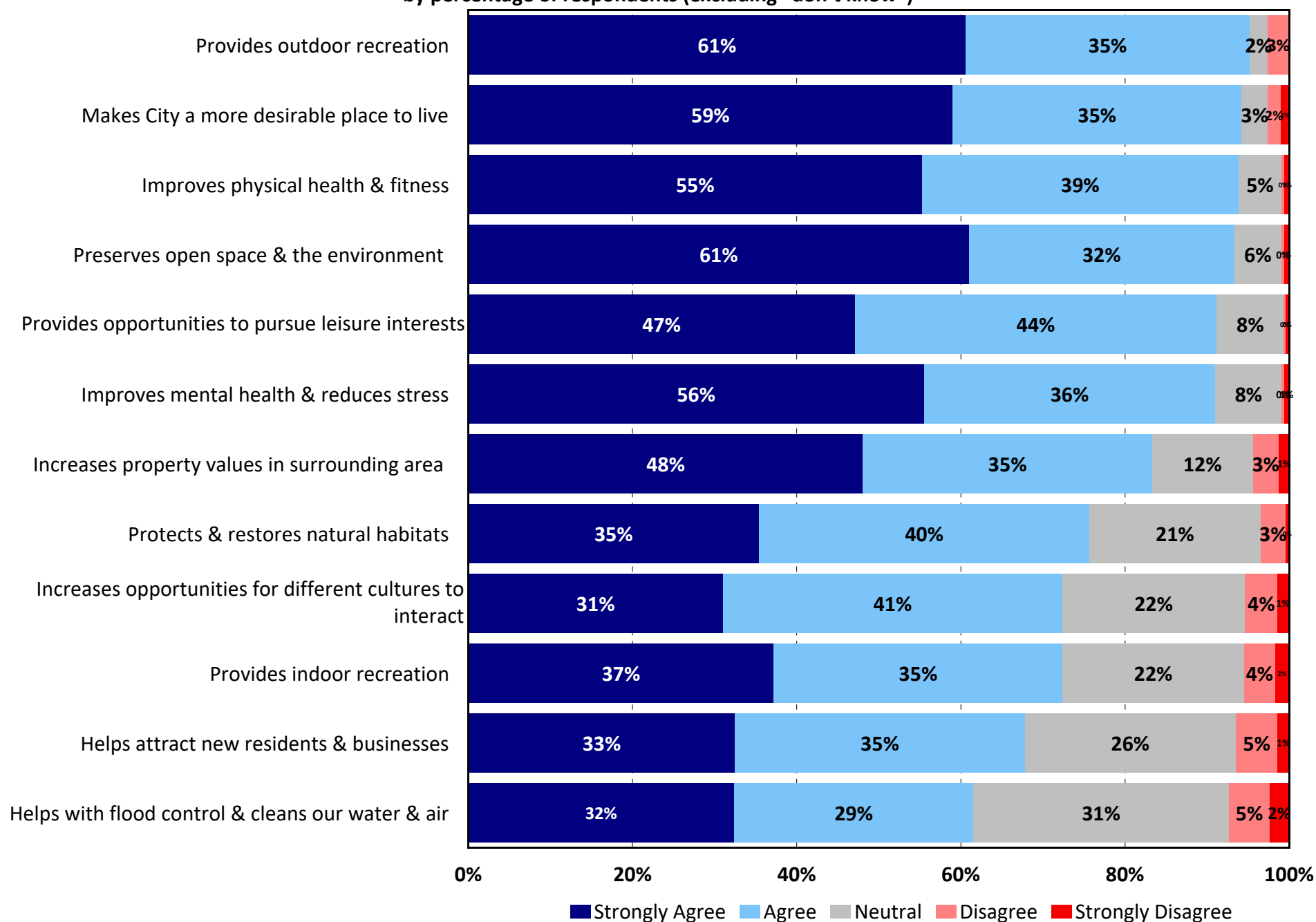
Q8. Which THREE of the items from the list in Question 7 should receive the MOST EMPHASIS over the next five years?

by percentage of respondents who selected the items as one of their top three choices



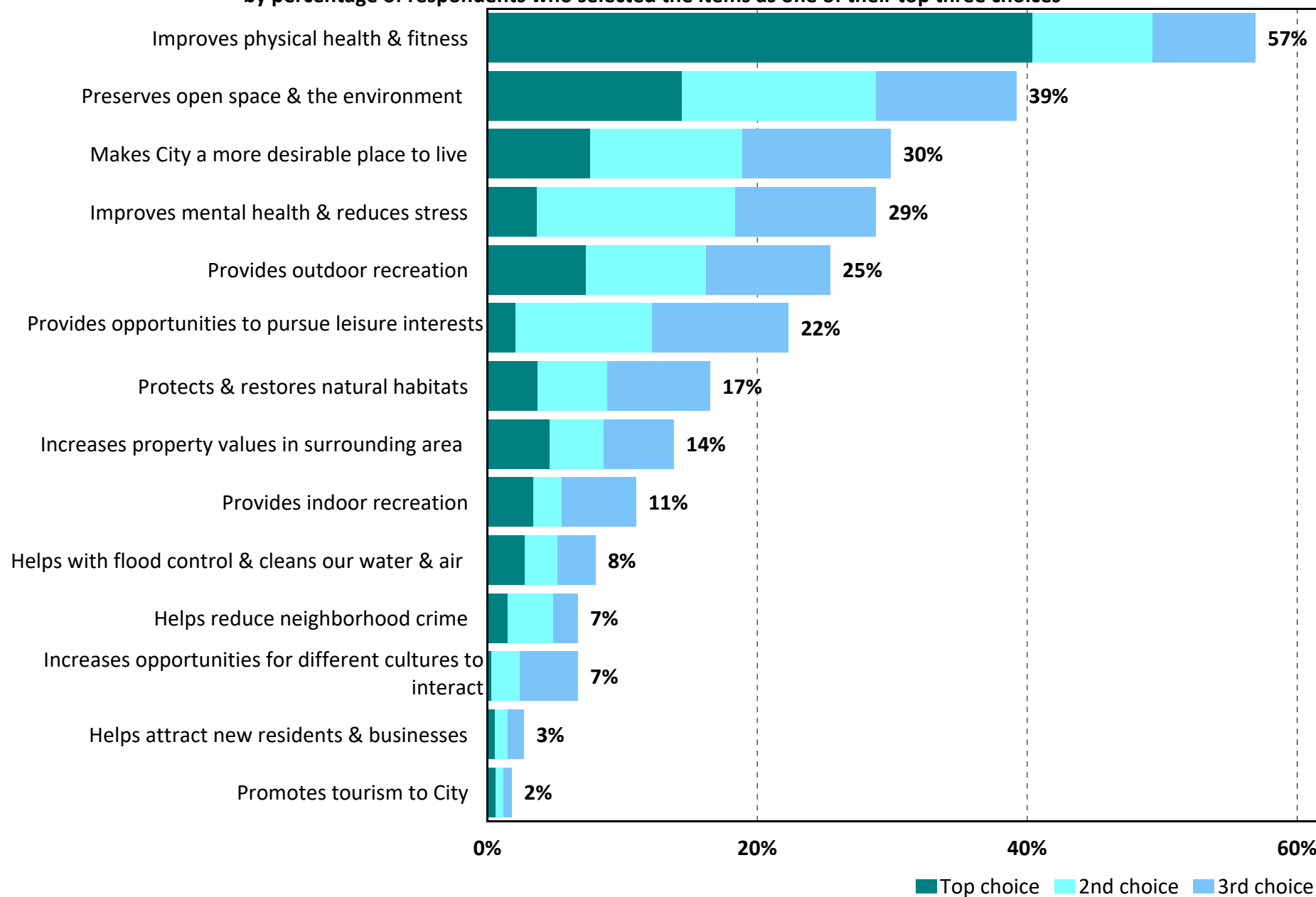
Q9. Please rate your agreement with each item.

by percentage of respondents (excluding "don't know")



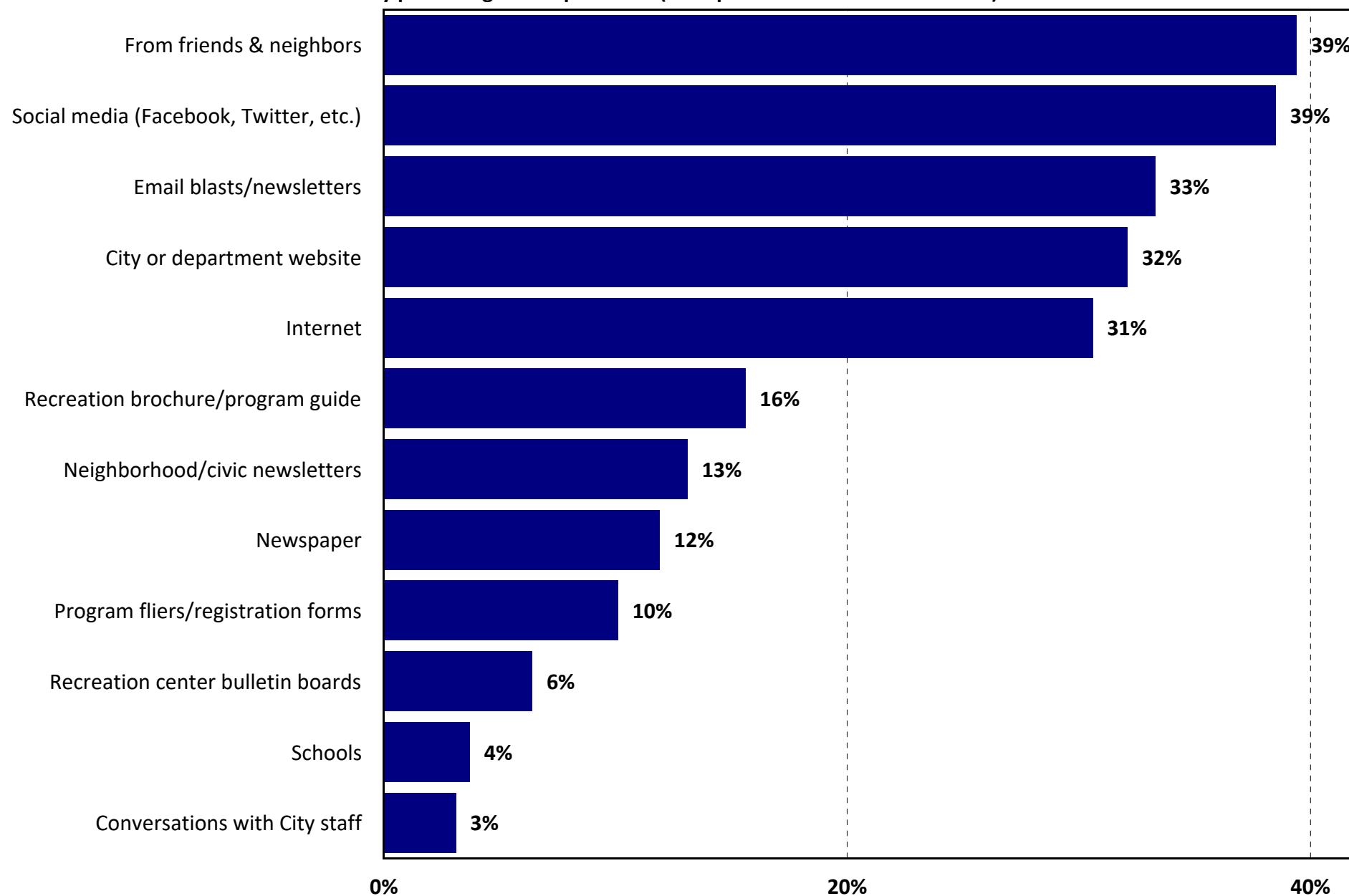
Q10. Which THREE of the benefits listed in Question 9 are MOST IMPORTANT to you/your household?

by percentage of respondents who selected the items as one of their top three choices



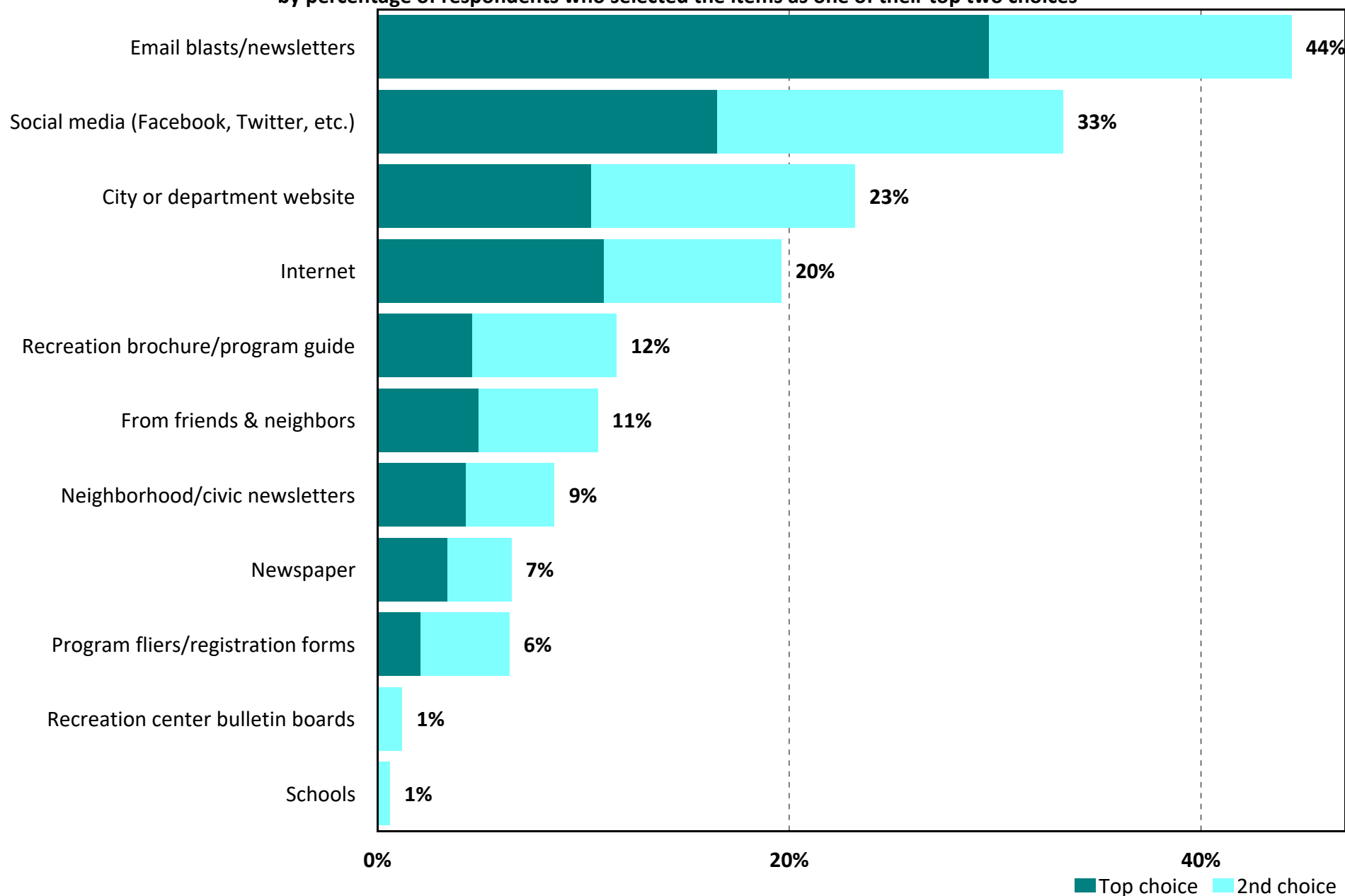
Q11. How do you currently learn about the programs and services that are offered by the City of Clemson?

by percentage of respondents (multiple selections could be made)



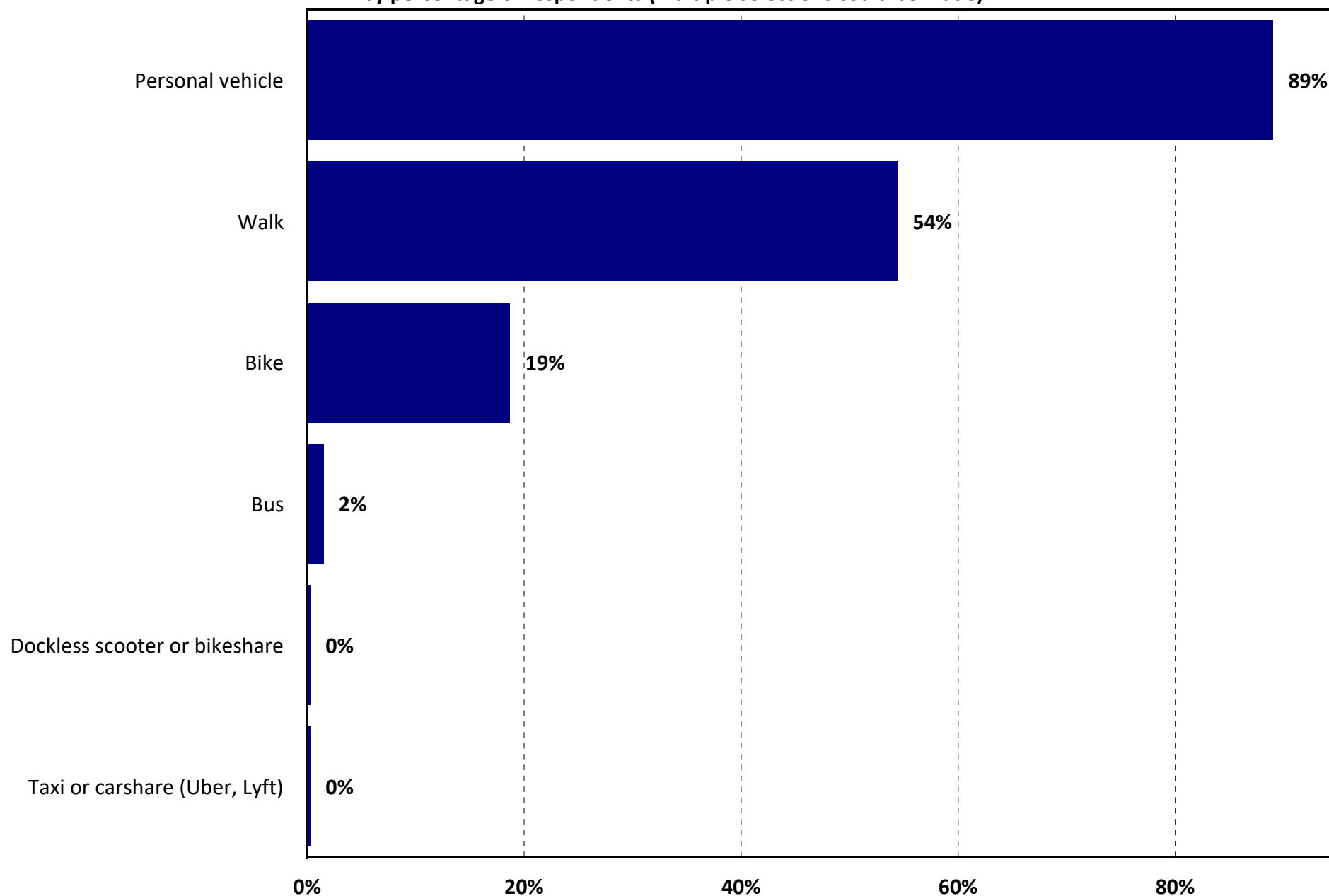
Q12. Which TWO of the sources of information do you MOST PREFER to use to get information about city programs and services?

by percentage of respondents who selected the items as one of their top two choices



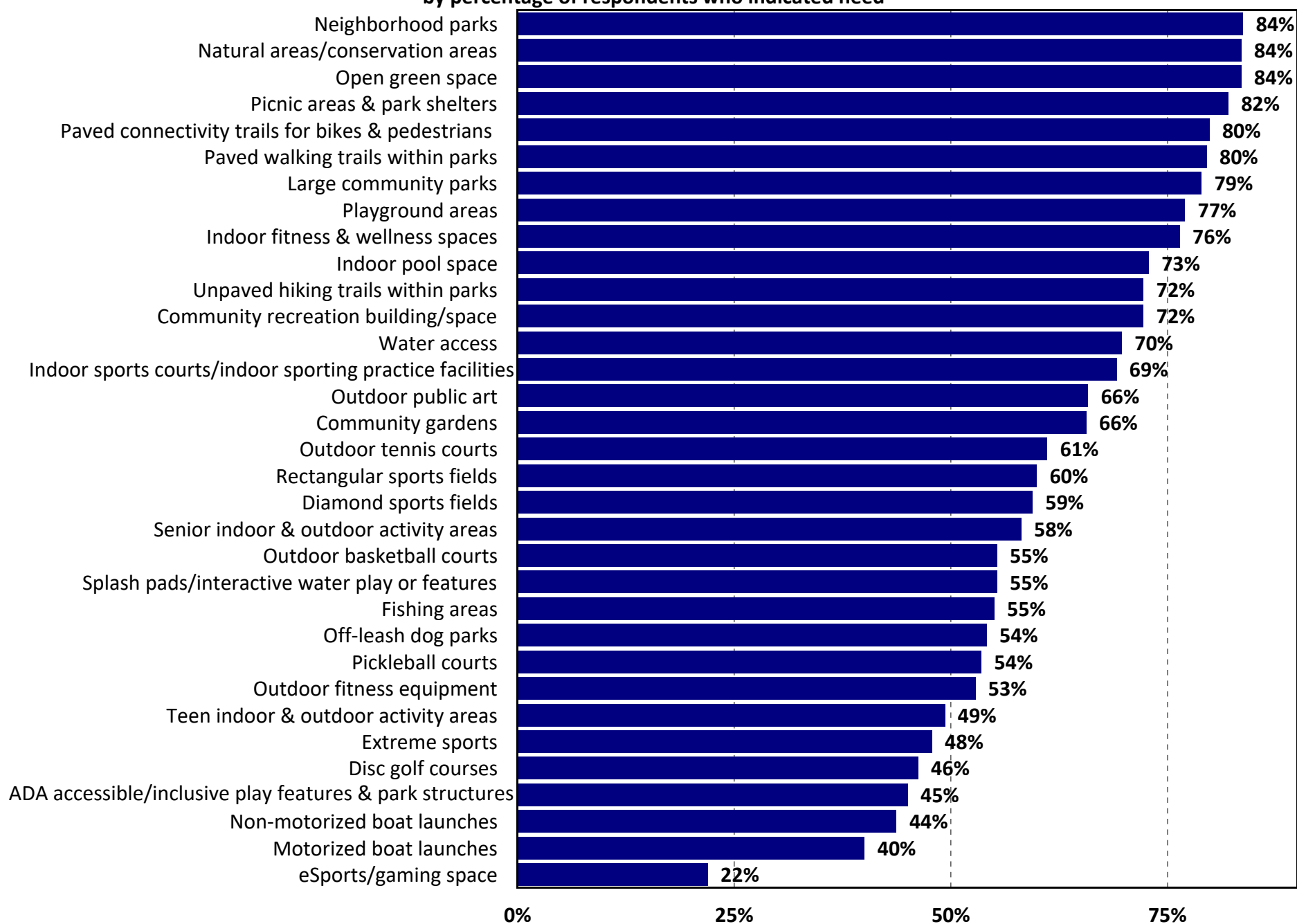
Q13. Please CHECK ALL the ways you typically travel to the parks and recreation areas that you use.

by percentage of respondents (multiple selections could be made)



Q14. Need for Recreation Facilities or Amenities.

by percentage of respondents who indicated need



0%

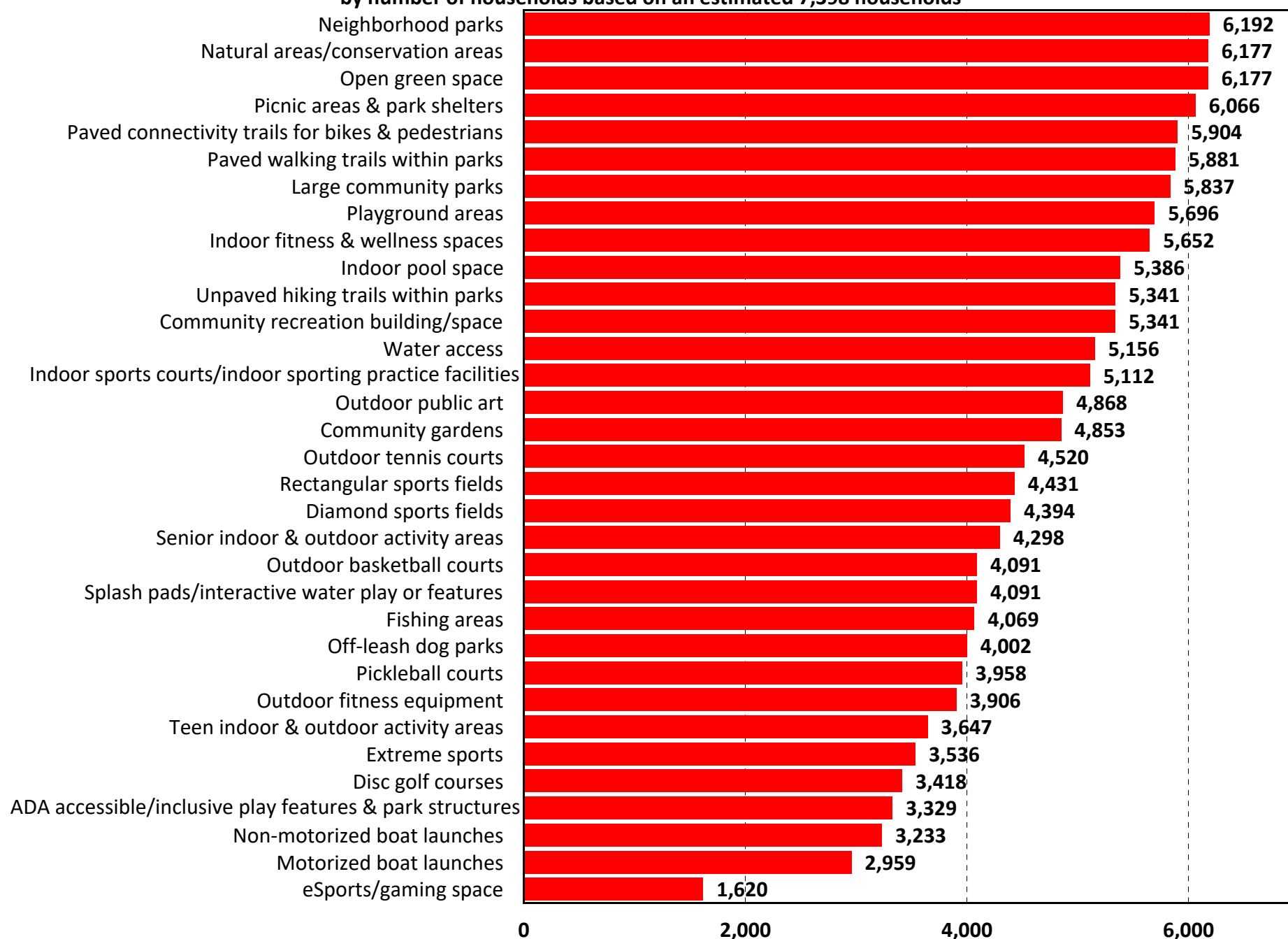
25%

50%

75%

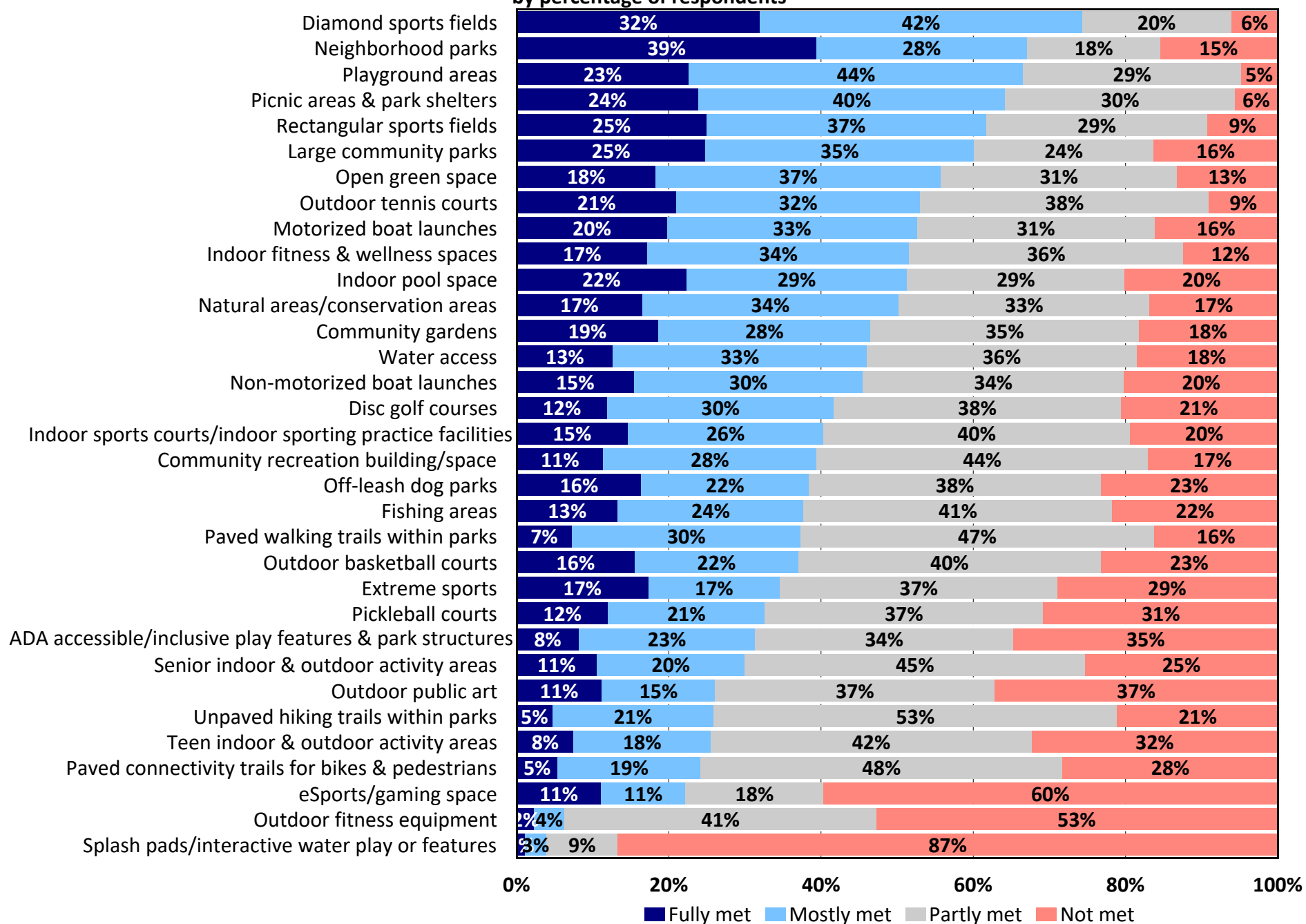
Q14. Estimated Number of Households Who Have a Need for Amenities/Facilities

by number of households based on an estimated 7,398 households



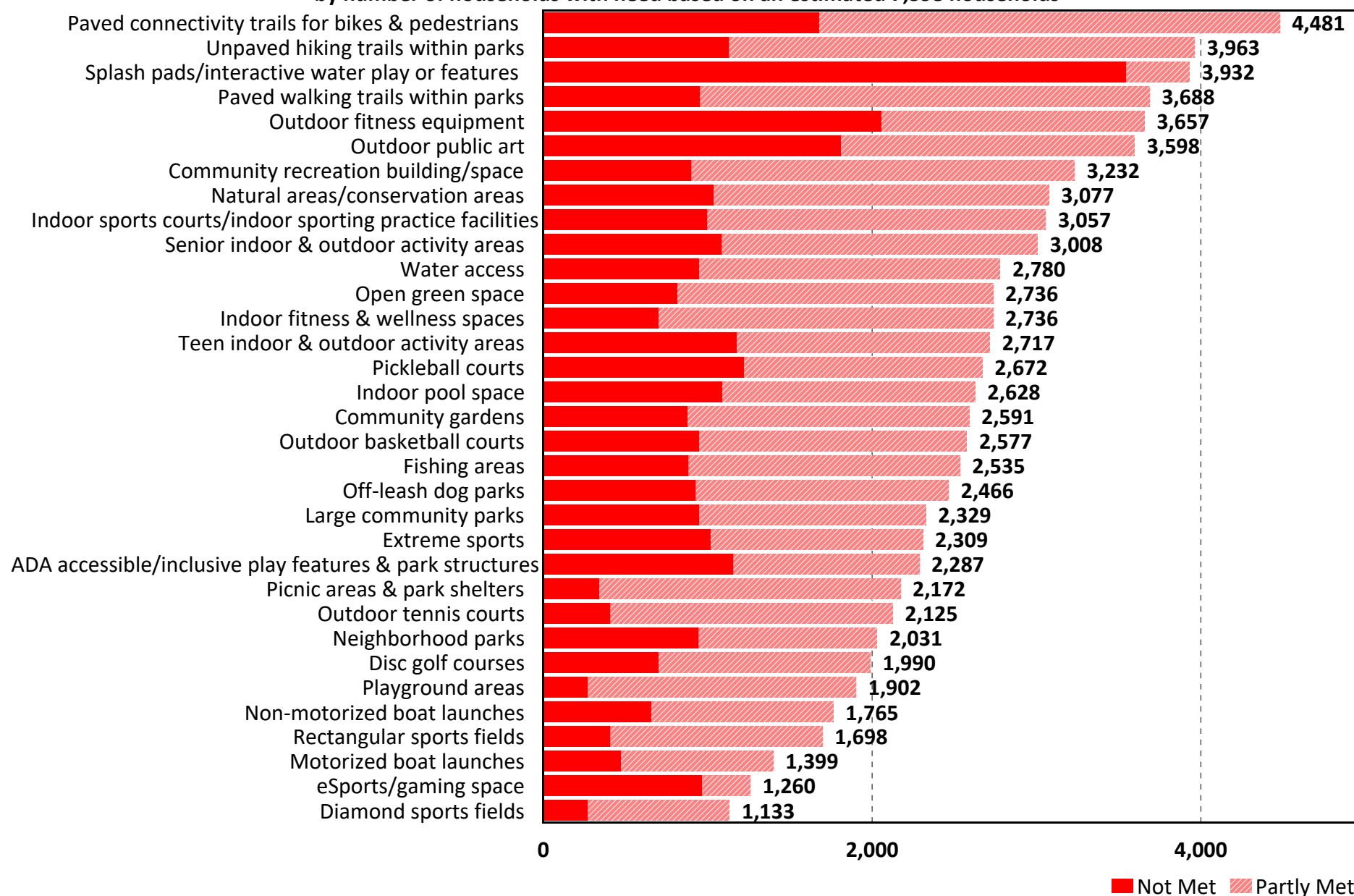
Q14b. How Well Needs Are Being Met for Recreation Facilities or Amenities

by percentage of respondents



Q14c. Estimated Number of Households Whose Facility/Amenity Needs Are Only “Partly Met” or “Not Met”

by number of households with need based on an estimated 7,398 households



0

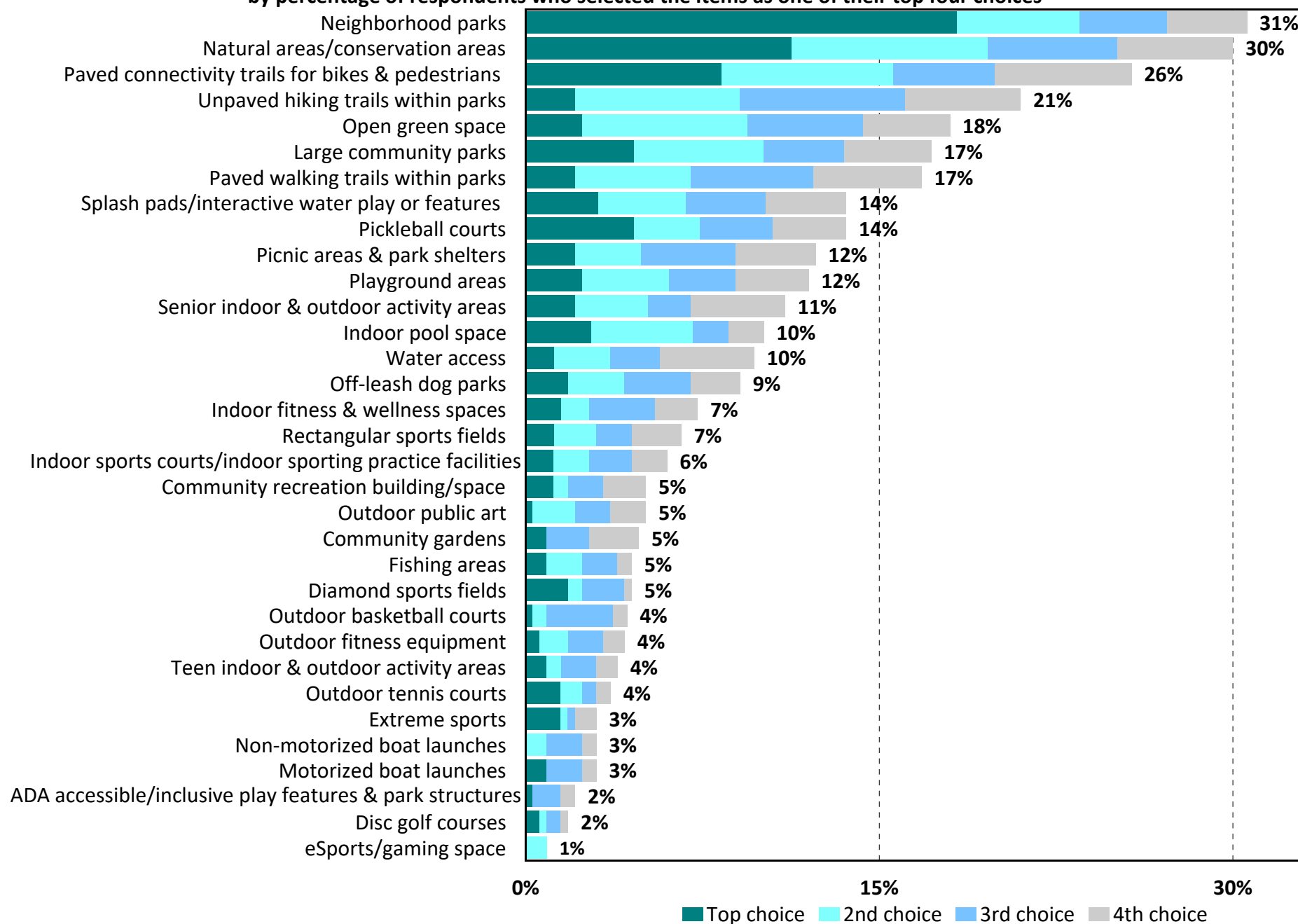
2,000

4,000

Not Met Partly Met

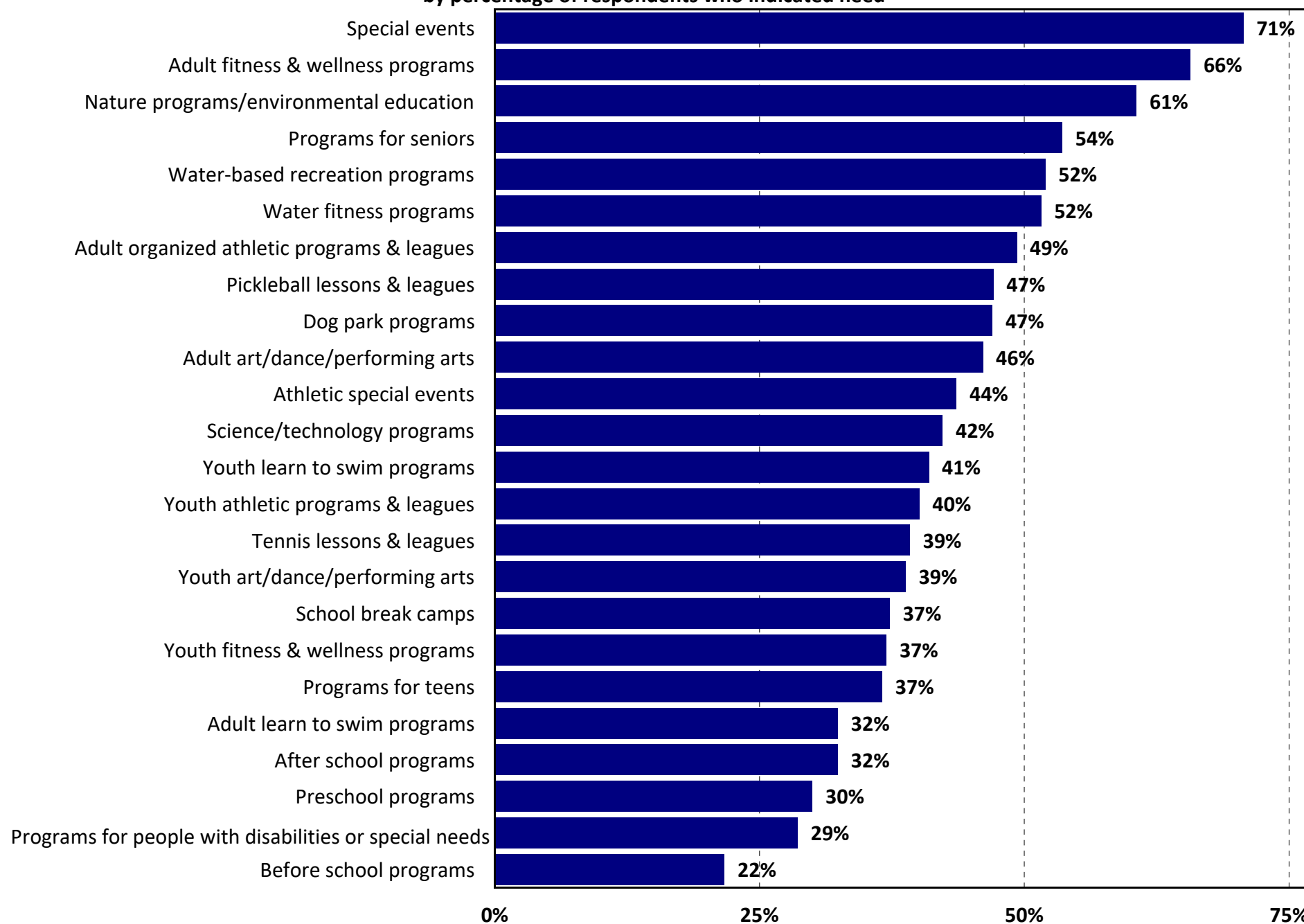
Q15. Facilities/Amenities Most Important to Households.

by percentage of respondents who selected the items as one of their top four choices



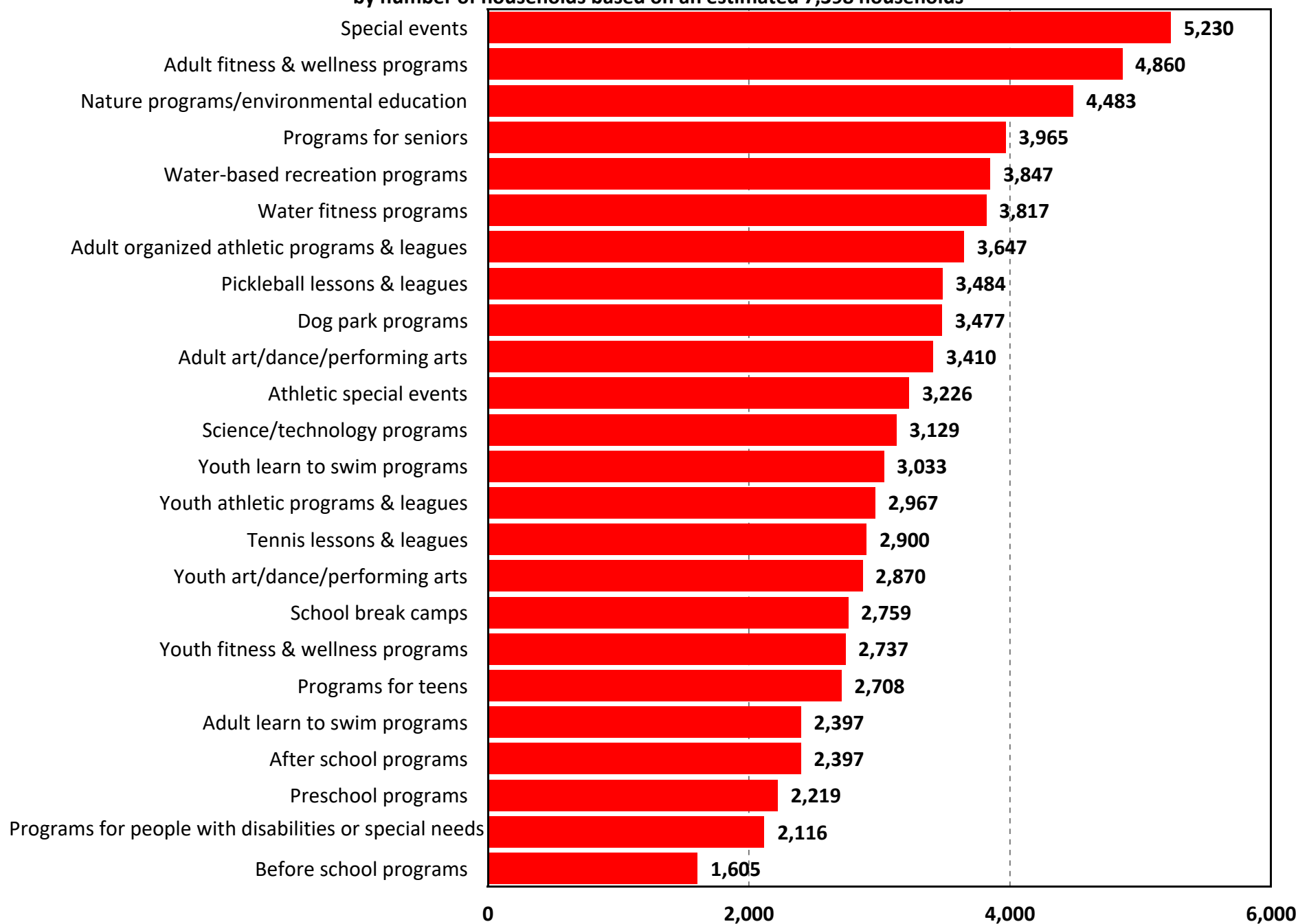
Q16. Need for Recreation Programs/Activities

by percentage of respondents who indicated need



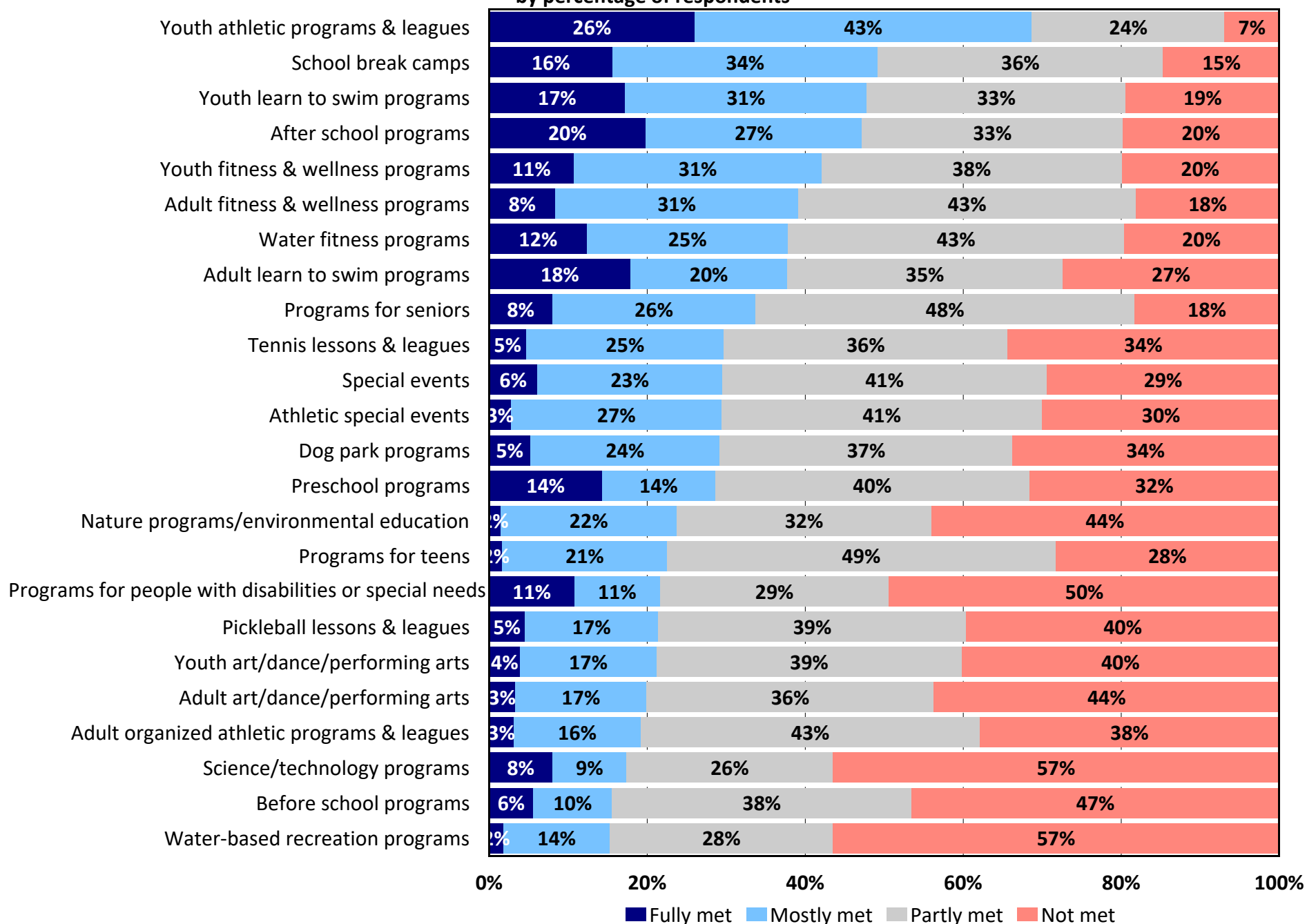
Q16. Estimated Number of Households Who Have a Need for Programs/Activities.

by number of households based on an estimated 7,398 households



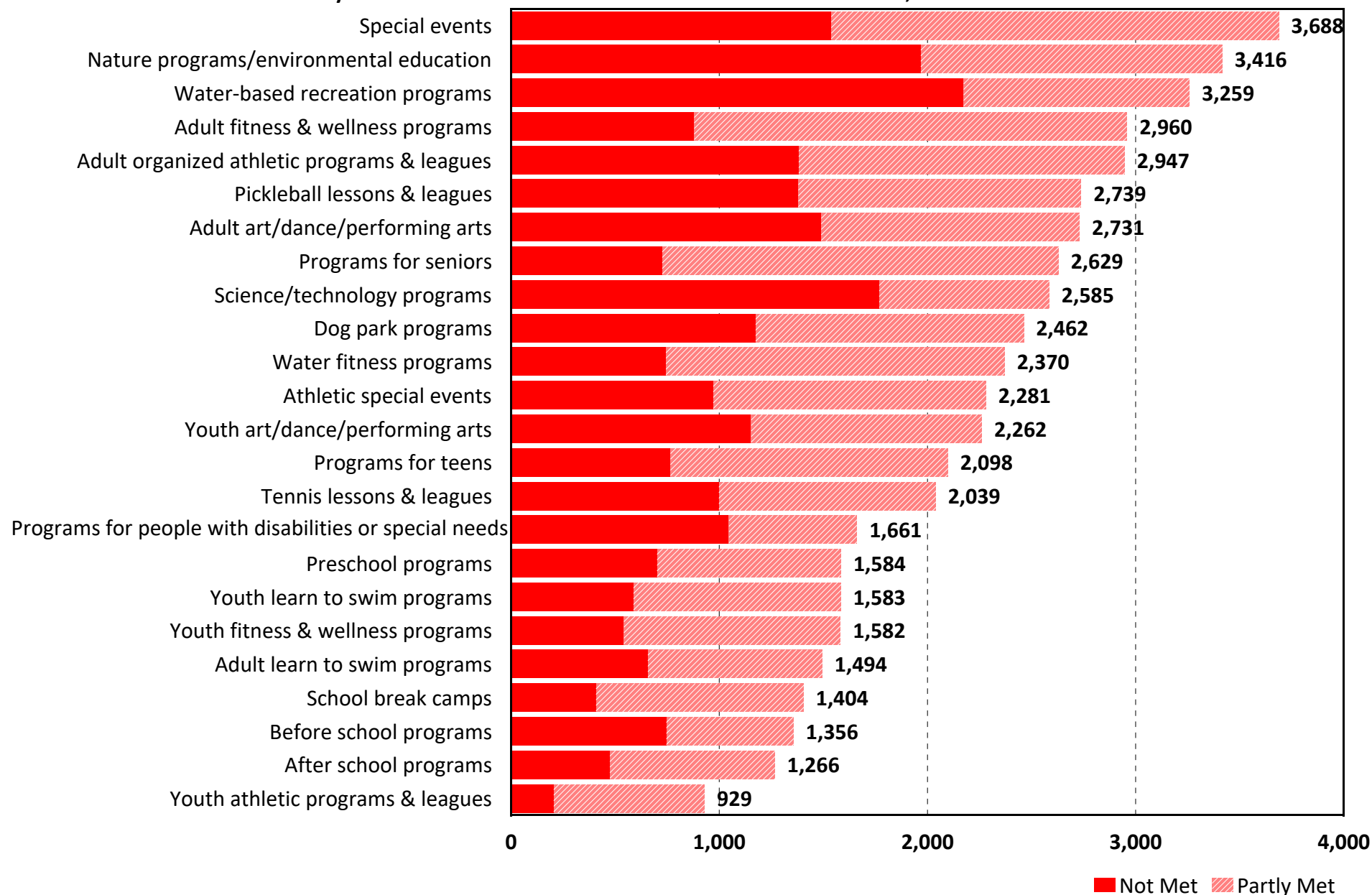
Q16b. How Well Needs Are Being Met for Recreation Programs/Activities

by percentage of respondents



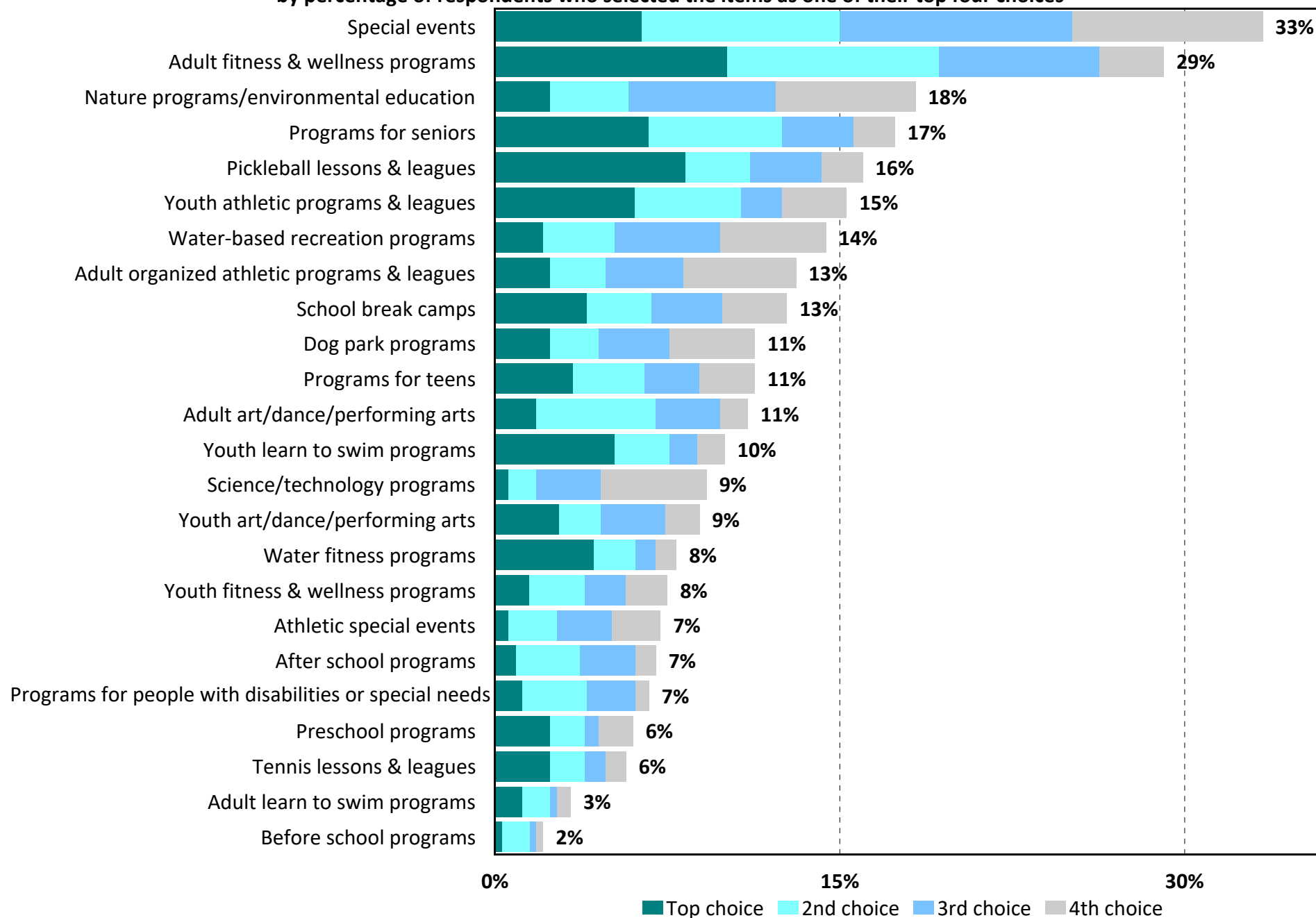
Q16c. Estimated Number of Households Whose Program/Activity Needs Are Only “Partly Met” or “Not Met”

by number of households with need based on an estimated 7,398 households



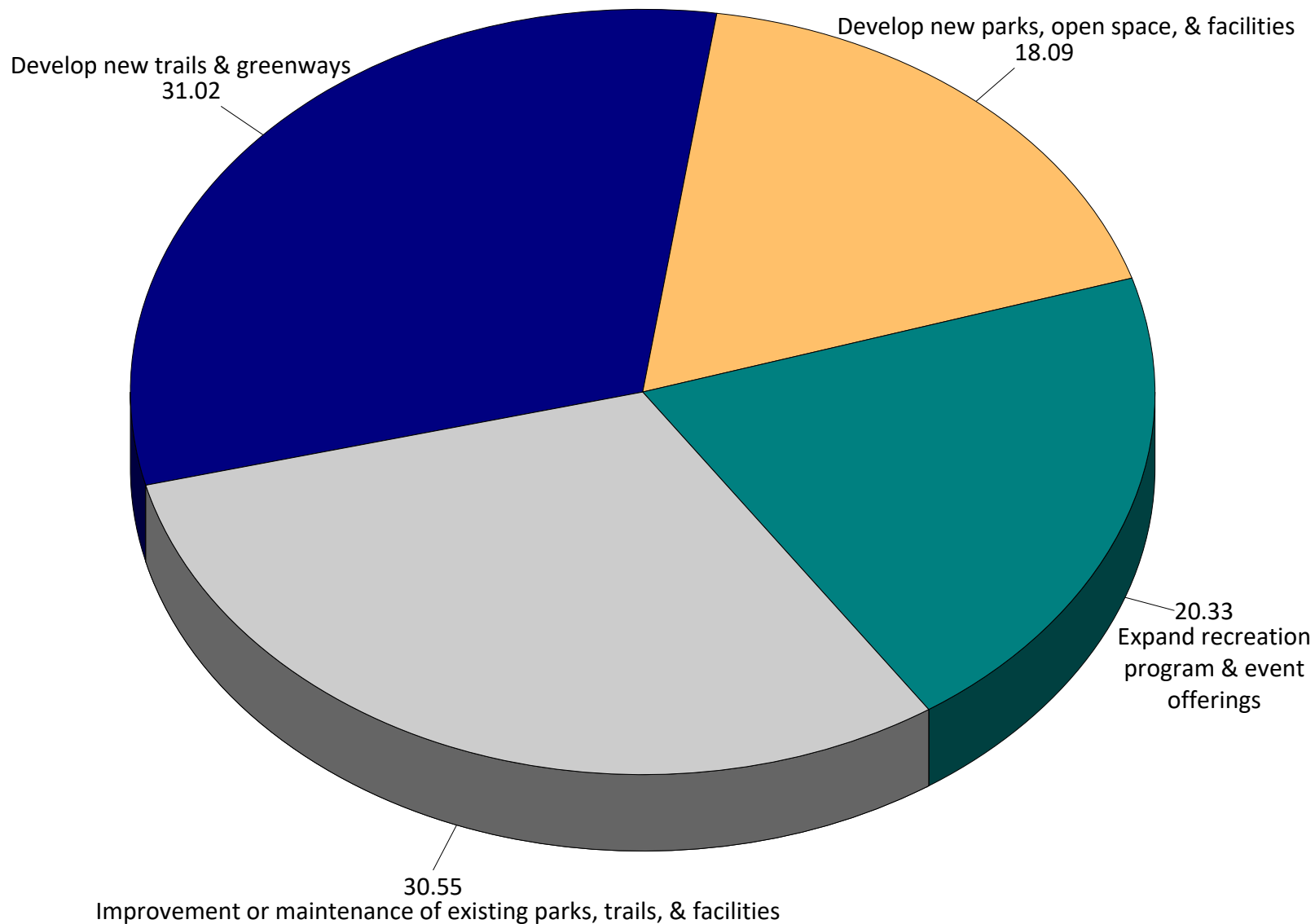
Q17. Programs/Activities Most Important to Households.

by percentage of respondents who selected the items as one of their top four choices



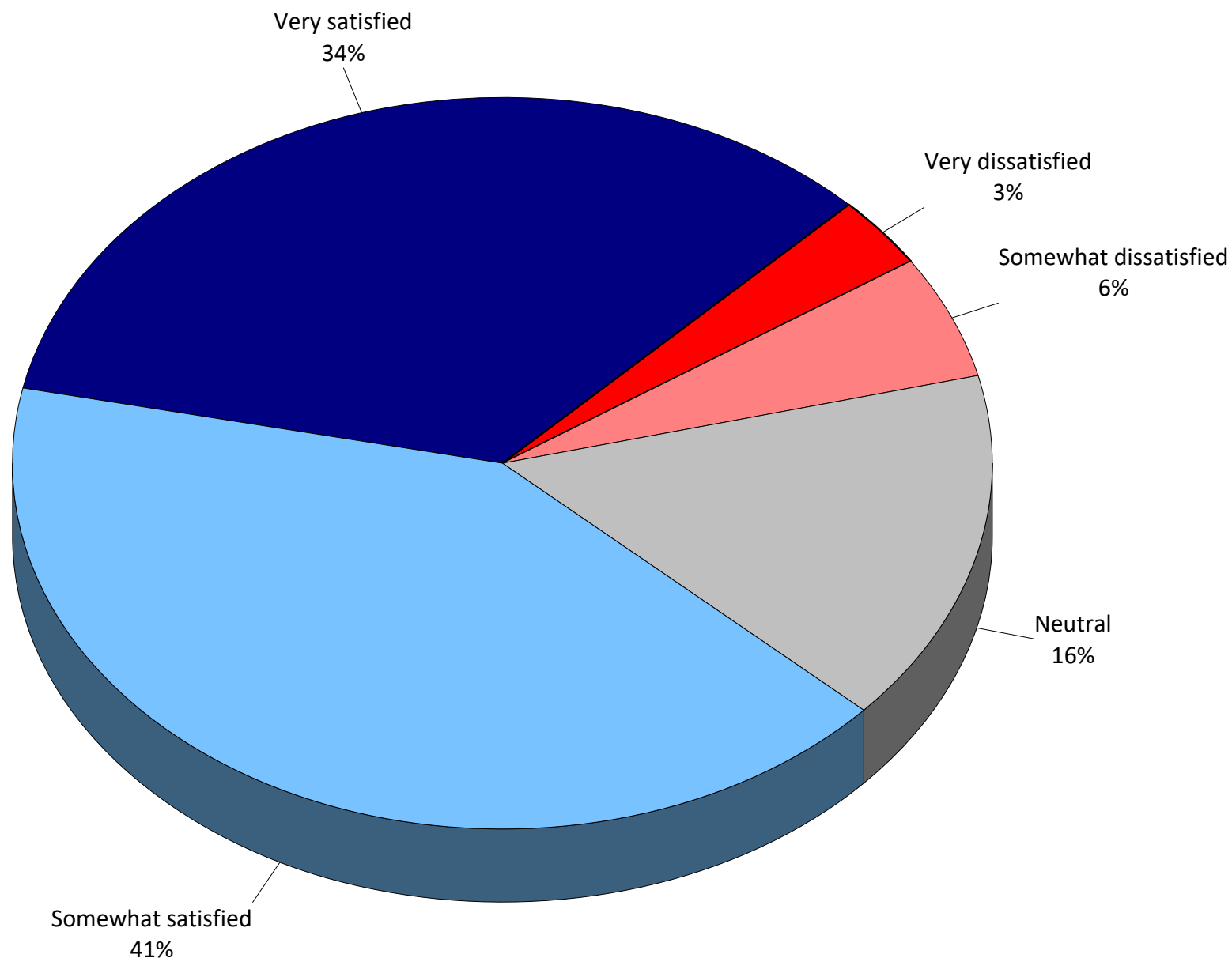
Q18. If you had an additional \$100, how would you allocate the funds among the parks and recreation categories listed below?

by percentage of respondents



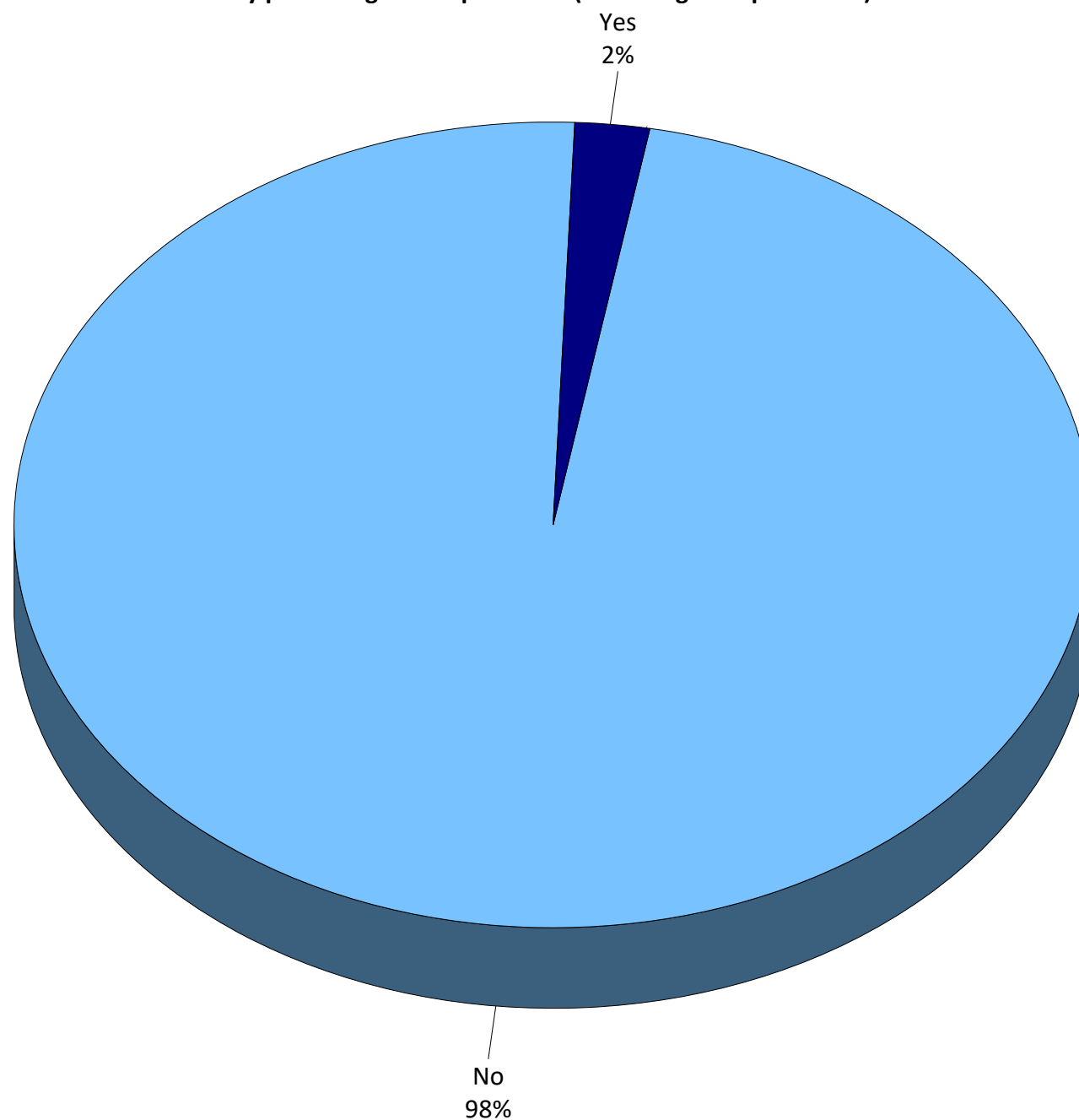
Q19. Please rate your satisfaction with the overall value your household receives from the City of Clemson Parks and Recreation Department.

by percentage of respondents (excluding "don't know")



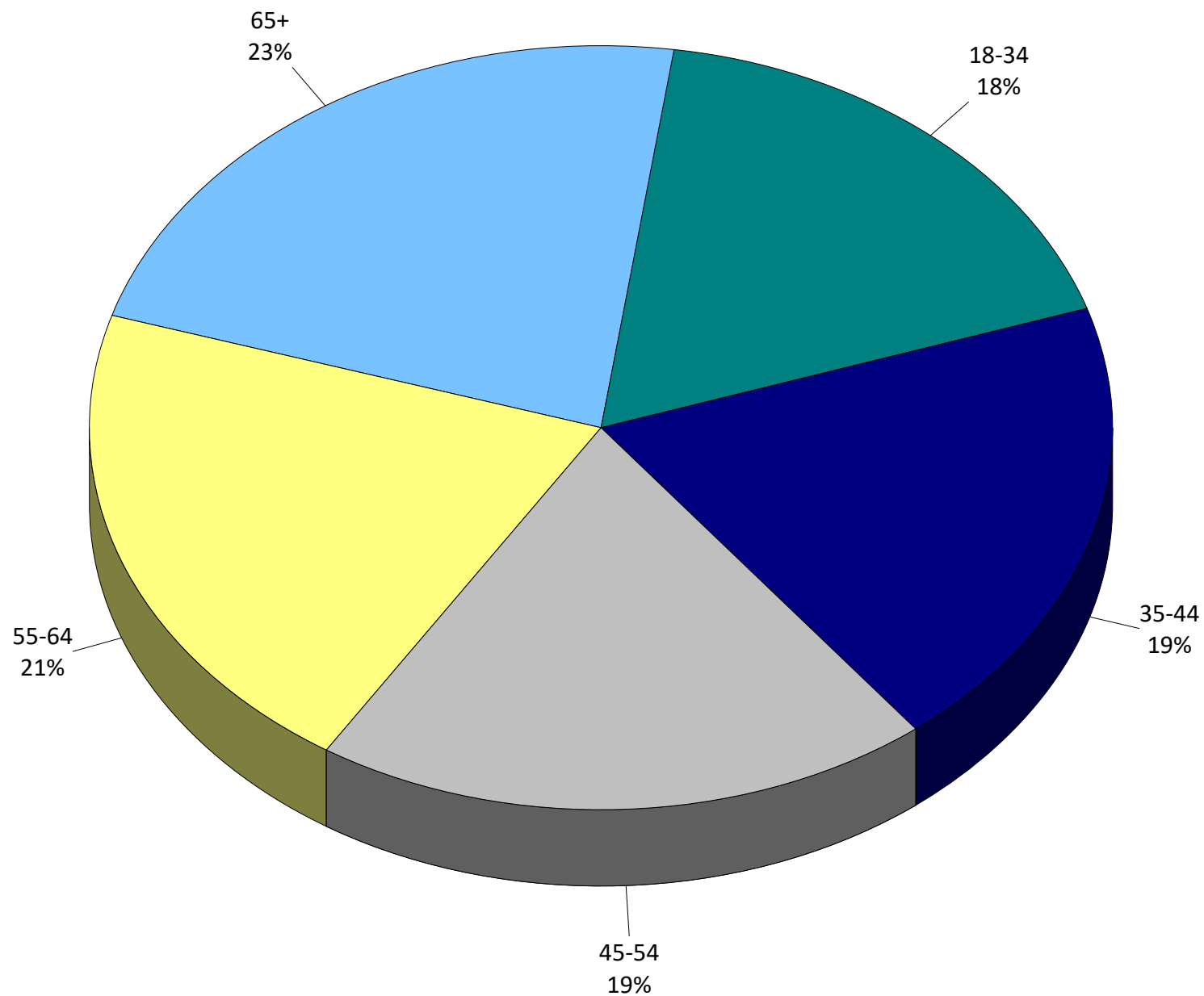
Q20. Are you currently enrolled as a Clemson University student?

by percentage of respondents (excluding "not provided")



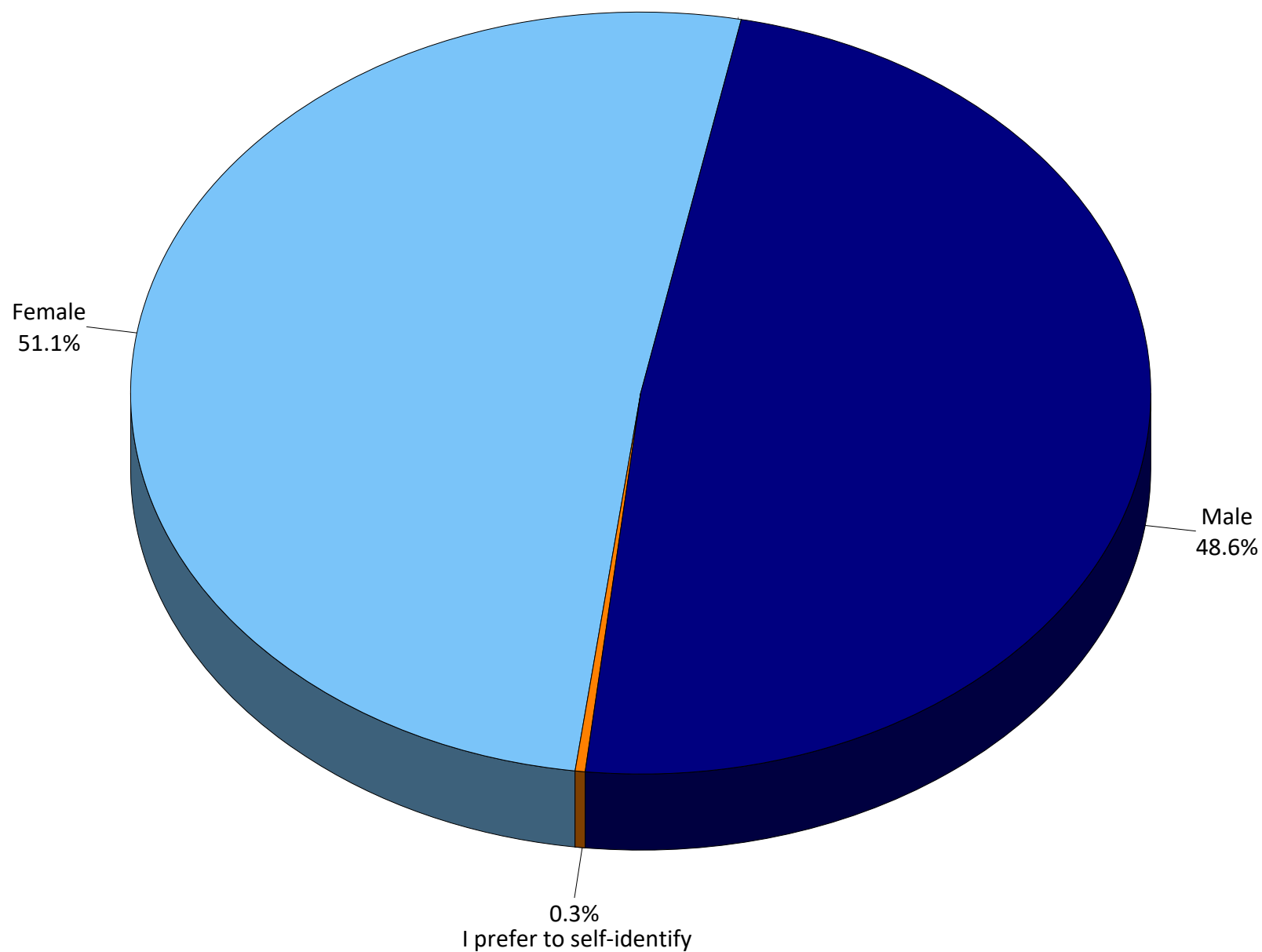
Q21. What is your age?

by percentage of respondents (excluding "not provided")



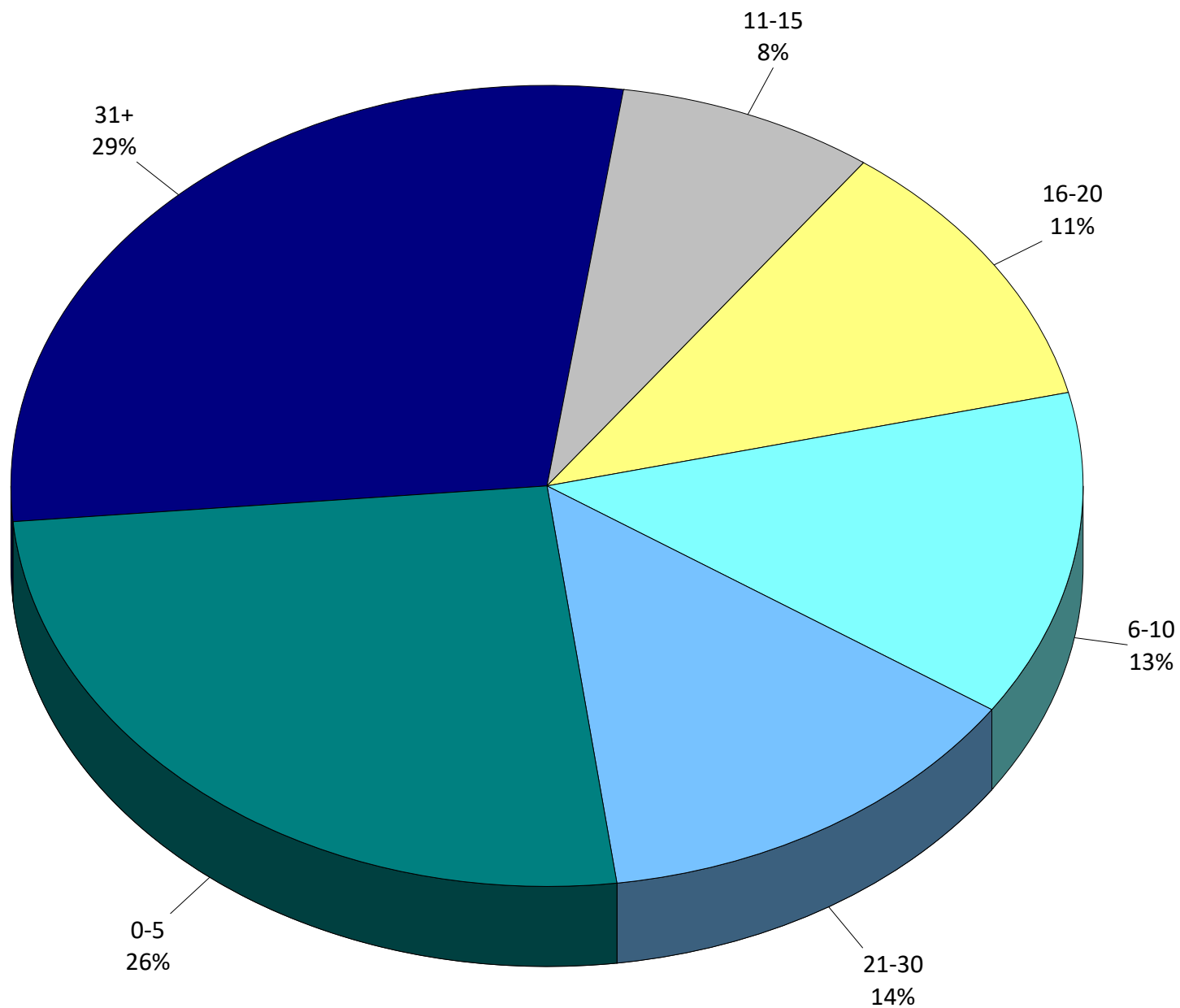
Q22. Your gender:

by percentage of respondents (excluding "not provided")



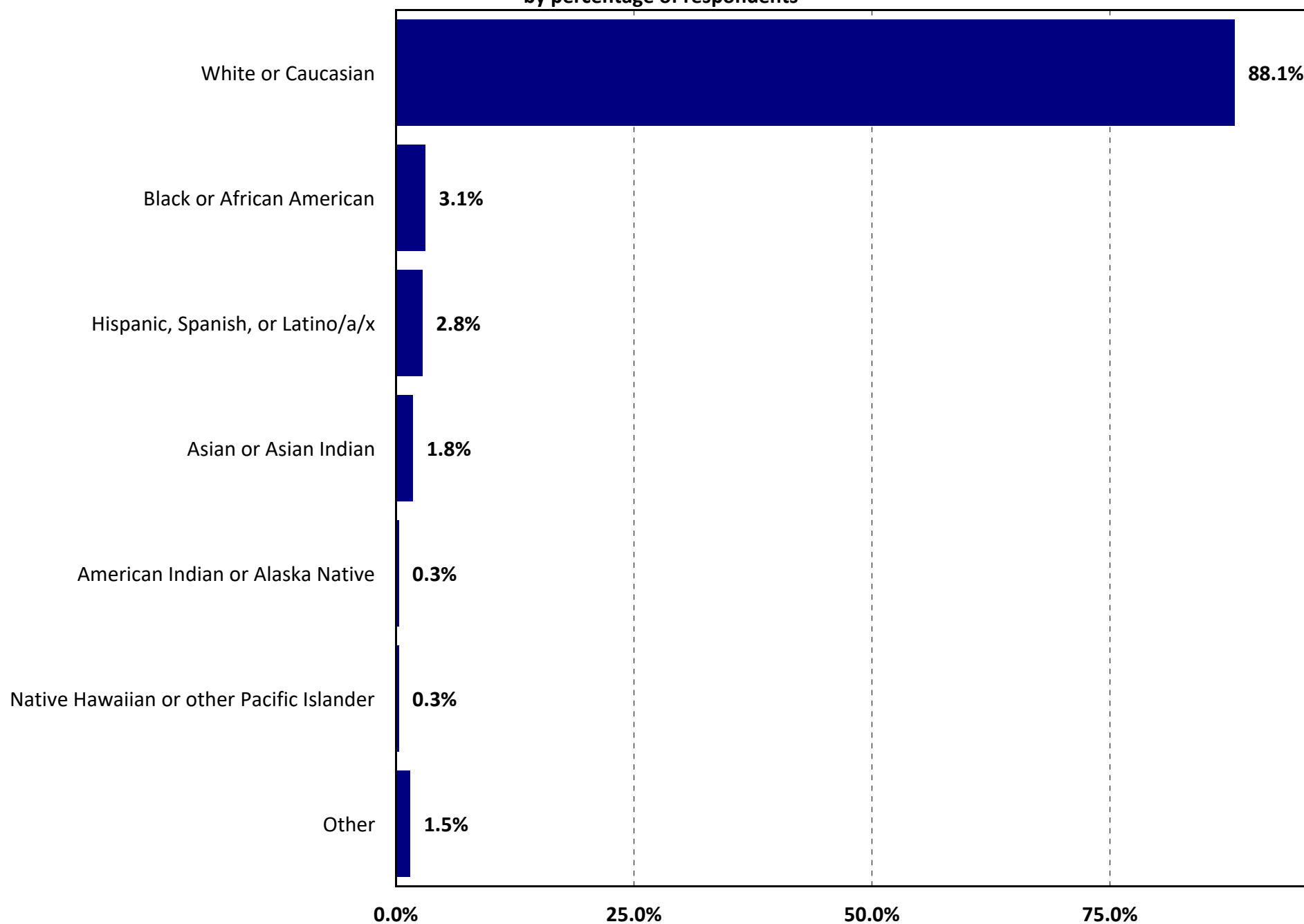
Q23. How many years have you lived in the City of Clemson?

by percentage of respondents (excluding "not provided")



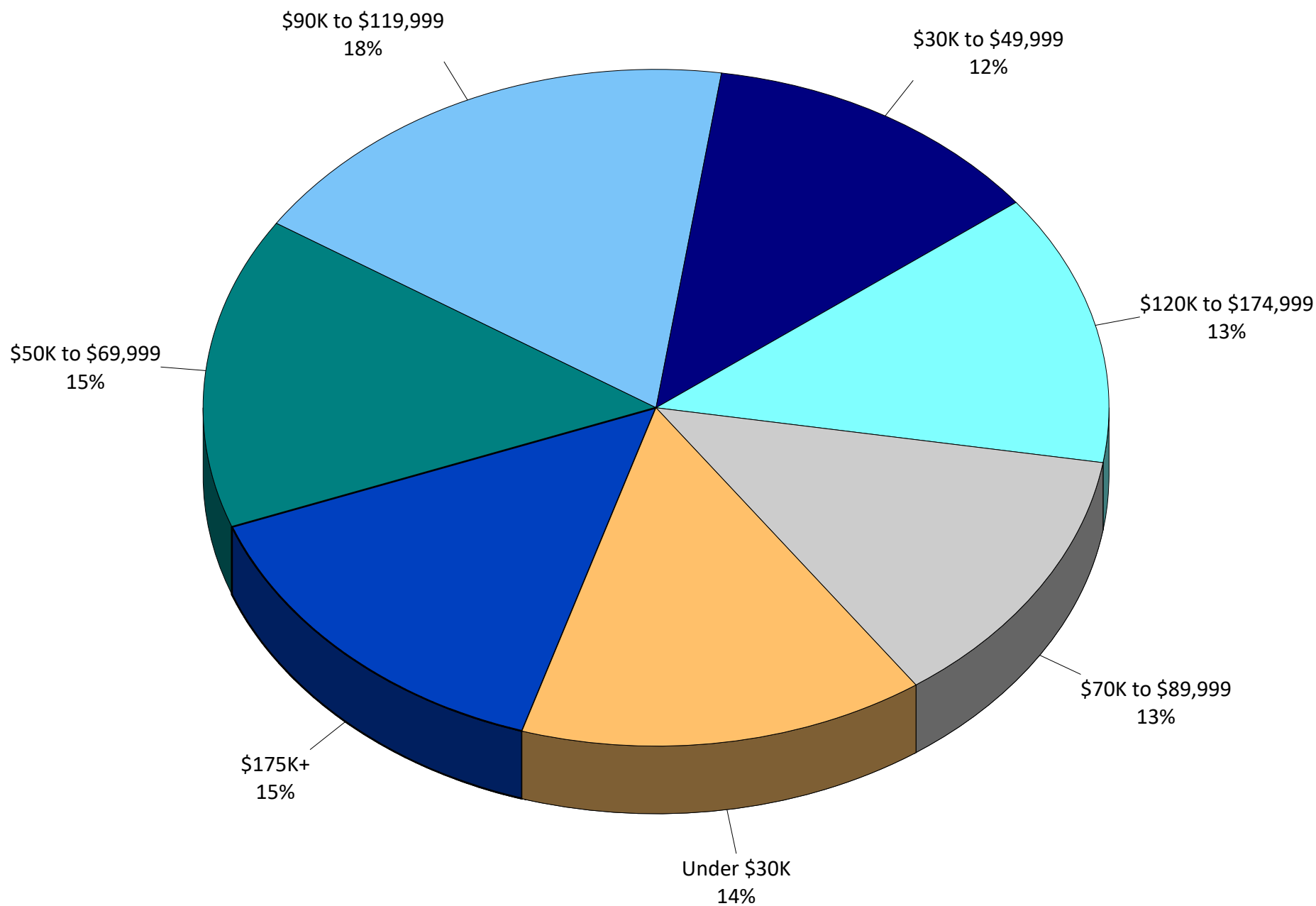
Q24. Which of the following best describes your race/ethnicity?

by percentage of respondents



Q25. Would you say your total annual household income is...

by percentage of respondents (excluding "not provided")



3

**Priority Investment
Rating**

Priority Investment Rating

Clemson, SC

The **Priority Investment Rating (PIR)** was developed by ETC Institute to provide governments with an objective tool for evaluating the priority that should be placed on parks and recreation investments. The Priority Investment Rating was developed by ETC Institute to identify the facilities and programs residents think should receive the highest priority for investment. The priority investment rating reflects the importance residents place on items (sum of top 3 choices) and the unmet needs (needs that are only being partly or not met) for each facility/program relative to the facility/program that rated the highest overall. Since decisions related to future investments should consider both the level of unmet need and the importance of facilities and programs, the PIR weights each of these components equally.

The PIR reflects the sum of the Unmet Needs Rating and the Importance Rating as shown in the equation below:

$$\text{PIR} = \text{UNR} + \text{IR}$$

For example, if the Unmet Needs Rating for playgrounds is 26.5 (out of 100) and the Importance Rating for playgrounds is 52 (out of 100), the Priority Investment Rating for playgrounds would be 78.5 (out of 200).

How to Analyze the Charts:

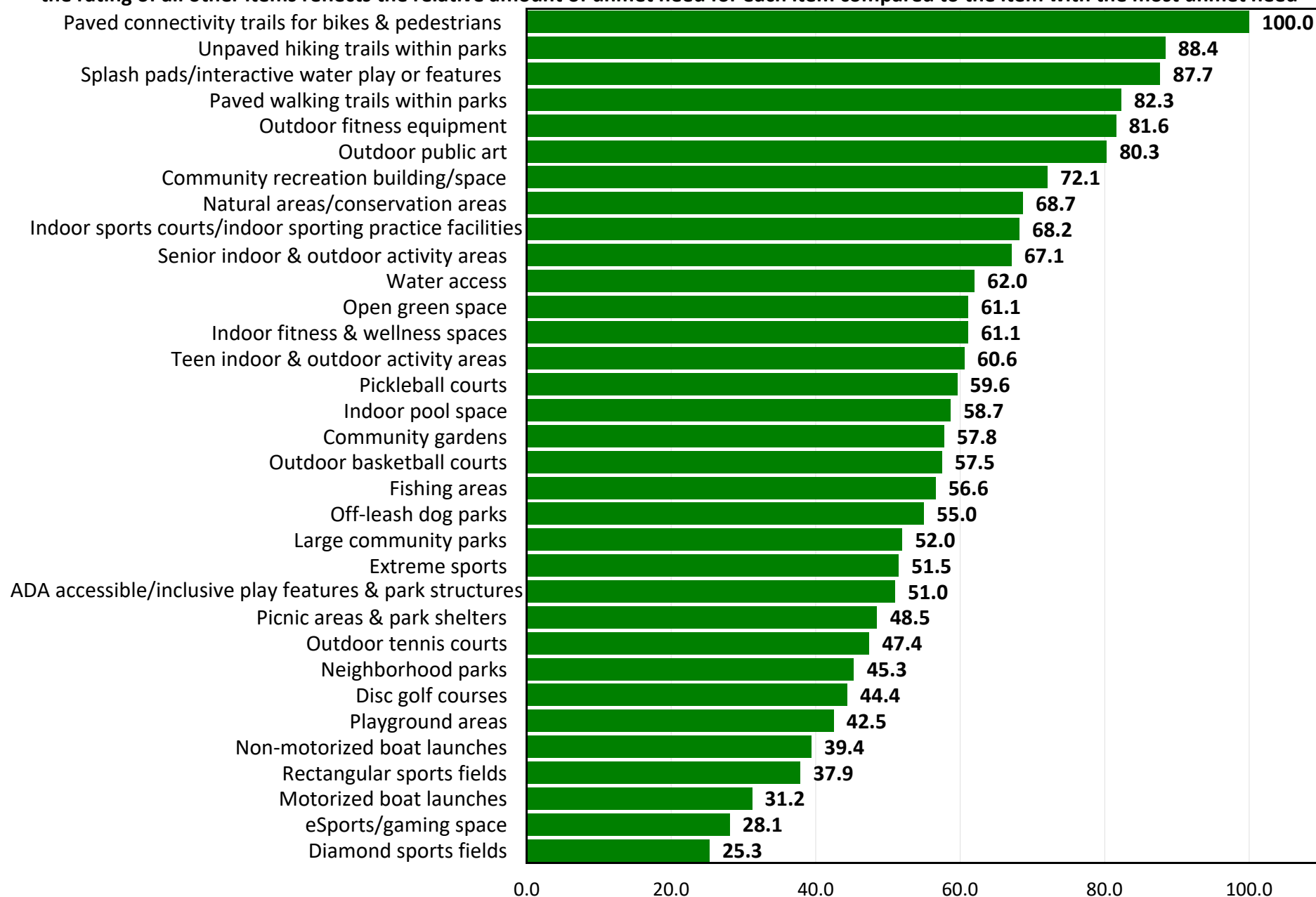
- **High Priority Areas** are those with a PIR of at least 100. A rating of 100 or above generally indicates there is a relatively high level of unmet need and residents generally think it is important to fund improvements in these areas. Improvements in this area are likely to have a positive impact on the greatest number of households.
- **Medium Priority Areas** are those with a PIR of 50-99. A rating in this range generally indicates there is a medium to high level of unmet need or a significant percentage of residents generally think it is important to fund improvements in these areas.
- **Low Priority Areas** are those with a PIR below 50. A rating in this range generally indicates there is a relatively low level of unmet need and residents do not think it is important to fund improvements in these areas. Improvements may be warranted if the needs of very specialized populations are being targeted.

The following pages show the Unmet Needs Rating, Importance Rating, and Priority Investment Rating for facilities and programs.

Unmet Needs Rating for Facilities/Amenities

the rating for the item with the most unmet need=100

the rating of all other items reflects the relative amount of unmet need for each item compared to the item with the most unmet need



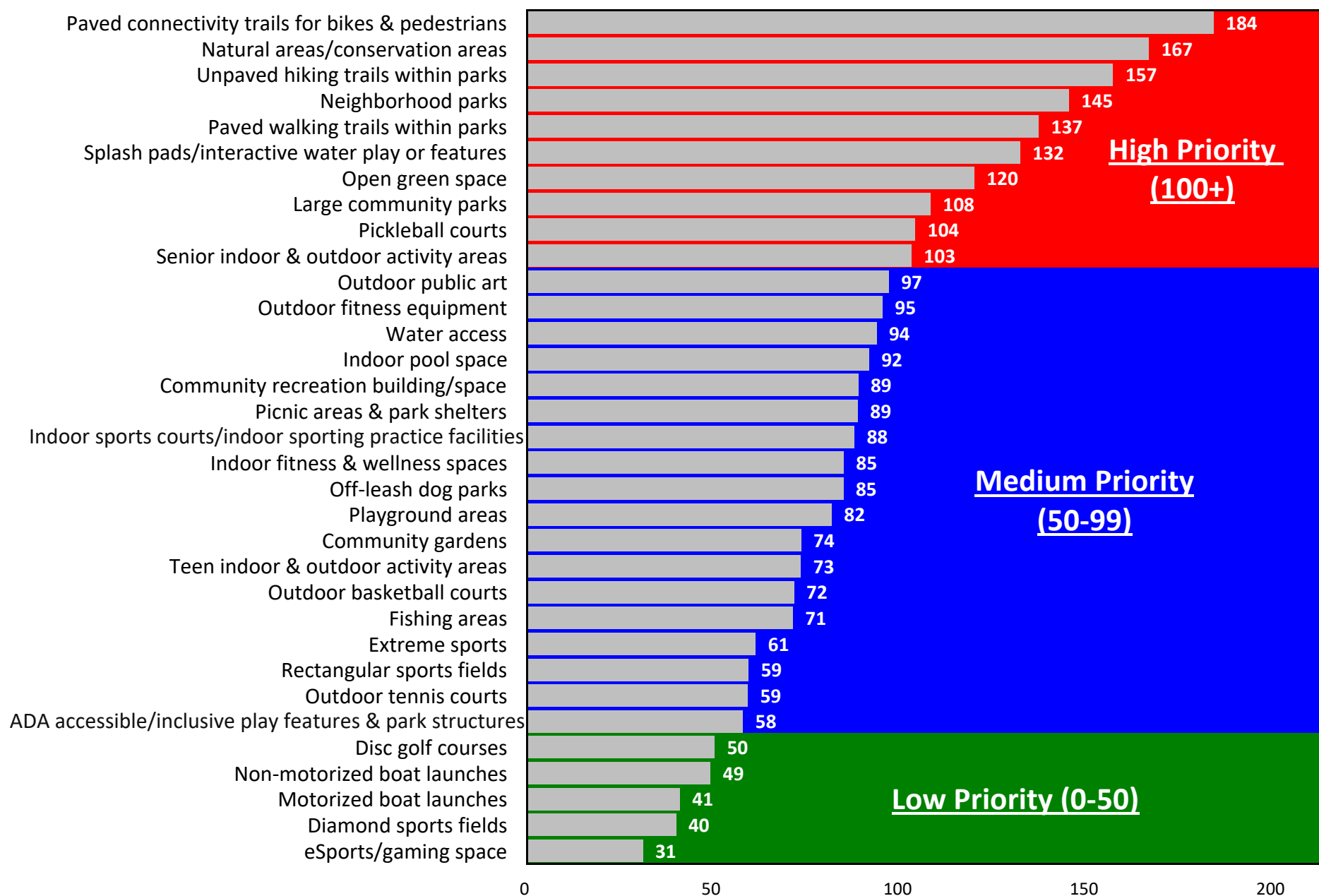
Importance Rating for Facilities/Amenities

the rating for the item rated as the most important=100

the rating of all other items reflects the relative level of importance for each item compared to the item rated as the most important



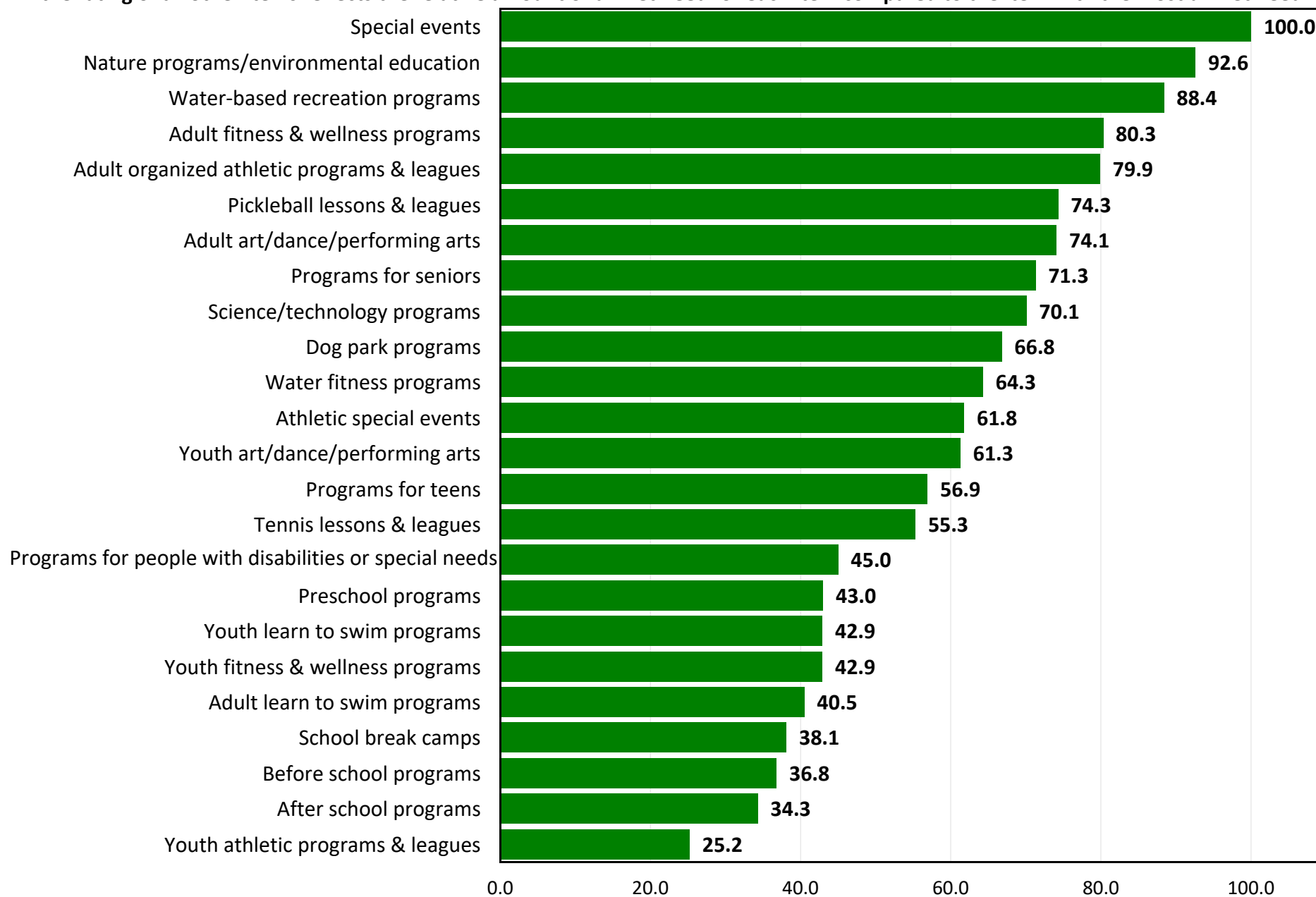
Top Priorities for Investment for Facilities/Amenities Based on Priority Investment Rating



Unmet Needs Rating for Programs/Activities

the rating for the item with the most unmet need=100

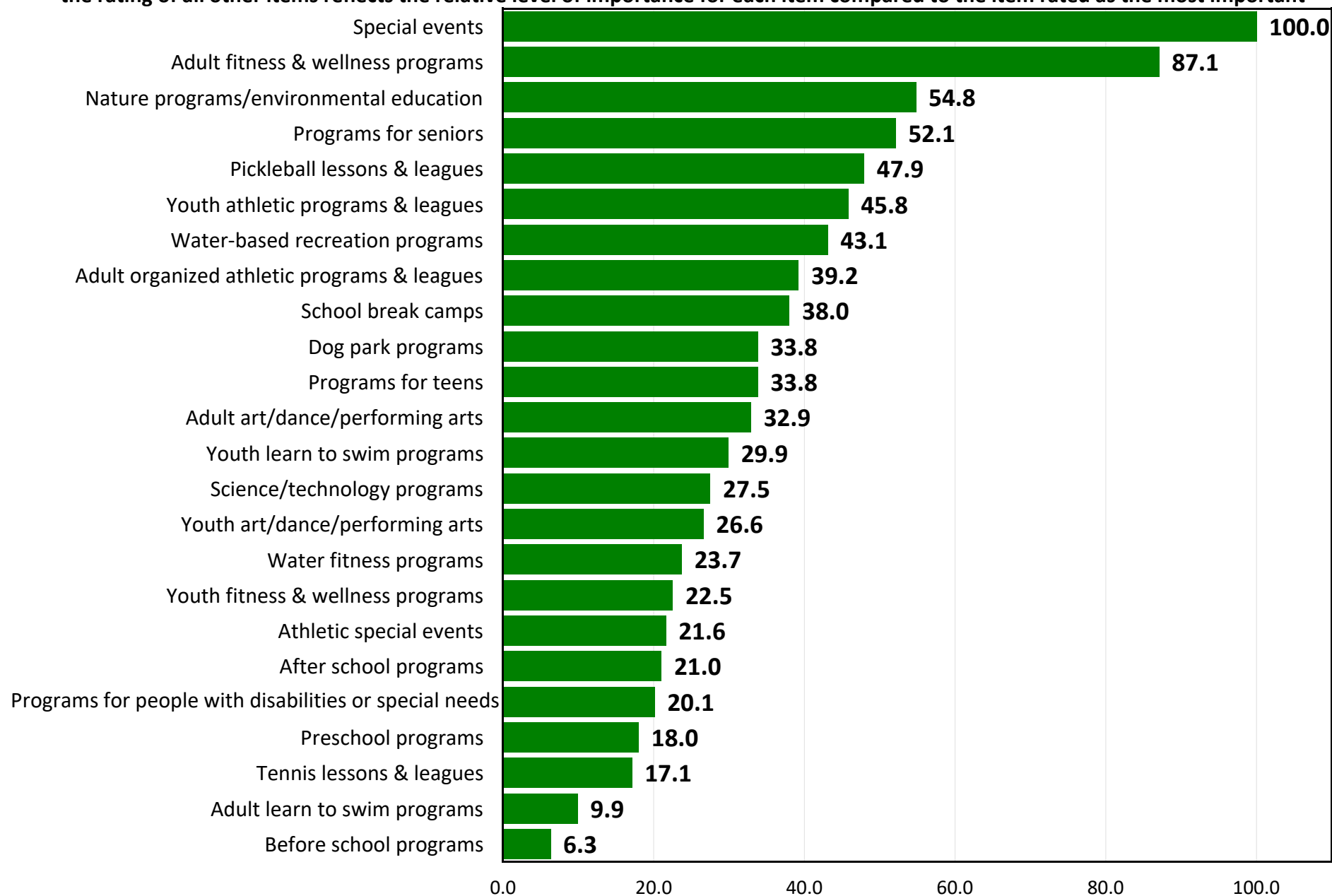
the rating of all other items reflects the relative amount of unmet need for each item compared to the item with the most unmet need



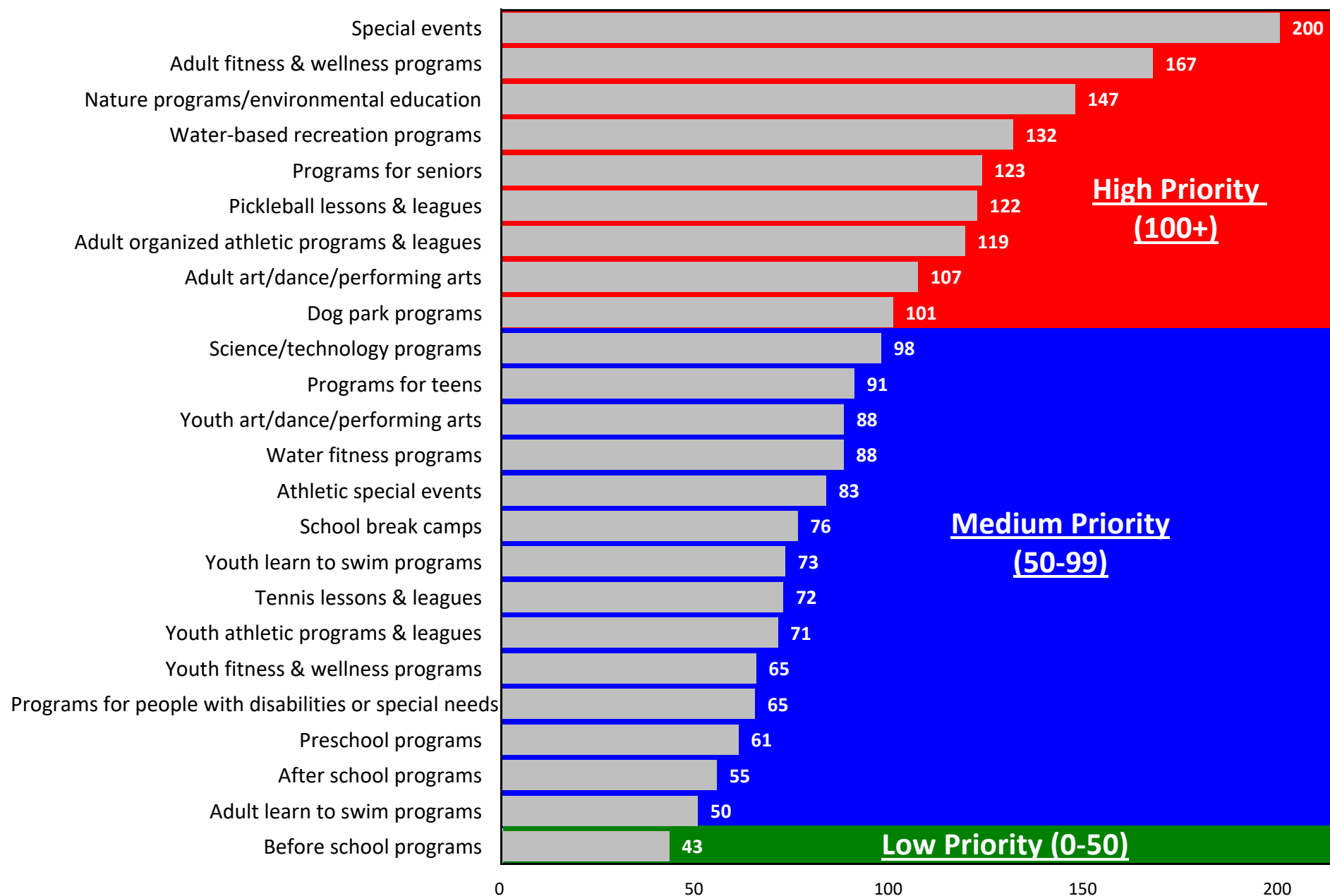
Importance Rating for Programs/Activities

the rating for the item rated as the most important=100

the rating of all other items reflects the relative level of importance for each item compared to the item rated as the most important



Top Priorities for Investment for Programs/Activities Based on Priority Investment Rating





4

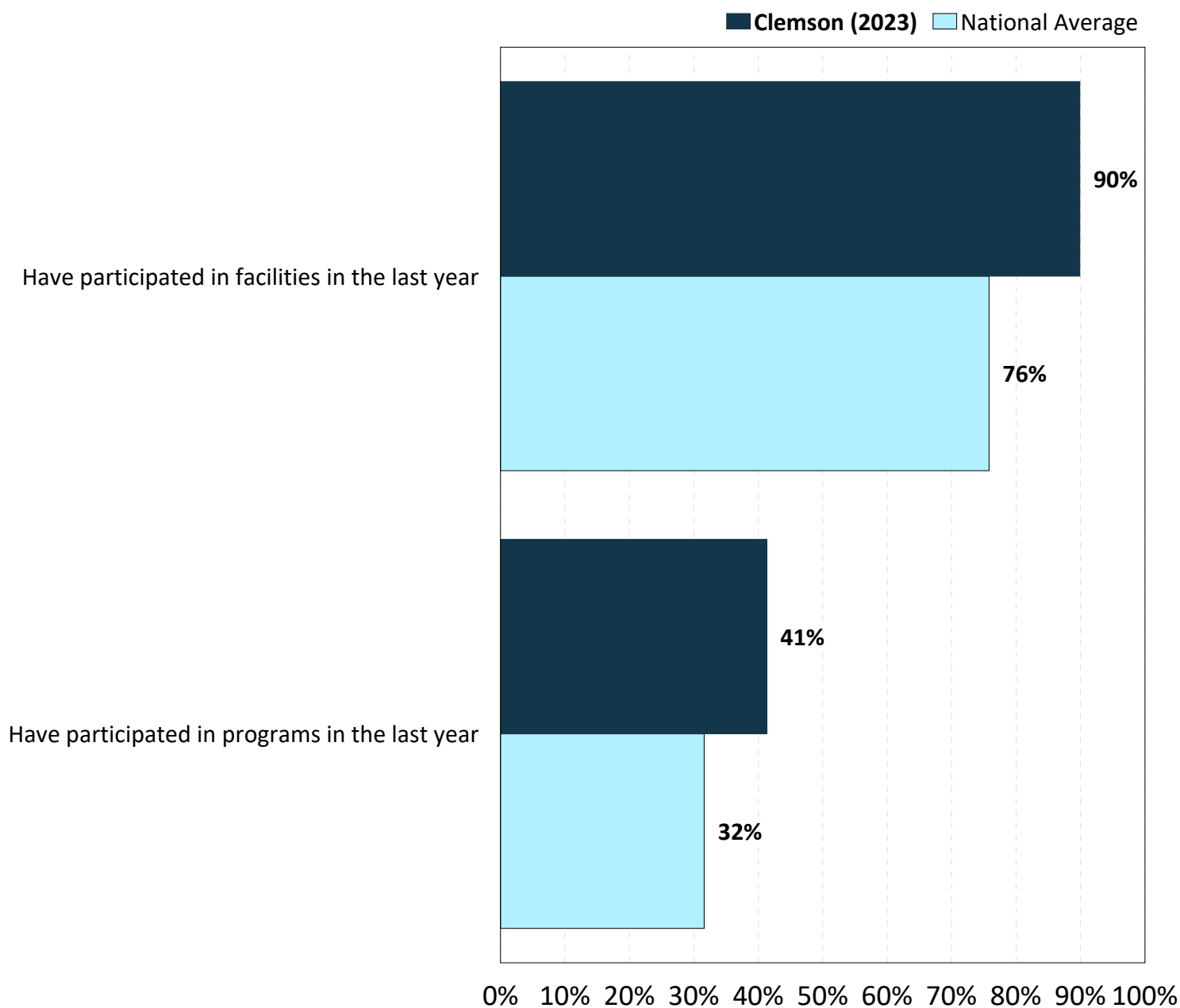
Benchmarks

National Benchmarks

Note: The benchmarking data contained in this report is protected intellectual property. Any reproduction of the benchmarking information in this report by persons or organizations not directly affiliated with Clemson Parks and Recreation is not authorized without written consent from ETC Institute.

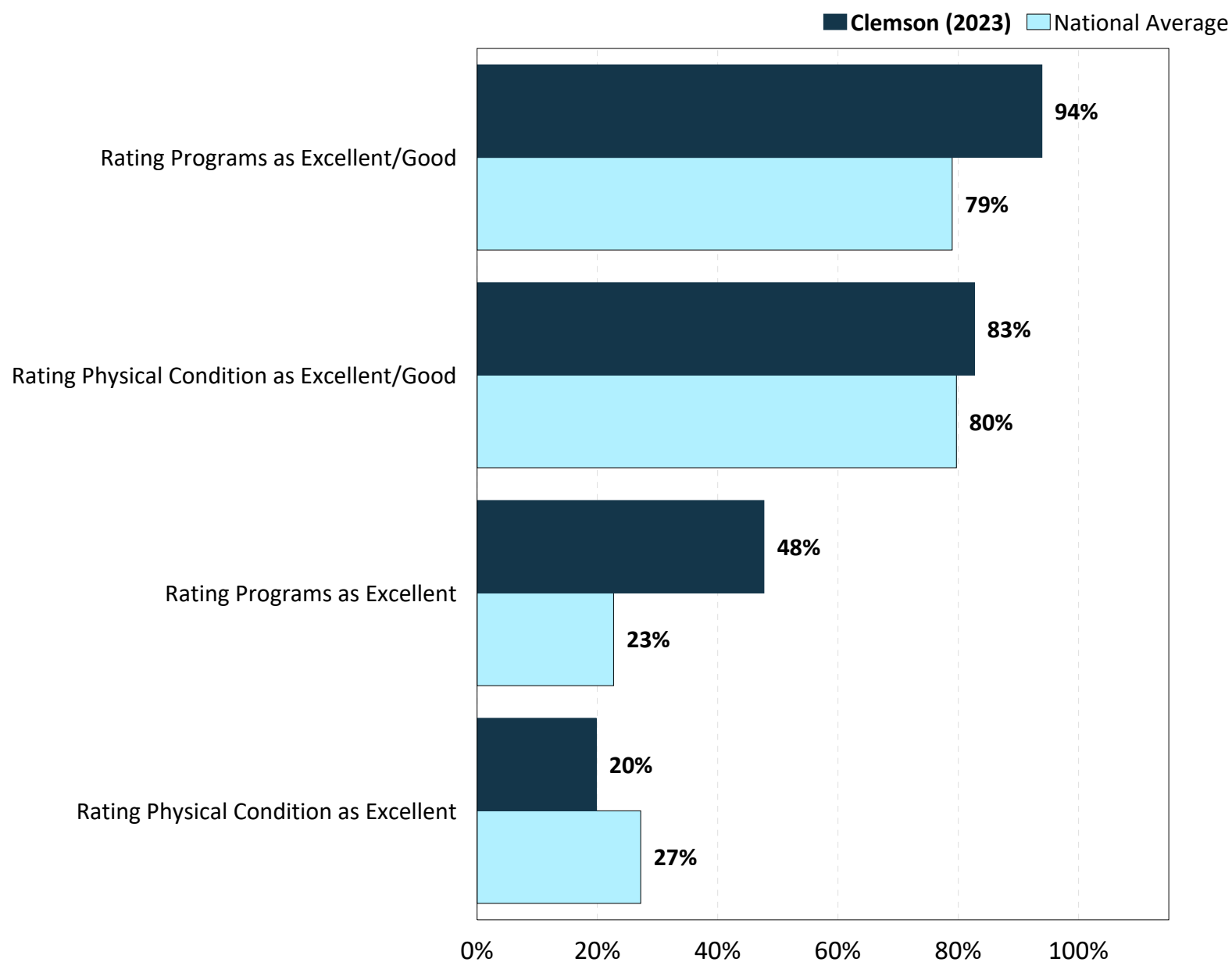
Use of Recreation Facilities/Programs

by percentage of respondents



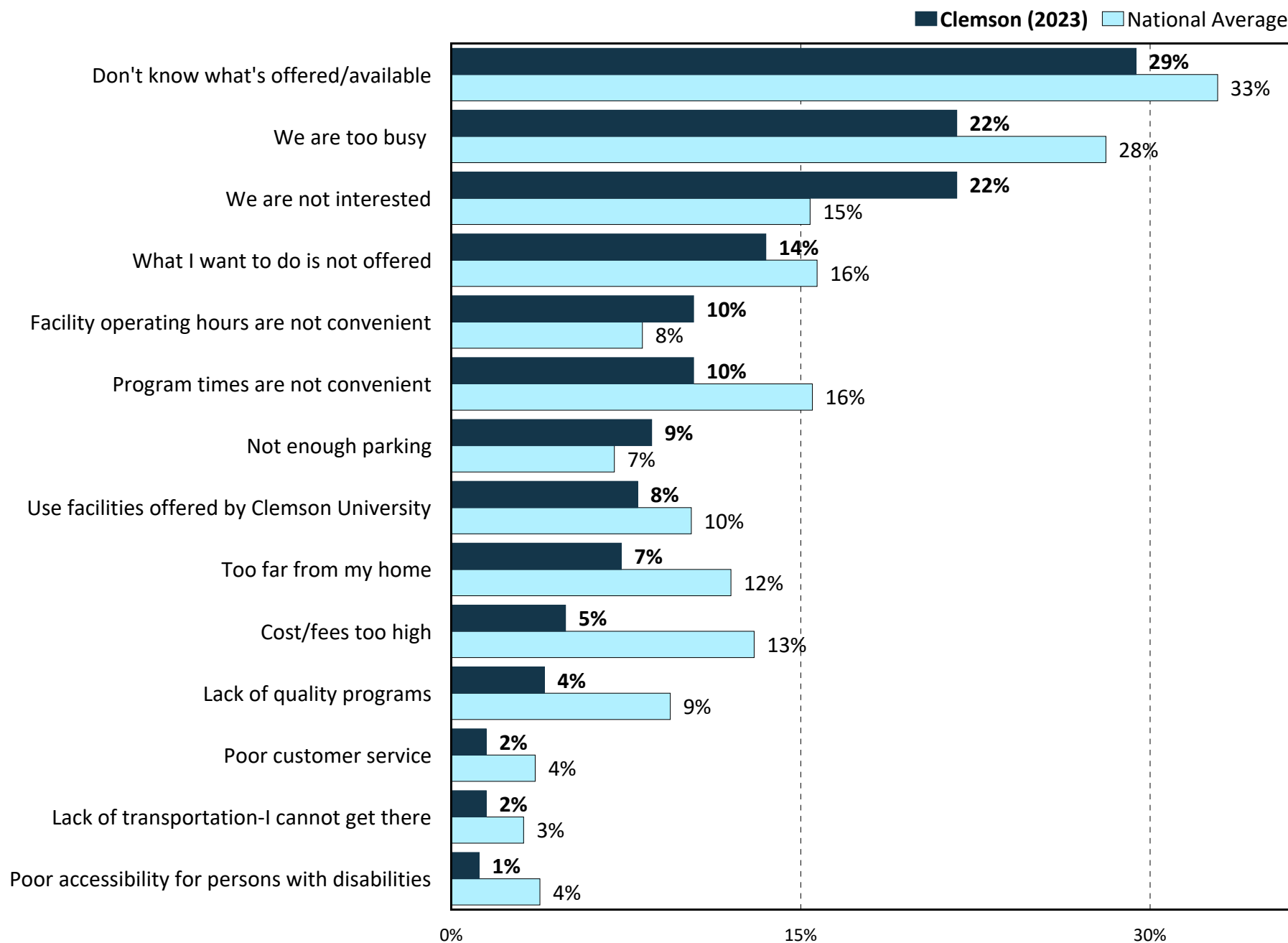
Rating Parks and Recreation Facilities/Programs

by percentage of respondents



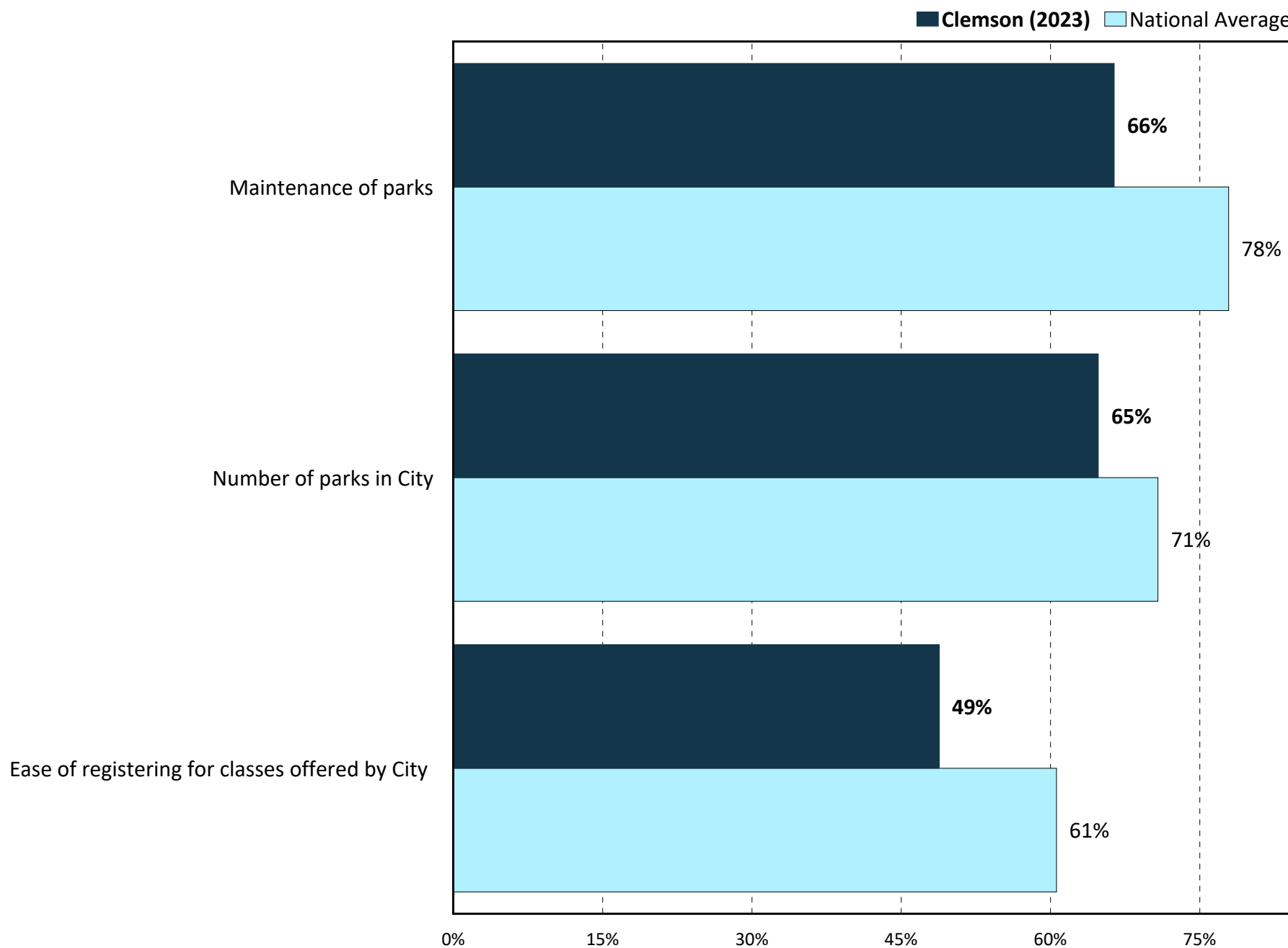
Barriers

by % of respondents



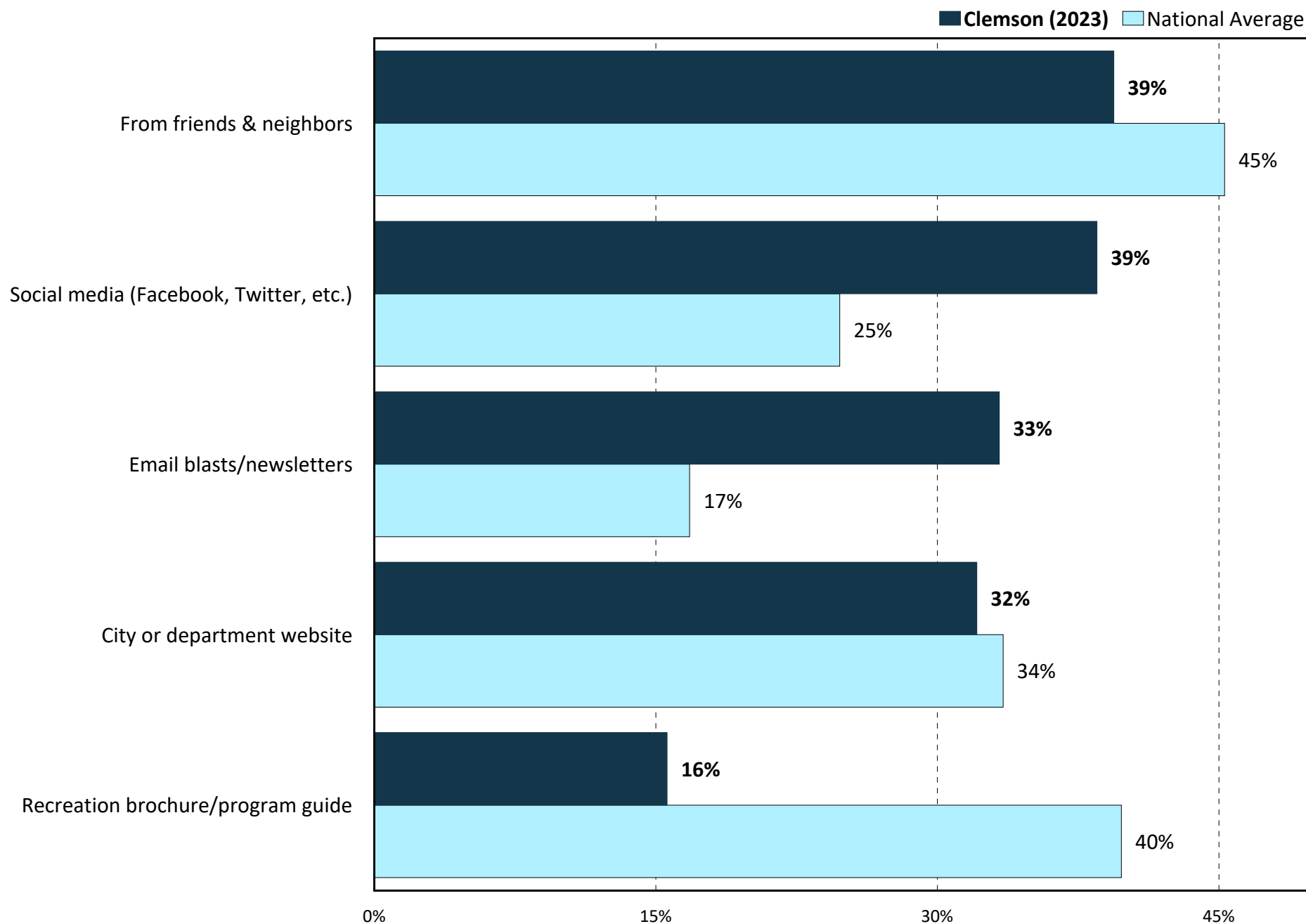
Satisfaction of Facilities/Programs

by % of respondents



Sources Used for Information about Parks and Recreation

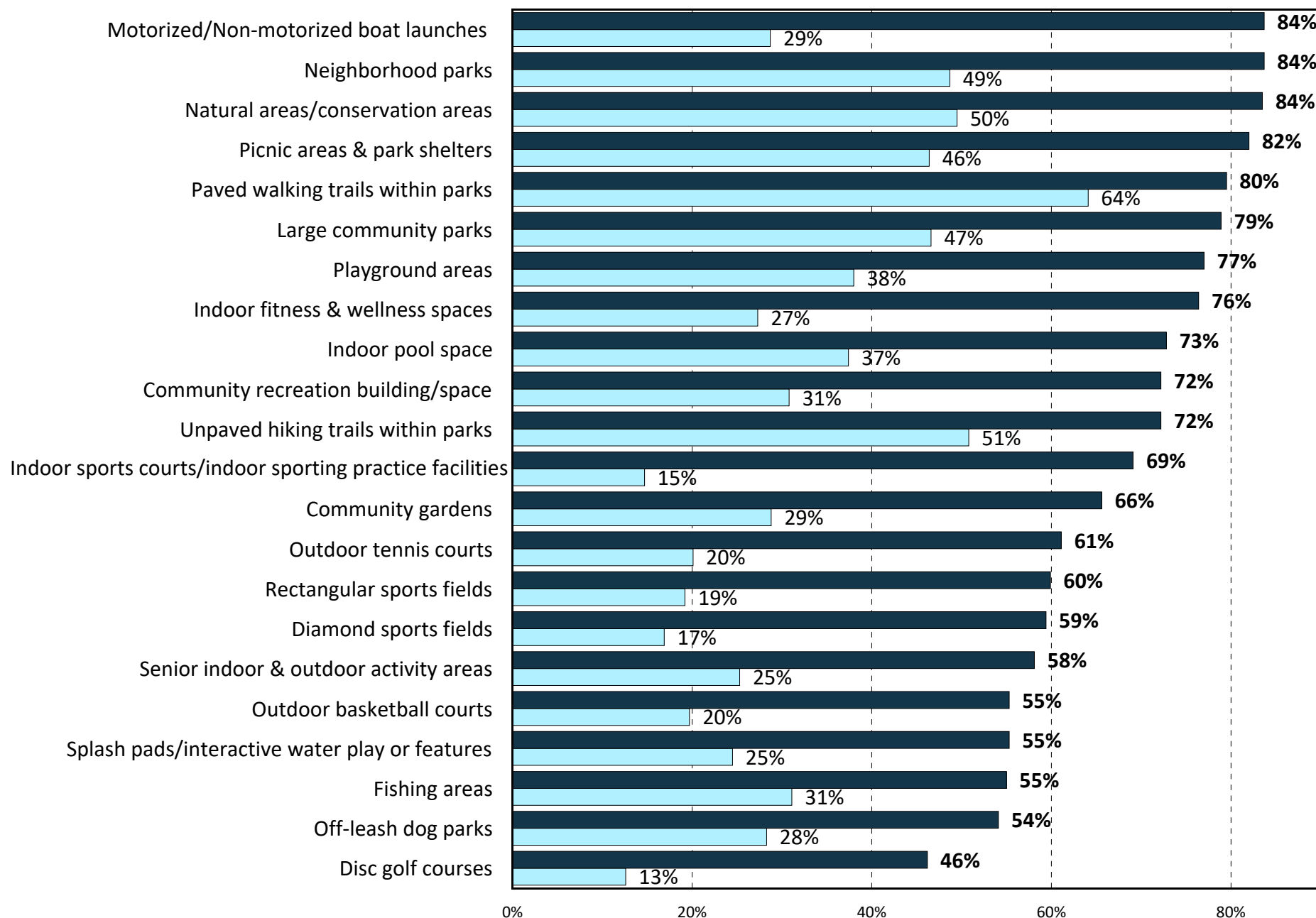
by % of respondents



Respondents with Need for Facilities and Amenities

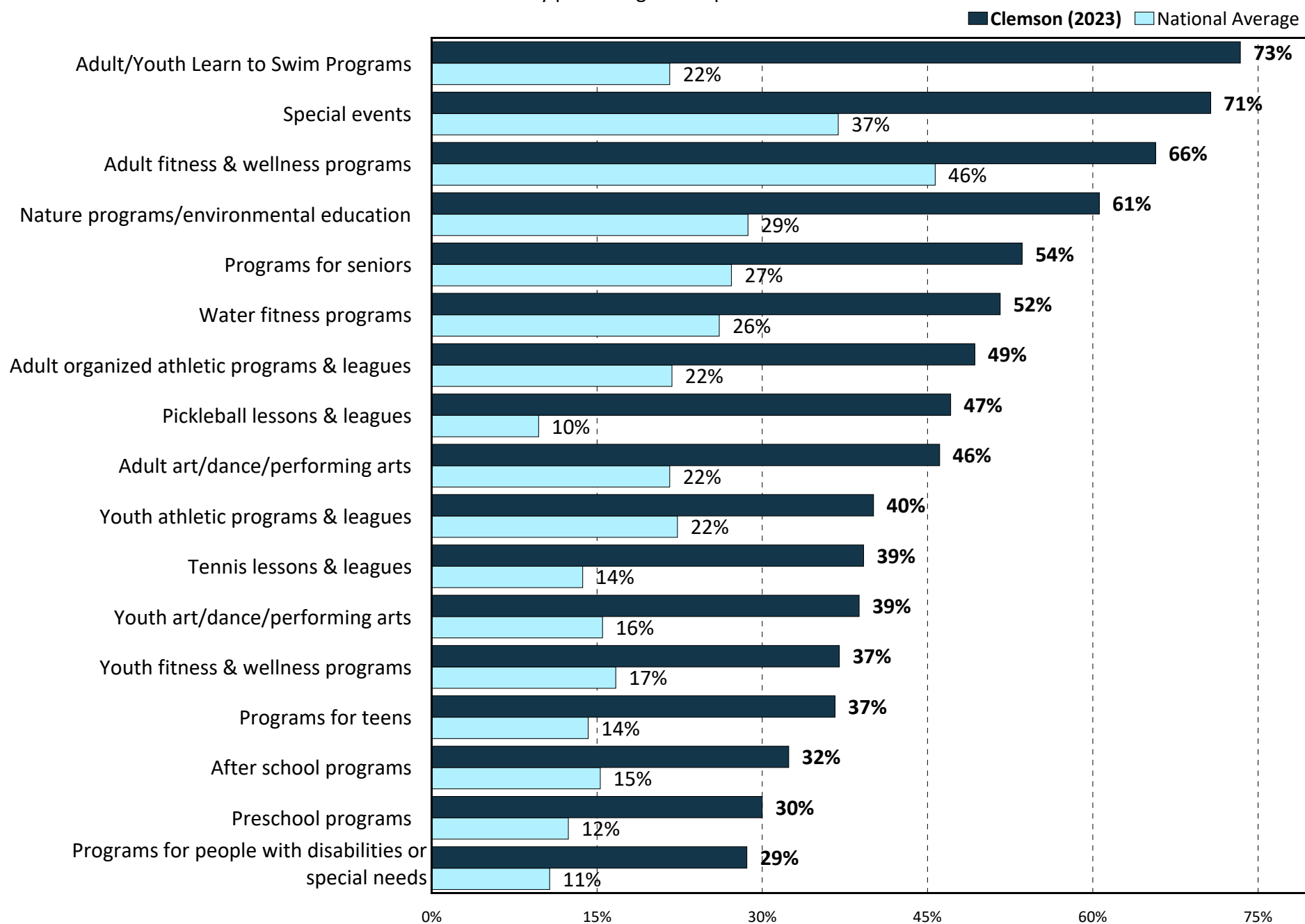
by percentage of respondents

■ Clemson (2023) ■ National Average



Respondents with Need for Recreation Programs

by percentage of respondents



5

**Importance-
Satisfaction Rating**

Importance-Satisfaction Analysis

Clemson, SC

Overview

Today, city officials have limited resources which need to be targeted to actions that are of the most benefit to their citizens. Two of the most important criteria for decision making are (1) to target resources toward services of the highest importance to citizens; and (2) to target resources toward those services where citizens are the least satisfied.

The Importance-Satisfaction (IS) rating is a unique tool that allows public officials to better understand both of these highly important decision-making criteria for each of the services they are providing. The Importance-Satisfaction rating is based on the concept that public agencies will maximize overall customer satisfaction by emphasizing improvements in those areas where the level of satisfaction is relatively low, and the perceived importance of the service is relatively high.

Methodology

The rating is calculated by summing the percentage of responses for items selected as one of the most important items for the city to provide. The sum is then multiplied by 1 minus the percentage of respondents who indicated they were positively satisfied with the city's performance in the related area (the sum of the ratings of 4 ("good") and 5 ("excellent") on a 5-point scale excluding "don't know" responses). "Don't Know" responses are excluded from the calculation to ensure the satisfaction ratings among service categories are comparable. $[IS = \text{Importance} \times (1 - \text{Satisfaction})]$.

Example of the Calculation: In an example scenario, respondents were asked to rate their satisfaction parks and facilities then select the top three most important aspects to their household. In this example, twenty-eight percent (28%) of respondents selected *quality/number of outdoor amenities* as one of the most important services.

Regarding satisfaction, 73% of respondents rated the city's overall performance in the *quality/number of outdoor amenities* as a "4" or "5" on a 5-point scale (where "5" means "Very Satisfied") excluding "Don't Know" responses. The I-S rating for *quality/number of outdoor amenities* was calculated by multiplying the sum of the most important percentages by 1 minus the sum of the satisfaction percentages. In this example 28% was multiplied by 51% (1-0.73). This calculation yielded an I-S rating of 0.0750 which ranked 3rd out of 15 city services.

The maximum rating is 1.00 and would be achieved when 100% of the respondents select an item as one of their top three choices and 0% indicate they are positively satisfied with the delivery of the service.

The lowest rating is 0.00 and could be achieved under either of the following two situations:

- If 100% of the respondents were positively satisfied with the delivery of the service
- If none (0%) of the respondents selected the service as one for the three most important areas for the city to emphasize over the next five years.

Interpreting the Ratings

Ratings that are greater than or equal to 0.20 identify areas that should receive significantly more emphasis over the next two years. Ratings from 0.10 to 0.20 identify service areas that should receive increased emphasis. Ratings less than 0.10 should continue to receive the current level of emphasis.

- *Definitely Increase Emphasis* ($IS \geq 0.20$)
- *Increase Current Emphasis* ($0.10 \leq IS < 0.20$)
- *Maintain Current Emphasis* ($IS < 0.10$)

The results for the City of Clemson are provided on the following pages.

Importance-Satisfaction Rating

City of Clemson, SC

Recreation, Parks, and Cultural Services

Category of Service	Most Important %	Most Important Rank	Satisfaction %	Satisfaction Rank	Importance-Satisfaction Rating	I-S Rating Rank
High Priority (IS .10-.20)						
Availability of information about programs/facilities	24%	2	42%	14	0.1394	1
Quality of programs for adults	23%	3	39%	17	0.1388	2
Maintenance of parks	35%	1	66%	2	0.1183	3
Variety of programs offered by the city	19%	6	45%	13	0.1023	4
Medium Priority (IS <.10)						
Variety of different types of parks in the city	19%	4	58%	8	0.0807	5
Security in city parks	18%	7	58%	7	0.0751	6
Maintenance of trails	19%	5	61%	6	0.0729	7
User friendliness of city website	9%	11	39%	16	0.0560	8
Security on city trails	11%	10	50%	10	0.0539	9
Quality of programs for families with children	14%	8	63%	4	0.0530	10
Program schedule (time/day)	9%	13	41%	15	0.0522	11
Overall value your household receives for taxes paid	12%	9	62%	5	0.0442	12
Fees charged for city recreation programs	7%	15	51%	9	0.0329	13
Number of parks in the city	9%	12	65%	3	0.0313	14
Ease of registering for classes offered by the city	5%	16	49%	11	0.0251	15
How close parks are located to your home	7%	14	71%	1	0.0203	16
Ease of renting/reserving a city facility	1%	17	46%	12	0.0032	17

Note: The I-S Rating is calculated by multiplying the "Most Important" % by (1-'Satisfaction' %)

Most Important %:

The "Most Important" percentage represents the sum of the first, second, and third most important responses for each item. Respondents were asked to identify the three items they think are most important for the city to emphasize over the next five years.

Satisfaction %:

The "Satisfaction" percentage represents the sum of the ratings "5" and "4" excluding 'don't knows.' Respondents ranked their level of satisfaction with each of the items on a scale of 5 to 1 with "5" being Very Satisfied and "1" being Very Dissatisfied.

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Tabular Data

Q1. Please complete this survey with all household members in mind. Counting yourself, how many people in your household are...

	Mean	Sum
number	2.70	860
Under age 5	0.18	56
Ages 5-9	0.22	69
Ages 10-14	0.17	54
Ages 15-19	0.20	63
Ages 20-24	0.11	36
Ages 25-34	0.23	73
Ages 35-44	0.35	112
Ages 45-54	0.36	115
Ages 55-64	0.37	119
Ages 65-79	0.41	130
Ages 80+	0.10	33

Q2. Have you or members of your household visited any of the City of Clemson parks or recreation facilities during the past 12 months?

Q2. Have you visited any City parks or recreation facilities during past 12 months

	Number	Percent
Yes	294	89.9 %
No	33	10.1 %
Total	327	100.0 %

Q2a. Overall, how would you rate the physical condition of the City of Clemson parks you have visited?

Q2a. How would you rate overall physical condition of
parks you have visited

	Number	Percent
Excellent	56	19.0 %
Good	178	60.5 %
Fair	47	16.0 %
Poor	2	0.7 %
Not provided	11	3.7 %
Total	294	100.0 %

WITHOUT NOT PROVIDED**Q2a. Overall, how would you rate the physical condition of the City of Clemson parks you have visited?
(without "not provided")**

Q2a. How would you rate overall physical condition of
parks you have visited

	Number	Percent
Excellent	56	19.8 %
Good	178	62.9 %
Fair	47	16.6 %
Poor	2	0.7 %
Total	283	100.0 %

Q2b. In the last 12 months, how often have you used the following parks and recreation facilities provided by the City of Clemson Parks and Recreation Department?

(N=294)

	Frequently (once a week or more)	Sometimes (1-2 times a month)	Rarely (less than 5 times a year)	Never	Did not know existed
Q2b-1. Ashley Dearing Park or Tottie's Place	7.8%	17.3%	36.4%	23.1%	15.3%
Q2b-2. Catherine Smith Plaza	0.7%	4.1%	19.4%	36.1%	39.8%
Q2b-3. Central-Clemson Recreation Center	22.8%	18.4%	22.4%	22.1%	14.3%
Q2b-4. Clemson Park & Community Garden	6.8%	12.6%	24.1%	29.3%	27.2%
Q2b-5. Dawson Park	1.0%	3.7%	14.3%	41.8%	39.1%
Q2b-6. Earle Anderson Park	6.1%	3.1%	13.3%	35.4%	42.2%
Q2b-7. Gateway Park	5.8%	8.2%	21.8%	35.4%	28.9%
Q2b-8. Jaycee Park	1.7%	5.4%	23.1%	37.1%	32.7%
Q2b-9. Larry W. Abernathy Waterfront Park	6.8%	19.7%	37.8%	24.1%	11.6%
Q2b-10. Mountain View Park	2.7%	8.8%	18.4%	33.3%	36.7%
Q2b-11. Rotary Park	0.0%	0.7%	11.6%	39.5%	48.3%
Q2b-12. Shanklin-Sams Greenspace	1.0%	1.0%	12.6%	34.0%	51.4%
Q2b-13. Twelve Mile Recreation Area	2.4%	8.2%	37.8%	35.4%	16.3%
Q2b-14. W.C. Nettles Park	24.1%	31.0%	31.0%	7.5%	6.5%

WITHOUT DID NOT KNOW EXISTED

Q2b. In the last 12 months, how often have you used the following parks and recreation facilities provided by the City of Clemson Parks and Recreation Department? (without "did not know existed")

(N=294)

	Frequently (once a week or more)	Sometimes (1- 2 times a month)	Rarely (less than 5 times a year)	Never
Q2b-1. Ashley Dearing Park or Tottie's Place	9.2%	20.5%	43.0%	27.3%
Q2b-2. Catherine Smith Plaza	1.1%	6.8%	32.2%	59.9%
Q2b-3. Central-Clemson Recreation Center	26.6%	21.4%	26.2%	25.8%
Q2b-4. Clemson Park & Community Garden	9.3%	17.3%	33.2%	40.2%
Q2b-5. Dawson Park	1.7%	6.1%	23.5%	68.7%
Q2b-6. Earle Anderson Park	10.6%	5.3%	22.9%	61.2%
Q2b-7. Gateway Park	8.1%	11.5%	30.6%	49.8%
Q2b-8. Jaycee Park	2.5%	8.1%	34.3%	55.1%
Q2b-9. Larry W. Abernathy Waterfront Park	7.7%	22.3%	42.7%	27.3%
Q2b-10. Mountain View Park	4.3%	14.0%	29.0%	52.7%
Q2b-11. Rotary Park	0.0%	1.3%	22.4%	76.3%
Q2b-12. Shanklin-Sams Greenspace	2.1%	2.1%	25.9%	69.9%
Q2b-13. Twelve Mile Recreation Area	2.8%	9.8%	45.1%	42.3%
Q2b-14. W.C. Nettles Park	25.8%	33.1%	33.1%	8.0%

Q3. Do you live within a 10-minute walk from a park?

Q3. Do you live within a 10-minute walk from a park	Number	Percent
Yes	193	59.0 %
No	112	34.3 %
Not provided	22	6.7 %
Total	327	100.0 %

WITHOUT NOT PROVIDED**Q3. Do you live within a 10-minute walk from a park? (without "not provided")**

Q3. Do you live within a 10-minute walk from a park	Number	Percent
Yes	193	63.3 %
No	112	36.7 %
Total	305	100.0 %

Q3b. Approximately how long would it take for you to walk to the nearest park from your home?

Q3b. How long would it take for you to walk to nearest park from your home	Number	Percent
11-15 minutes	11	9.8 %
16-20 minutes	23	20.5 %
21-25 minutes	25	22.3 %
26+ minutes	40	35.7 %
Not provided	13	11.6 %
Total	112	100.0 %

WITHOUT NOT PROVIDED**Q3b. Approximately how long would it take for you to walk to the nearest park from your home? (without "not provided")**

Q3b. How long would it take for you to walk to nearest park from your home	Number	Percent
11-15 minutes	11	11.1 %
16-20 minutes	23	23.2 %
21-25 minutes	25	25.3 %
26+ minutes	40	40.4 %
Total	99	100.0 %

Q4. Do you have a pedestrian route (trails, sidewalks) to safely access the closest park from your home?

Q4. Do you have a pedestrian route to safely access closest park from your home	Number	Percent
Yes	136	41.6 %
Yes, but needs improvement	39	11.9 %
No	140	42.8 %
Not provided	12	3.7 %
Total	327	100.0 %

WITHOUT NOT PROVIDED**Q4. Do you have a pedestrian route (trails, sidewalks) to safely access the closest park from your home? (without "not provided")**

Q4. Do you have a pedestrian route to safely access closest park from your home	Number	Percent
Yes	136	43.2 %
Yes, but needs improvement	39	12.4 %
No	140	44.4 %
Total	315	100.0 %

Q5. Have you or other members of your household participated in any recreation programs offered by the City of Clemson Parks and Recreation Department during the past 12 months?

Q5. Have you participated in any recreation programs offered by City Parks & Recreation Department during past 12 months	Number	Percent
Yes	135	41.3 %
No	192	58.7 %
Total	327	100.0 %

Q5a. Approximately how many different recreation programs offered by the City of Clemson Parks and Recreation Department have you or members of your household participated in over the past 12 months?

Q5a. How many different recreation programs have you participated in	Number	Percent
1 to 3 programs	95	70.4 %
4 to 6 programs	31	23.0 %
7 to 9 programs	6	4.4 %
10+ programs	2	1.5 %
Not provided	1	0.7 %
Total	135	100.0 %

WITHOUT NOT PROVIDED

Q5a. Approximately how many different recreation programs offered by the City of Clemson Parks and Recreation Department have you or members of your household participated in over the past 12 months? (without "not provided")

Q5a. How many different recreation programs have you participated in	Number	Percent
1 to 3 programs	95	70.9 %
4 to 6 programs	31	23.1 %
7 to 9 programs	6	4.5 %
10+ programs	2	1.5 %
Total	134	100.0 %

Q5b. Overall, how would you rate the quality of the City of Clemson Parks and Recreation Department programs you participated in?

Q5b. How would you rate overall quality of programs you participated in	Number	Percent
Excellent	63	46.7 %
Good	61	45.2 %
Fair	7	5.2 %
Poor	1	0.7 %
Not provided	3	2.2 %
Total	135	100.0 %

WITHOUT NOT PROVIDED

Q5b. Overall, how would you rate the quality of the City of Clemson Parks and Recreation Department programs you participated in? (without "not provided")

Q5b. How would you rate overall quality of programs you participated in	Number	Percent
Excellent	63	47.7 %
Good	61	46.2 %
Fair	7	5.3 %
Poor	1	0.8 %
Total	132	100.0 %

Q6. Which of the following reasons prevent you or other members of your household from using recreation programs offered by the City? If you currently use them, what prevents you from using them more often?

Q6. Reasons that prevent you from using recreation programs	Number	Percent
Not enough parking	28	8.6 %
Facilities too crowded	26	8.0 %
What I want to do is not offered	44	13.5 %
Insufficient staffing	7	2.1 %
Too far from my home	24	7.3 %
Don't feel safe	6	1.8 %
Cost/fees too high	16	4.9 %
Lack of quality programs	13	4.0 %
Poor customer service	5	1.5 %
Program times/facility hours not convenient	34	10.4 %
Use facilities of other cities/private Institutions & Non-City programming	32	9.8 %
Use facilities offered by Clemson University	26	8.0 %
Don't know what's offered/available	96	29.4 %
Poor accessibility for persons with disabilities	4	1.2 %
Not interested/too busy	71	21.7 %
Lack of transportation-I cannot get there	5	1.5 %
Other	36	11.0 %
Nothing	70	21.4 %
Total	543	

Q7. Please rate your satisfaction on a scale of 5 to 1, where 5 means "Very Satisfied" and 1 means "Very Dissatisfied," with the following recreation, parks, and cultural services provided by the City of Clemson Parks and Recreation Department.

(N=327)

	Very satisfied	Satisfied	Neutral	Dissatisfi- ed	Very dissatisfi- ed	Don't know/not applicable
Q7-1. Overall value your household receives for taxes paid	18.3%	37.0%	27.5%	4.6%	1.8%	10.7%
Q7-2. Maintenance of parks	15.6%	45.0%	23.9%	6.1%	0.6%	8.9%
Q7-3. Maintenance of trails	13.5%	35.8%	22.9%	7.3%	1.2%	19.3%
Q7-4. Number of parks in City	21.7%	35.8%	23.2%	7.0%	0.9%	11.3%
Q7-5. Variety of different types of parks in City	14.7%	36.1%	22.9%	12.2%	1.2%	12.8%
Q7-6. Security in City parks	14.7%	33.6%	25.1%	8.6%	0.9%	17.1%
Q7-7. Security on City trails	10.7%	25.4%	30.3%	5.8%	0.6%	27.2%
Q7-8. Availability of information about programs/facilities	11.6%	25.7%	28.4%	18.7%	3.7%	11.9%
Q7-9. Quality of programs for families with children	14.1%	26.9%	18.7%	4.0%	1.2%	35.2%
Q7-10. Quality of programs for adults	6.7%	21.4%	31.5%	11.3%	1.8%	27.2%
Q7-11. User friendliness of City website	4.9%	24.2%	28.1%	12.8%	4.3%	25.7%
Q7-12. Variety of programs offered by City	7.0%	27.2%	28.1%	11.6%	1.5%	24.5%
Q7-13. Ease of registering for classes offered by City	7.6%	22.9%	22.9%	6.7%	2.4%	37.3%
Q7-14. Ease of renting/reserving a City facility	4.9%	15.0%	18.7%	4.0%	0.6%	56.9%
Q7-15. Fees charged for City recreation programs	9.5%	23.5%	23.2%	6.7%	1.8%	35.2%
Q7-16. Program schedule (time/day)	3.7%	23.2%	28.7%	8.0%	1.5%	34.9%
Q7-17. How close parks are located to your home	26.0%	39.1%	16.5%	8.3%	1.8%	8.3%

WITHOUT DON'T KNOW/NOT APPLICABLE

Q7. Please rate your satisfaction on a scale of 5 to 1, where 5 means "Very Satisfied" and 1 means "Very Dissatisfied," with the following recreation, parks, and cultural services provided by the City of Clemson Parks and Recreation Department. (without "don't know/not applicable")

(N=327)

	Very satisfied	Satisfied	Neutral	Dissatisfied	Very dissatisfied
Q7-1. Overall value your household receives for taxes paid	20.5%	41.4%	30.8%	5.1%	2.1%
Q7-2. Maintenance of parks	17.1%	49.3%	26.2%	6.7%	0.7%
Q7-3. Maintenance of trails	16.7%	44.3%	28.4%	9.1%	1.5%
Q7-4. Number of parks in City	24.5%	40.3%	26.2%	7.9%	1.0%
Q7-5. Variety of different types of parks in City	16.8%	41.4%	26.3%	14.0%	1.4%
Q7-6. Security in City parks	17.7%	40.6%	30.3%	10.3%	1.1%
Q7-7. Security on City trails	14.7%	34.9%	41.6%	8.0%	0.8%
Q7-8. Availability of information about programs/facilities	13.2%	29.2%	32.3%	21.2%	4.2%
Q7-9. Quality of programs for families with children	21.7%	41.5%	28.8%	6.1%	1.9%
Q7-10. Quality of programs for adults	9.2%	29.4%	43.3%	15.5%	2.5%
Q7-11. User friendliness of City website	6.6%	32.5%	37.9%	17.3%	5.8%
Q7-12. Variety of programs offered by City	9.3%	36.0%	37.2%	15.4%	2.0%
Q7-13. Ease of registering for classes offered by City	12.2%	36.6%	36.6%	10.7%	3.9%
Q7-14. Ease of renting/reserving a City facility	11.3%	34.8%	43.3%	9.2%	1.4%
Q7-15. Fees charged for City recreation programs	14.6%	36.3%	35.8%	10.4%	2.8%
Q7-16. Program schedule (time/day)	5.6%	35.7%	44.1%	12.2%	2.3%
Q7-17. How close parks are located to your home	28.3%	42.7%	18.0%	9.0%	2.0%

Q8. Which THREE of the items from the list in Question 7 should receive the MOST EMPHASIS over the next five years?

Q8. Top choice	Number	Percent
Overall value your household receives for taxes paid	20	6.1 %
Maintenance of parks	67	20.5 %
Maintenance of trails	15	4.6 %
Number of parks in City	11	3.4 %
Variety of different types of parks in City	27	8.3 %
Security in City parks	22	6.7 %
Security on City trails	6	1.8 %
Availability of information about programs/facilities	35	10.7 %
Quality of programs for families with children	12	3.7 %
Quality of programs for adults	18	5.5 %
User friendliness of City website	8	2.4 %
Variety of programs offered by City	12	3.7 %
Fees charged for City recreation programs	8	2.4 %
Program schedule (time/day)	7	2.1 %
How close parks are located to your home	7	2.1 %
None chosen	52	15.9 %
Total	327	100.0 %

Q8. Which THREE of the items from the list in Question 7 should receive the MOST EMPHASIS over the next five years?

Q8. 2nd choice	Number	Percent
Overall value your household receives for taxes paid	4	1.2 %
Maintenance of parks	29	8.9 %
Maintenance of trails	32	9.8 %
Number of parks in City	7	2.1 %
Variety of different types of parks in City	15	4.6 %
Security in City parks	26	8.0 %
Security on City trails	15	4.6 %
Availability of information about programs/facilities	25	7.6 %
Quality of programs for families with children	19	5.8 %
Quality of programs for adults	33	10.1 %
User friendliness of City website	12	3.7 %
Variety of programs offered by City	20	6.1 %
Ease of registering for classes offered by City	5	1.5 %
Fees charged for City recreation programs	4	1.2 %
Program schedule (time/day)	13	4.0 %
How close parks are located to your home	8	2.4 %
None chosen	60	18.3 %
Total	327	100.0 %

Q8. Which THREE of the items from the list in Question 7 should receive the MOST EMPHASIS over the next five years?

Q8. 3rd choice	Number	Percent
Overall value your household receives for taxes paid	14	4.3 %
Maintenance of parks	19	5.8 %
Maintenance of trails	14	4.3 %
Number of parks in City	11	3.4 %
Variety of different types of parks in City	21	6.4 %
Security in City parks	11	3.4 %
Security on City trails	14	4.3 %
Availability of information about programs/facilities	19	5.8 %
Quality of programs for families with children	16	4.9 %
Quality of programs for adults	23	7.0 %
User friendliness of City website	10	3.1 %
Variety of programs offered by City	29	8.9 %
Ease of registering for classes offered by City	11	3.4 %
Ease of renting/reserving a City facility	2	0.6 %
Fees charged for City recreation programs	10	3.1 %
Program schedule (time/day)	9	2.8 %
How close parks are located to your home	8	2.4 %
None chosen	86	26.3 %
Total	327	100.0 %

SUM OF TOP 3 CHOICES

Q8. Which THREE of the items from the list in Question 7 should receive the MOST EMPHASIS over the next five years? (top 3)

Q8. Sum of Top 3 Choices	Number	Percent
Overall value your household receives for taxes paid	38	11.6 %
Maintenance of parks	115	35.2 %
Maintenance of trails	61	18.7 %
Number of parks in City	29	8.9 %
Variety of different types of parks in City	63	19.3 %
Security in City parks	59	18.0 %
Security on City trails	35	10.7 %
Availability of information about programs/facilities	79	24.2 %
Quality of programs for families with children	47	14.4 %
Quality of programs for adults	74	22.6 %
User friendliness of City website	30	9.2 %
Variety of programs offered by City	61	18.7 %
Ease of registering for classes offered by City	16	4.9 %
Ease of renting/reserving a City facility	2	0.6 %
Fees charged for City recreation programs	22	6.7 %
Program schedule (time/day)	29	8.9 %
How close parks are located to your home	23	7.0 %
None chosen	52	15.9 %
Total	835	

Q9. The following are some of the benefits that you and your household may receive from PARKS, TRAILS, RECREATION FACILITIES, PROGRAMS AND SERVICES OF CLEMSON. Please rate your agreement with each item on a scale of 5 to 1, where 5 means "Strongly Agree" and 1 means "Strongly Disagree."

(N=327)

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
Q9-1. Improves physical health & fitness	51.4%	35.8%	4.9%	0.3%	0.6%	7.0%
Q9-2. Helps reduce neighborhood crime	21.4%	26.0%	27.5%	7.6%	1.2%	16.2%
Q9-3. Makes City a more desirable place to live	56.0%	33.3%	3.1%	1.5%	0.9%	5.2%
Q9-4. Preserves open space & the environment	57.8%	30.6%	5.5%	0.3%	0.6%	5.2%
Q9-5. Increases property values in surrounding area	43.1%	31.5%	11.0%	2.8%	1.2%	10.4%
Q9-6. Improves mental health & reduces stress	52.6%	33.6%	7.6%	0.3%	0.6%	5.2%
Q9-7. Increases opportunities for different cultures to interact	28.1%	37.6%	20.2%	3.7%	1.2%	9.2%
Q9-8. Helps attract new residents & businesses	29.1%	31.5%	22.9%	4.6%	1.2%	10.7%
Q9-9. Promotes tourism to City	23.9%	26.9%	30.3%	7.0%	0.9%	11.0%
Q9-10. Provides opportunities to pursue leisure interests	42.8%	40.1%	7.3%	0.3%	0.3%	9.2%
Q9-11. Helps with flood control & cleans our water & air	24.5%	22.0%	23.5%	3.7%	1.8%	24.5%
Q9-12. Protects & restores natural habitats	31.2%	35.5%	18.3%	2.8%	0.3%	11.9%
Q9-13. Provides outdoor recreation	57.8%	33.0%	2.1%	2.4%	0.0%	4.6%
Q9-14. Provides indoor recreation	33.0%	31.2%	19.6%	3.4%	1.5%	11.3%

WITHOUT DON'T KNOW

Q9. The following are some of the benefits that you and your household may receive from PARKS, TRAILS, RECREATION FACILITIES, PROGRAMS AND SERVICES OF CLEMSON. Please rate your agreement with each item on a scale of 5 to 1, where 5 means "Strongly Agree" and 1 means "Strongly Disagree." (without "don't know")

(N=327)

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Q9-1. Improves physical health & fitness	55.3%	38.5%	5.3%	0.3%	0.7%
Q9-2. Helps reduce neighborhood crime	25.5%	31.0%	32.8%	9.1%	1.5%
Q9-3. Makes City a more desirable place to live	59.0%	35.2%	3.2%	1.6%	1.0%
Q9-4. Preserves open space & the environment	61.0%	32.3%	5.8%	0.3%	0.6%
Q9-5. Increases property values in surrounding area	48.1%	35.2%	12.3%	3.1%	1.4%
Q9-6. Improves mental health & reduces stress	55.5%	35.5%	8.1%	0.3%	0.6%
Q9-7. Increases opportunities for different cultures to interact	31.0%	41.4%	22.2%	4.0%	1.3%
Q9-8. Helps attract new residents & businesses	32.5%	35.3%	25.7%	5.1%	1.4%
Q9-9. Promotes tourism to City	26.8%	30.2%	34.0%	7.9%	1.0%
Q9-10. Provides opportunities to pursue leisure interests	47.1%	44.1%	8.1%	0.3%	0.3%
Q9-11. Helps with flood control & cleans our water & air	32.4%	29.1%	31.2%	4.9%	2.4%
Q9-12. Protects & restores natural habitats	35.4%	40.3%	20.8%	3.1%	0.3%
Q9-13. Provides outdoor recreation	60.6%	34.6%	2.2%	2.6%	0.0%
Q9-14. Provides indoor recreation	37.2%	35.2%	22.1%	3.8%	1.7%

Q10. Which THREE of the benefits listed in Question 9 are MOST IMPORTANT to you and members of your household?

Q10. Top choice	Number	Percent
Improves physical health & fitness	132	40.4 %
Helps reduce neighborhood crime	5	1.5 %
Makes City a more desirable place to live	25	7.6 %
Preserves open space & the environment	47	14.4 %
Increases property values in surrounding area	15	4.6 %
Improves mental health & reduces stress	12	3.7 %
Increases opportunities for different cultures to interact	1	0.3 %
Helps attract new residents & businesses	2	0.6 %
Promotes tourism to City	2	0.6 %
Provides opportunities to pursue leisure interests	7	2.1 %
Helps with flood control & cleans our water & air	9	2.8 %
Protects & restores natural habitats	12	3.7 %
Provides outdoor recreation	24	7.3 %
Provides indoor recreation	11	3.4 %
None chosen	23	7.0 %
Total	327	100.0 %

Q10. Which THREE of the benefits listed in Question 9 are MOST IMPORTANT to you and members of your household?

Q10. 2nd choice	Number	Percent
Improves physical health & fitness	29	8.9 %
Helps reduce neighborhood crime	11	3.4 %
Makes City a more desirable place to live	37	11.3 %
Preserves open space & the environment	47	14.4 %
Increases property values in surrounding area	13	4.0 %
Improves mental health & reduces stress	48	14.7 %
Increases opportunities for different cultures to interact	7	2.1 %
Helps attract new residents & businesses	3	0.9 %
Promotes tourism to City	2	0.6 %
Provides opportunities to pursue leisure interests	33	10.1 %
Helps with flood control & cleans our water & air	8	2.4 %
Protects & restores natural habitats	17	5.2 %
Provides outdoor recreation	29	8.9 %
Provides indoor recreation	7	2.1 %
None chosen	36	11.0 %
Total	327	100.0 %

Q10. Which THREE of the benefits listed in Question 9 are MOST IMPORTANT to you and members of your household?

Q10. 3rd choice	Number	Percent
Improves physical health & fitness	25	7.6 %
Helps reduce neighborhood crime	6	1.8 %
Makes City a more desirable place to live	36	11.0 %
Preserves open space & the environment	34	10.4 %
Increases property values in surrounding area	17	5.2 %
Improves mental health & reduces stress	34	10.4 %
Increases opportunities for different cultures to interact	14	4.3 %
Helps attract new residents & businesses	4	1.2 %
Promotes tourism to City	2	0.6 %
Provides opportunities to pursue leisure interests	33	10.1 %
Helps with flood control & cleans our water & air	9	2.8 %
Protects & restores natural habitats	25	7.6 %
Provides outdoor recreation	30	9.2 %
Provides indoor recreation	18	5.5 %
None chosen	40	12.2 %
Total	327	100.0 %

SUM OF TOP 3 CHOICES

Q10. Which THREE of the benefits listed in Question 9 are MOST IMPORTANT to you and members of your household? (top 3)

Q10. Top choice	Number	Percent
Improves physical health & fitness	186	56.9 %
Helps reduce neighborhood crime	22	6.7 %
Makes City a more desirable place to live	98	30.0 %
Preserves open space & the environment	128	39.1 %
Increases property values in surrounding area	45	13.8 %
Improves mental health & reduces stress	94	28.7 %
Increases opportunities for different cultures to interact	22	6.7 %
Helps attract new residents & businesses	9	2.8 %
Promotes tourism to City	6	1.8 %
Provides opportunities to pursue leisure interests	73	22.3 %
Helps with flood control & cleans our water & air	26	8.0 %
Protects & restores natural habitats	54	16.5 %
Provides outdoor recreation	83	25.4 %
Provides indoor recreation	36	11.0 %
None chosen	23	7.0 %
Total	905	

Q11. How do you currently learn about the programs and services that are offered by the City of Clemson?

Q11. How do you currently learn about programs & services offered by City	Number	Percent
Newspaper	39	11.9 %
City or department website	105	32.1 %
Internet	100	30.6 %
Email blasts/newsletters	109	33.3 %
Program fliers/registration forms	33	10.1 %
From friends & neighbors	129	39.4 %
Social media (Facebook, Twitter, etc.)	126	38.5 %
Recreation brochure/program guide	51	15.6 %
Conversations with City staff	10	3.1 %
Neighborhood/civic newsletters	43	13.1 %
Recreation center bulletin boards	21	6.4 %
Schools	12	3.7 %
Other	18	5.5 %
Total	796	

Q12. Which TWO of the sources of information do you MOST PREFER to use to get information about city programs and services?

Q12. Top choice	Number	Percent
Newspaper	11	3.4 %
City or department website	34	10.4 %
Internet	36	11.0 %
Email blasts/newsletters	97	29.7 %
Program fliers/registration forms	7	2.1 %
From friends & neighbors	16	4.9 %
Social media (Facebook, Twitter, etc.)	54	16.5 %
Recreation brochure/program guide	15	4.6 %
Neighborhood/civic newsletters	14	4.3 %
None chosen	43	13.1 %
Total	327	100.0 %

Q12. Which TWO of the sources of information do you MOST PREFER to use to get information about city programs and services?

Q12. 2nd choice	Number	Percent
Newspaper	10	3.1 %
City or department website	42	12.8 %
Internet	28	8.6 %
Email blasts/newsletters	48	14.7 %
Program fliers/registration forms	14	4.3 %
From friends & neighbors	19	5.8 %
Social media (Facebook, Twitter, etc.)	55	16.8 %
Recreation brochure/program guide	23	7.0 %
Neighborhood/civic newsletters	14	4.3 %
Recreation center bulletin boards	4	1.2 %
Schools	2	0.6 %
None chosen	68	20.8 %
Total	327	100.0 %

SUM OF TOP 2 CHOICES

Q12. Which TWO of the sources of information do you MOST PREFER to use to get information about city programs and services? (top 2)

Q12. Sum of Top 2 Choices	Number	Percent
Newspaper	21	6.4 %
City or department website	76	23.2 %
Internet	64	19.6 %
Email blasts/newsletters	145	44.3 %
Program fliers/registration forms	21	6.4 %
From friends & neighbors	35	10.7 %
Social media (Facebook, Twitter, etc.)	109	33.3 %
Recreation brochure/program guide	38	11.6 %
Neighborhood/civic newsletters	28	8.6 %
Recreation center bulletin boards	4	1.2 %
Schools	2	0.6 %
None chosen	43	13.1 %
Total	586	

Q13. Please CHECK ALL the ways you typically travel to the parks and recreation areas that you use.

Q13. All the ways you typically travel to parks & recreation areas you use

	Number	Percent
Personal vehicle (car, truck, van, SUV, motorcycle)	291	89.0 %
Bike	61	18.7 %
Walk	178	54.4 %
Bus	5	1.5 %
Dockless scooter or bikeshare	1	0.3 %
Taxi or carshare (Uber, Lyft)	1	0.3 %
Other	5	1.5 %
None, I do not visit parks or recreation areas	16	4.9 %
Total	558	

Q13-7. Other:

Q13-7. Other	Number	Percent
Golf cart	2	40.0 %
Run	1	20.0 %
By boat-Twelve Mile Rec area	1	20.0 %
Boat to Abernathy	1	20.0 %
Total	5	100.0 %

Q14. A variety of recreation facilities and amenities are listed below that are already offered in the community or may be offered in the future. Please indicate how well your needs for each facility or amenity are met on a scale of 4 to 1, where 4 means your needs are "Fully Met" and 1 means your needs are "Not Met" at all.

(N=327)

	Fully met	Mostly met	Partly met	Not met	No need
Q14-1. Neighborhood parks (smaller parks within a 10-minute walking distance of your home)	33.0%	23.2%	14.7%	12.8%	16.2%
Q14-2. Large community parks (regional attractions that draw in users from the area)	19.6%	27.8%	18.7%	12.8%	21.1%
Q14-3. Natural areas/conservation areas (mostly naturally wooded, wetlands areas, or open areas without lawn areas that are left natural with little to no maintenance)	13.8%	28.1%	27.5%	14.1%	16.5%
Q14-4. Open green space (lawn areas that are regularly maintained for passive recreation)	15.3%	31.2%	26.0%	11.0%	16.5%
Q14-5. Picnic areas & park shelters	19.6%	33.0%	24.8%	4.6%	18.0%
Q14-6. Outdoor public art	7.3%	9.8%	24.2%	24.5%	34.3%
Q14-7. Playground areas	17.4%	33.9%	22.0%	3.7%	22.9%
Q14-8. Fishing areas	7.3%	13.5%	22.3%	11.9%	45.0%
Q14-9. Paved connectivity trails for bikes & pedestrians (greenways)	4.3%	15.0%	37.9%	22.6%	20.2%
Q14-10. Unpaved hiking trails within parks	3.4%	15.3%	38.2%	15.3%	27.8%
Q14-11. Paved walking trails within parks	5.8%	23.9%	37.0%	12.8%	20.5%
Q14-12. Off-leash dog parks	8.9%	11.9%	20.8%	12.5%	45.9%
Q14-13. Diamond sports fields (e.g., baseball, softball)	19.0%	25.1%	11.6%	3.7%	40.7%
Q14-14. Rectangular sports fields (e.g., soccer, lacrosse, etc.)	15.0%	22.0%	17.4%	5.5%	40.1%
Q14-15. Outdoor basketball courts	8.6%	11.9%	22.0%	12.8%	44.6%
Q14-16. Outdoor tennis courts	12.8%	19.6%	23.2%	5.5%	38.8%
Q14-17. Pickleball courts	6.4%	11.0%	19.6%	16.5%	46.5%
Q14-18. Extreme sports (i.e., skate parks/pump tracks)	8.3%	8.3%	17.4%	13.8%	52.3%
Q14-19. Splash pads/interactive water play or features	0.6%	1.5%	5.2%	48.0%	44.6%
Q14-20. Community recreation building/space	8.3%	20.2%	31.5%	12.2%	27.8%

Q14. A variety of recreation facilities and amenities are listed below that are already offered in the community or may be offered in the future. Please indicate how well your needs for each facility or amenity are met on a scale of 4 to 1, where 4 means your needs are "Fully Met" and 1 means your needs are "Not Met" at all.

	Fully met	Mostly met	Partly met	Not met	No need
Q14-21. Indoor sports courts or other indoor sporting practice facilities	10.1%	17.7%	27.8%	13.5%	30.9%
Q14-22. Indoor fitness & wellness spaces	13.1%	26.3%	27.5%	9.5%	23.5%
Q14-23. Indoor pool space	16.2%	21.1%	20.8%	14.7%	27.2%
Q14-24. eSports/gaming space	2.4%	2.4%	4.0%	13.1%	78.0%
Q14-25. Senior indoor & outdoor activity areas	6.1%	11.3%	26.0%	14.7%	41.9%
Q14-26. Teen indoor & outdoor activity areas	3.7%	8.9%	20.8%	15.9%	50.8%
Q14-27. Community gardens	12.2%	18.3%	23.2%	11.9%	34.3%
Q14-28. ADA accessible/inclusive play features & park structures	3.7%	10.4%	15.3%	15.6%	55.0%
Q14-29. Disc golf courses	5.5%	13.8%	17.4%	9.5%	53.8%
Q14-30. Motorized boat launches	8.0%	13.1%	12.5%	6.4%	59.9%
Q14-31. Non-motorized boat launches	6.7%	13.1%	15.0%	8.9%	56.3%
Q14-32. Outdoor fitness equipment	1.2%	2.1%	21.7%	27.8%	47.1%
Q14-33. Water access	8.9%	23.2%	24.8%	12.8%	30.3%
Q14-34. Other	0.0%	0.3%	0.3%	5.5%	93.9%

ONLY HOUSEHOLDS THAT HAVE A NEED

Q14. A variety of recreation facilities and amenities are listed below that are already offered in the community or may be offered in the future. Please indicate how well your needs for each facility or amenity are met on a scale of 4 to 1, where 4 means your needs are "Fully Met" and 1 means your needs are "Not Met" at all. (without "no need")

(N=327)

	Fully met	Mostly met	Partly met	Not met
Q14-1. Neighborhood parks (smaller parks within a 10-minute walking distance of your home)	39.4%	27.7%	17.5%	15.3%
Q14-2. Large community parks (regional attractions that draw in users from the area)	24.8%	35.3%	23.6%	16.3%
Q14-3. Natural areas/conservation areas (mostly naturally wooded, wetlands areas, or open areas without lawn areas that are left natural with little to no maintenance)	16.5%	33.7%	33.0%	16.8%
Q14-4. Open green space (lawn areas that are regularly maintained for passive recreation)	18.3%	37.4%	31.1%	13.2%
Q14-5. Picnic areas & park shelters	23.9%	40.3%	30.2%	5.6%
Q14-6. Outdoor public art	11.2%	14.9%	36.7%	37.2%
Q14-7. Playground areas	22.6%	44.0%	28.6%	4.8%
Q14-8. Fishing areas	13.3%	24.4%	40.6%	21.7%
Q14-9. Paved connectivity trails for bikes & pedestrians (greenways)	5.4%	18.8%	47.5%	28.4%
Q14-10. Unpaved hiking trails within parks	4.7%	21.2%	53.0%	21.2%
Q14-11. Paved walking trails within parks	7.3%	30.0%	46.5%	16.2%
Q14-12. Off-leash dog parks	16.4%	22.0%	38.4%	23.2%
Q14-13. Diamond sports fields (e.g., baseball, softball)	32.0%	42.3%	19.6%	6.2%
Q14-14. Rectangular sports fields (e.g., soccer, lacrosse, etc.)	25.0%	36.7%	29.1%	9.2%
Q14-15. Outdoor basketball courts	15.5%	21.5%	39.8%	23.2%
Q14-16. Outdoor tennis courts	21.0%	32.0%	38.0%	9.0%
Q14-17. Pickleball courts	12.0%	20.6%	36.6%	30.9%
Q14-18. Extreme sports (i.e., skate parks/pump tracks)	17.3%	17.3%	36.5%	28.8%
Q14-19. Splash pads/interactive water play or features	1.1%	2.8%	9.4%	86.7%
Q14-20. Community recreation building/space	11.4%	28.0%	43.6%	16.9%

ONLY HOUSEHOLDS THAT HAVE A NEED

Q14. A variety of recreation facilities and amenities are listed below that are already offered in the community or may be offered in the future. Please indicate how well your needs for each facility or amenity are met on a scale of 4 to 1, where 4 means your needs are "Fully Met" and 1 means your needs are "Not Met" at all. (without "no need")

	Fully met	Mostly met	Partly met	Not met
Q14-21. Indoor sports courts or other indoor sporting practice facilities	14.6%	25.7%	40.3%	19.5%
Q14-22. Indoor fitness & wellness spaces	17.2%	34.4%	36.0%	12.4%
Q14-23. Indoor pool space	22.3%	29.0%	28.6%	20.2%
Q14-24. eSports/gaming space	11.1%	11.1%	18.1%	59.7%
Q14-25. Senior indoor & outdoor activity areas	10.5%	19.5%	44.7%	25.3%
Q14-26. Teen indoor & outdoor activity areas	7.5%	18.0%	42.2%	32.3%
Q14-27. Community gardens	18.6%	27.9%	35.3%	18.1%
Q14-28. ADA accessible/inclusive play features & park structures	8.2%	23.1%	34.0%	34.7%
Q14-29. Disc golf courses	11.9%	29.8%	37.7%	20.5%
Q14-30. Motorized boat launches	19.8%	32.8%	31.3%	16.0%
Q14-31. Non-motorized boat launches	15.4%	30.1%	34.3%	20.3%
Q14-32. Outdoor fitness equipment	2.3%	4.0%	41.0%	52.6%
Q14-33. Water access	12.7%	33.3%	35.5%	18.4%
Q14-34. Other	0.0%	5.0%	5.0%	90.0%

Q15. Which FOUR of the facilities and amenities listed in Question 14 do you think are MOST IMPORTANT to you and the members of your household?

Q15. Top choice	Number	Percent
Neighborhood parks (smaller parks within a 10-minute walking distance of your home)	60	18.3 %
Large community parks (regional attractions that draw in users from the area)	15	4.6 %
Natural areas/conservation areas (mostly naturally wooded, wetlands areas, or open areas without lawn areas that are left natural with little to no maintenance)	37	11.3 %
Open green space (lawn areas that are regularly maintained for passive recreation)	8	2.4 %
Picnic areas & park shelters	7	2.1 %
Outdoor public art	1	0.3 %
Playground areas	8	2.4 %
Fishing areas	3	0.9 %
Paved connectivity trails for bikes & pedestrians (greenways)	27	8.3 %
Unpaved hiking trails within parks	7	2.1 %
Paved walking trails within parks	7	2.1 %
Off-leash dog parks	6	1.8 %
Diamond sports fields (e.g., baseball, softball)	6	1.8 %
Rectangular sports fields (e.g., soccer, lacrosse, etc.)	4	1.2 %
Outdoor basketball courts	1	0.3 %
Outdoor tennis courts	5	1.5 %
Pickleball courts	15	4.6 %
Extreme sports (i.e., skate parks/pump tracks)	5	1.5 %
Splash pads/interactive water play or features	10	3.1 %
Community recreation building/space	4	1.2 %
Indoor sports courts or other indoor sporting practice facilities	4	1.2 %
Indoor fitness & wellness spaces	5	1.5 %
Indoor pool space	9	2.8 %
Senior indoor & outdoor activity areas	7	2.1 %
Teen indoor & outdoor activity areas	3	0.9 %
Community gardens	3	0.9 %
ADA accessible/inclusive play features & park structures	1	0.3 %
Disc golf courses	2	0.6 %
Motorized boat launches	3	0.9 %
Outdoor fitness equipment	2	0.6 %
Water access	4	1.2 %
Other	8	2.4 %
None chosen	40	12.2 %
Total	327	100.0 %

Q15. Which FOUR of the facilities and amenities listed in Question 14 do you think are MOST IMPORTANT to you and the members of your household?

Q15. 2nd choice	Number	Percent
Neighborhood parks (smaller parks within a 10-minute walking distance of your home)	17	5.2 %
Large community parks (regional attractions that draw in users from the area)	18	5.5 %
Natural areas/conservation areas (mostly naturally wooded, wetlands areas, or open areas without lawn areas that are left natural with little to no maintenance)	27	8.3 %
Open green space (lawn areas that are regularly maintained for passive recreation)	23	7.0 %
Picnic areas & park shelters	9	2.8 %
Outdoor public art	6	1.8 %
Playground areas	12	3.7 %
Fishing areas	5	1.5 %
Paved connectivity trails for bikes & pedestrians (greenways)	24	7.3 %
Unpaved hiking trails within parks	23	7.0 %
Paved walking trails within parks	16	4.9 %
Off-leash dog parks	8	2.4 %
Diamond sports fields (e.g., baseball, softball)	2	0.6 %
Rectangular sports fields (e.g., soccer, lacrosse, etc.)	6	1.8 %
Outdoor basketball courts	2	0.6 %
Outdoor tennis courts	3	0.9 %
Pickleball courts	9	2.8 %
Extreme sports (i.e., skate parks/pump tracks)	1	0.3 %
Splash pads/interactive water play or features	12	3.7 %
Community recreation building/space	2	0.6 %
Indoor sports courts or other indoor sporting practice facilities	5	1.5 %
Indoor fitness & wellness spaces	4	1.2 %
Indoor pool space	14	4.3 %
eSports/gaming space	3	0.9 %
Senior indoor & outdoor activity areas	10	3.1 %
Teen indoor & outdoor activity areas	2	0.6 %
Disc golf courses	1	0.3 %
Non-motorized boat launches	3	0.9 %
Outdoor fitness equipment	4	1.2 %
Water access	8	2.4 %
None chosen	48	14.7 %
Total	327	100.0 %

Q15. Which FOUR of the facilities and amenities listed in Question 14 do you think are MOST IMPORTANT to you and the members of your household?

Q15. 3rd choice	Number	Percent
Neighborhood parks (smaller parks within a 10-minute walking distance of your home)	12	3.7 %
Large community parks (regional attractions that draw in users from the area)	11	3.4 %
Natural areas/conservation areas (mostly naturally wooded, wetlands areas, or open areas without lawn areas that are left natural with little to no maintenance)	18	5.5 %
Open green space (lawn areas that are regularly maintained for passive recreation)	16	4.9 %
Picnic areas & park shelters	13	4.0 %
Outdoor public art	5	1.5 %
Playground areas	9	2.8 %
Fishing areas	5	1.5 %
Paved connectivity trails for bikes & pedestrians (greenways)	14	4.3 %
Unpaved hiking trails within parks	23	7.0 %
Paved walking trails within parks	17	5.2 %
Off-leash dog parks	9	2.8 %
Diamond sports fields (e.g., baseball, softball)	6	1.8 %
Rectangular sports fields (e.g., soccer, lacrosse, etc.)	5	1.5 %
Outdoor basketball courts	9	2.8 %
Outdoor tennis courts	2	0.6 %
Pickleball courts	10	3.1 %
Extreme sports (i.e., skate parks/pump tracks)	1	0.3 %
Splash pads/interactive water play or features	11	3.4 %
Community recreation building/space	5	1.5 %
Indoor sports courts or other indoor sporting practice facilities	6	1.8 %
Indoor fitness & wellness spaces	9	2.8 %
Indoor pool space	5	1.5 %
Senior indoor & outdoor activity areas	6	1.8 %
Teen indoor & outdoor activity areas	5	1.5 %
Community gardens	6	1.8 %
ADA accessible/inclusive play features & park structures	4	1.2 %
Disc golf courses	2	0.6 %
Motorized boat launches	5	1.5 %
Non-motorized boat launches	5	1.5 %
Outdoor fitness equipment	5	1.5 %
Water access	7	2.1 %
None chosen	61	18.7 %
Total	327	100.0 %

Q15. Which FOUR of the facilities and amenities listed in Question 14 do you think are MOST IMPORTANT to you and the members of your household?

Q15. 4th choice	Number	Percent
Neighborhood parks (smaller parks within a 10-minute walking distance of your home)	11	3.4 %
Large community parks (regional attractions that draw in users from the area)	12	3.7 %
Natural areas/conservation areas (mostly naturally wooded, wetlands areas, or open areas without lawn areas that are left natural with little to no maintenance)	16	4.9 %
Open green space (lawn areas that are regularly maintained for passive recreation)	12	3.7 %
Picnic areas & park shelters	11	3.4 %
Outdoor public art	5	1.5 %
Playground areas	10	3.1 %
Fishing areas	2	0.6 %
Paved connectivity trails for bikes & pedestrians (greenways)	19	5.8 %
Unpaved hiking trails within parks	16	4.9 %
Paved walking trails within parks	15	4.6 %
Off-leash dog parks	7	2.1 %
Diamond sports fields (e.g., baseball, softball)	1	0.3 %
Rectangular sports fields (e.g., soccer, lacrosse, etc.)	7	2.1 %
Outdoor basketball courts	2	0.6 %
Outdoor tennis courts	2	0.6 %
Pickleball courts	10	3.1 %
Extreme sports (i.e., skate parks/pump tracks)	3	0.9 %
Splash pads/interactive water play or features	11	3.4 %
Community recreation building/space	6	1.8 %
Indoor sports courts or other indoor sporting practice facilities	5	1.5 %
Indoor fitness & wellness spaces	6	1.8 %
Indoor pool space	5	1.5 %
Senior indoor & outdoor activity areas	13	4.0 %
Teen indoor & outdoor activity areas	3	0.9 %
Community gardens	7	2.1 %
ADA accessible/inclusive play features & park structures	2	0.6 %
Disc golf courses	1	0.3 %
Motorized boat launches	2	0.6 %
Non-motorized boat launches	2	0.6 %
Outdoor fitness equipment	3	0.9 %
Water access	13	4.0 %
None chosen	87	26.6 %
Total	327	100.0 %

SUM OF TOP 4 CHOICES

Q15. Which FOUR of the facilities and amenities listed in Question 14 do you think are MOST IMPORTANT to you and the members of your household? (top 4)

Q15. Sum of Top 4 Choices	Number	Percent
Neighborhood parks (smaller parks within a 10-minute walking distance of your home)	100	30.6 %
Large community parks (regional attractions that draw in users from the area)	56	17.1 %
Natural areas/conservation areas (mostly naturally wooded, wetlands areas, or open areas without lawn areas that are left natural with little to no maintenance)	98	30.0 %
Open green space (lawn areas that are regularly maintained for passive recreation)	59	18.0 %
Picnic areas & park shelters	40	12.2 %
Outdoor public art	17	5.2 %
Playground areas	39	11.9 %
Fishing areas	15	4.6 %
Paved connectivity trails for bikes & pedestrians (greenways)	84	25.7 %
Unpaved hiking trails within parks	69	21.1 %
Paved walking trails within parks	55	16.8 %
Off-leash dog parks	30	9.2 %
Diamond sports fields (e.g., baseball, softball)	15	4.6 %
Rectangular sports fields (e.g., soccer, lacrosse, etc.)	22	6.7 %
Outdoor basketball courts	14	4.3 %
Outdoor tennis courts	12	3.7 %
Pickleball courts	44	13.5 %
Extreme sports (i.e., skate parks/pump tracks)	10	3.1 %
Splash pads/interactive water play or features	44	13.5 %
Community recreation building/space	17	5.2 %
Indoor sports courts or other indoor sporting practice facilities	20	6.1 %
Indoor fitness & wellness spaces	24	7.3 %
Indoor pool space	33	10.1 %
eSports/gaming space	3	0.9 %
Senior indoor & outdoor activity areas	36	11.0 %
Teen indoor & outdoor activity areas	13	4.0 %
Community gardens	16	4.9 %
ADA accessible/inclusive play features & park structures	7	2.1 %
Disc golf courses	6	1.8 %
Motorized boat launches	10	3.1 %
Non-motorized boat launches	10	3.1 %
Outdoor fitness equipment	14	4.3 %
Water access	32	9.8 %
Other	8	2.4 %
None chosen	40	12.2 %
Total	1112	

Q16. A variety of recreation programs and activities are listed below that are already offered in the community or may be offered in the future. Please indicate how well your needs for each program or activity are met on a scale of 4 to 1, where 4 means your needs are "Fully Met" and 1 means your needs are "Not Met" at all.

(N=327)

	Fully met	Mostly met	Partly met	Not met	No need
Q16-1. Youth learn to swim programs	7.0%	12.5%	13.5%	8.0%	59.0%
Q16-2. Adult learn to swim programs	5.8%	6.4%	11.3%	8.9%	67.6%
Q16-3. Water fitness programs	6.4%	13.1%	22.0%	10.1%	48.3%
Q16-4. Tennis lessons & leagues	1.8%	9.8%	14.1%	13.5%	60.9%
Q16-5. Pickleball lessons & leagues	2.1%	8.0%	18.3%	18.7%	52.9%
Q16-6. Preschool programs	4.3%	4.3%	11.9%	9.5%	70.0%
Q16-7. Before school programs	1.2%	2.1%	8.3%	10.1%	78.3%
Q16-8. After school programs	6.4%	8.9%	10.7%	6.4%	67.6%
Q16-9. School break camps (fall/spring/summer)	5.8%	12.5%	13.5%	5.5%	62.7%
Q16-10. Youth athletic programs & leagues	10.4%	17.1%	9.8%	2.8%	59.9%
Q16-11. Youth fitness & wellness programs	4.0%	11.6%	14.1%	7.3%	63.0%
Q16-12. Adult fitness & wellness programs	5.5%	20.2%	28.1%	11.9%	34.3%
Q16-13. Programs for teens	0.6%	7.6%	18.0%	10.4%	63.3%
Q16-14. Programs for seniors	4.3%	13.8%	25.7%	9.8%	46.5%
Q16-15. Youth art/dance/performing arts	1.5%	6.7%	15.0%	15.6%	61.2%
Q16-16. Adult art/dance/performing arts	1.5%	7.6%	16.8%	20.2%	53.8%
Q16-17. Adult organized athletic programs & leagues	1.5%	8.0%	21.1%	18.7%	50.8%
Q16-18. Programs for people with disabilities or special needs	3.1%	3.1%	8.3%	14.1%	71.6%
Q16-19. Special events (i.e., concerts, movies, history programs, & cultural events)	4.3%	16.5%	29.1%	20.8%	29.4%
Q16-20. Water-based recreation programs (e.g., sailing, kayaking, etc.)	0.9%	7.0%	14.7%	29.4%	48.0%
Q16-21. Athletic special events (i.e., cross-country or running races)	1.2%	11.6%	17.7%	13.1%	56.3%
Q16-22. Nature programs/environmental education	0.9%	13.5%	19.6%	26.6%	39.4%

Q16. A variety of recreation programs and activities are listed below that are already offered in the community or may be offered in the future. Please indicate how well your needs for each program or activity are met on a scale of 4 to 1, where 4 means your needs are "Fully Met" and 1 means your needs are "Not Met" at all.

	Fully met	Mostly met	Partly met	Not met	No need
Q16-23. Dog park programs	2.4%	11.3%	17.4%	15.9%	52.9%
Q16-24. Science/technology programs (kids outdoor science programs/computer classes, etc.)	3.4%	4.0%	11.0%	23.9%	57.8%
Q16-25. Other	0.0%	0.0%	0.0%	100.0%	0.0%

ONLY HOUSEHOLDS THAT HAVE A NEED

Q16. A variety of recreation programs and activities are listed below that are already offered in the community or may be offered in the future. Please indicate how well your needs for each program or activity are met on a scale of 4 to 1, where 4 means your needs are "Fully Met" and 1 means your needs are "Not Met" at all. (without "don't know")

(N=327)

	Fully met	Mostly met	Partly met	Not met
Q16-1. Youth learn to swim programs	17.2%	30.6%	32.8%	19.4%
Q16-2. Adult learn to swim programs	17.9%	19.8%	34.9%	27.4%
Q16-3. Water fitness programs	12.4%	25.4%	42.6%	19.5%
Q16-4. Tennis lessons & leagues	4.7%	25.0%	35.9%	34.4%
Q16-5. Pickleball lessons & leagues	4.5%	16.9%	39.0%	39.6%
Q16-6. Preschool programs	14.3%	14.3%	39.8%	31.6%
Q16-7. Before school programs	5.6%	9.9%	38.0%	46.5%
Q16-8. After school programs	19.8%	27.4%	33.0%	19.8%
Q16-9. School break camps (fall/spring/summer)	15.6%	33.6%	36.1%	14.8%
Q16-10. Youth athletic programs & leagues	26.0%	42.7%	24.4%	6.9%
Q16-11. Youth fitness & wellness programs	10.7%	31.4%	38.0%	19.8%
Q16-12. Adult fitness & wellness programs	8.4%	30.7%	42.8%	18.1%
Q16-13. Programs for teens	1.7%	20.8%	49.2%	28.3%
Q16-14. Programs for seniors	8.0%	25.7%	48.0%	18.3%
Q16-15. Youth art/dance/performing arts	3.9%	17.3%	38.6%	40.2%
Q16-16. Adult art/dance/performing arts	3.3%	16.6%	36.4%	43.7%
Q16-17. Adult organized athletic programs & leagues	3.1%	16.1%	42.9%	37.9%
Q16-18. Programs for people with disabilities or special needs	10.8%	10.8%	29.0%	49.5%
Q16-19. Special events (i.e., concerts, movies, history programs, & cultural events)	6.1%	23.4%	41.1%	29.4%
Q16-20. Water-based recreation programs (e.g., sailing, kayaking, etc.)	1.8%	13.5%	28.2%	56.5%
Q16-21. Athletic special events (i.e., cross-country or running races)	2.8%	26.6%	40.6%	30.1%
Q16-22. Nature programs/environmental education	1.5%	22.2%	32.3%	43.9%

ONLY HOUSEHOLDS THAT HAVE A NEED

Q16. A variety of recreation programs and activities are listed below that are already offered in the community or may be offered in the future. Please indicate how well your needs for each program or activity are met on a scale of 4 to 1, where 4 means your needs are "Fully Met" and 1 means your needs are "Not Met" at all. (without "don't know")

	Fully met	Mostly met	Partly met	Not met
Q16-23. Dog park programs	5.2%	24.0%	37.0%	33.8%
Q16-24. Science/technology programs (kids outdoor science programs/computer classes, etc.)	8.0%	9.4%	26.1%	56.5%
Q16-25. Other	0.0%	0.0%	0.0%	100.0%

Q16-25. Other:

Q16-25. Other	Number	Percent
Outdoor pool heated and covered in cold weather	1	50.0 %
Swimming outdoors	1	50.0 %
Total	2	100.0 %

Q17. Which FOUR of the programs or activities listed in Question 16 do you think are MOST IMPORTANT to you and the members of your household?

<u>Q17. Top choice</u>	<u>Number</u>	<u>Percent</u>
Youth learn to swim programs	17	5.2 %
Adult learn to swim programs	4	1.2 %
Water fitness programs	14	4.3 %
Tennis lessons & leagues	8	2.4 %
Pickleball lessons & leagues	27	8.3 %
Preschool programs	8	2.4 %
Before school programs	1	0.3 %
After school programs	3	0.9 %
School break camps (fall/spring/summer)	13	4.0 %
Youth athletic programs & leagues	20	6.1 %
Youth fitness & wellness programs	5	1.5 %
Adult fitness & wellness programs	33	10.1 %
Programs for teens	11	3.4 %
Programs for seniors	22	6.7 %
Youth art/dance/performing arts	9	2.8 %
Adult art/dance/performing arts	6	1.8 %
Adult organized athletic programs & leagues	8	2.4 %
Programs for people with disabilities or special needs	4	1.2 %
Special events (i.e., concerts, movies, history programs, & cultural events)	21	6.4 %
Water-based recreation programs (e.g., sailing, kayaking, etc.)	7	2.1 %
Athletic special events (i.e., cross-country or running races)	2	0.6 %
Nature programs/environmental education	8	2.4 %
Dog park programs	8	2.4 %
Science/technology programs (kids outdoor science programs/ computer classes, etc.)	2	0.6 %
<u>None chosen</u>	<u>66</u>	<u>20.2 %</u>
Total	327	100.0 %

Q17. Which FOUR of the programs or activities listed in Question 16 do you think are MOST IMPORTANT to you and the members of your household?

Q17. 2nd choice	Number	Percent
Youth learn to swim programs	8	2.4 %
Adult learn to swim programs	4	1.2 %
Water fitness programs	6	1.8 %
Tennis lessons & leagues	5	1.5 %
Pickleball lessons & leagues	9	2.8 %
Preschool programs	5	1.5 %
Before school programs	4	1.2 %
After school programs	9	2.8 %
School break camps (fall/spring/summer)	9	2.8 %
Youth athletic programs & leagues	15	4.6 %
Youth fitness & wellness programs	8	2.4 %
Adult fitness & wellness programs	30	9.2 %
Programs for teens	10	3.1 %
Programs for seniors	19	5.8 %
Youth art/dance/performing arts	6	1.8 %
Adult art/dance/performing arts	17	5.2 %
Adult organized athletic programs & leagues	8	2.4 %
Programs for people with disabilities or special needs	9	2.8 %
Special events (i.e., concerts, movies, history programs, & cultural events)	28	8.6 %
Water-based recreation programs (e.g., sailing, kayaking, etc.)	10	3.1 %
Athletic special events (i.e., cross-country or running races)	7	2.1 %
Nature programs/environmental education	11	3.4 %
Dog park programs	7	2.1 %
Science/technology programs (kids outdoor science programs/ computer classes, etc.)	4	1.2 %
None chosen	79	24.2 %
Total	327	100.0 %

Q17. Which FOUR of the programs or activities listed in Question 16 do you think are MOST IMPORTANT to you and the members of your household?

Q17. 3rd choice	Number	Percent
Youth learn to swim programs	4	1.2 %
Adult learn to swim programs	1	0.3 %
Water fitness programs	3	0.9 %
Tennis lessons & leagues	3	0.9 %
Pickleball lessons & leagues	10	3.1 %
Preschool programs	2	0.6 %
Before school programs	1	0.3 %
After school programs	8	2.4 %
School break camps (fall/spring/summer)	10	3.1 %
Youth athletic programs & leagues	6	1.8 %
Youth fitness & wellness programs	6	1.8 %
Adult fitness & wellness programs	23	7.0 %
Programs for teens	8	2.4 %
Programs for seniors	10	3.1 %
Youth art/dance/performing arts	9	2.8 %
Adult art/dance/performing arts	9	2.8 %
Adult organized athletic programs & leagues	11	3.4 %
Programs for people with disabilities or special needs	7	2.1 %
Special events (i.e., concerts, movies, history programs, & cultural events)	33	10.1 %
Water-based recreation programs (e.g., sailing, kayaking, etc.)	15	4.6 %
Athletic special events (i.e., cross-country or running races)	8	2.4 %
Nature programs/environmental education	21	6.4 %
Dog park programs	10	3.1 %
Science/technology programs (kids outdoor science programs/ computer classes, etc.)	9	2.8 %
None chosen	100	30.6 %
Total	327	100.0 %

Q17. Which FOUR of the programs or activities listed in Question 16 do you think are MOST IMPORTANT to you and the members of your household?

<u>Q17. 4th choice</u>	<u>Number</u>	<u>Percent</u>
Youth learn to swim programs	4	1.2 %
Adult learn to swim programs	2	0.6 %
Water fitness programs	3	0.9 %
Tennis lessons & leagues	3	0.9 %
Pickleball lessons & leagues	6	1.8 %
Preschool programs	5	1.5 %
Before school programs	1	0.3 %
After school programs	3	0.9 %
School break camps (fall/spring/summer)	9	2.8 %
Youth athletic programs & leagues	9	2.8 %
Youth fitness & wellness programs	6	1.8 %
Adult fitness & wellness programs	9	2.8 %
Programs for teens	8	2.4 %
Programs for seniors	6	1.8 %
Youth art/dance/performing arts	5	1.5 %
Adult art/dance/performing arts	4	1.2 %
Adult organized athletic programs & leagues	16	4.9 %
Programs for people with disabilities or special needs	2	0.6 %
Special events (i.e., concerts, movies, history programs, & cultural events)	27	8.3 %
Water-based recreation programs (e.g., sailing, kayaking, etc.)	15	4.6 %
Athletic special events (i.e., cross-country or running races)	7	2.1 %
Nature programs/environmental education	20	6.1 %
Dog park programs	12	3.7 %
Science/technology programs (kids outdoor science programs/ computer classes, etc.)	15	4.6 %
<u>None chosen</u>	<u>130</u>	<u>39.8 %</u>
Total	327	100.0 %

SUM OF TOP 4 CHOICES**Q17. Which FOUR of the programs or activities listed in Question 16 do you think are MOST IMPORTANT to you and the members of your household? (top 4)**

Q17. Sum of Top 4 Choices	Number	Percent
Youth learn to swim programs	33	10.1 %
Adult learn to swim programs	11	3.4 %
Water fitness programs	26	8.0 %
Tennis lessons & leagues	19	5.8 %
Pickleball lessons & leagues	52	15.9 %
Preschool programs	20	6.1 %
Before school programs	7	2.1 %
After school programs	23	7.0 %
School break camps (fall/spring/summer)	41	12.5 %
Youth athletic programs & leagues	50	15.3 %
Youth fitness & wellness programs	25	7.6 %
Adult fitness & wellness programs	95	29.1 %
Programs for teens	37	11.3 %
Programs for seniors	57	17.4 %
Youth art/dance/performing arts	29	8.9 %
Adult art/dance/performing arts	36	11.0 %
Adult organized athletic programs & leagues	43	13.1 %
Programs for people with disabilities or special needs	22	6.7 %
Special events (i.e., concerts, movies, history programs, & cultural events)	109	33.3 %
Water-based recreation programs (e.g., sailing, kayaking, etc.)	47	14.4 %
Athletic special events (i.e., cross-country or running races)	24	7.3 %
Nature programs/environmental education	60	18.3 %
Dog park programs	37	11.3 %
Science/technology programs (kids outdoor science programs/ computer classes, etc.)	30	9.2 %
None chosen	66	20.2 %
Total	999	

Q18. If you had an additional \$100, how would you allocate the funds among the parks and recreation categories listed below?

	Mean
Develop new parks, open space, & facilities	18.09
Develop new trails & greenways	31.02
Expand recreation program & event offerings	20.33
Improvement or maintenance of existing parks, trails, & facilities	30.55

Q19. Please rate your satisfaction using a scale of 5 to 1, where 5 means "Very Satisfied" and 1 means "Very Dissatisfied," with the overall value your household receives from the City of Clemson Parks and Recreation Department.

Q19. Your satisfaction with overall value your household receives from City Parks & Recreation

Department	Number	Percent
Very satisfied	106	32.4 %
Somewhat satisfied	128	39.1 %
Neutral	48	14.7 %
Somewhat dissatisfied	17	5.2 %
Very dissatisfied	10	3.1 %
Don't know	18	5.5 %
Total	327	100.0 %

WITHOUT DON'T KNOW

Q19. Please rate your satisfaction using a scale of 5 to 1, where 5 means "Very Satisfied" and 1 means "Very Dissatisfied," with the overall value your household receives from the City of Clemson Parks and Recreation Department. (without "don't know")

Q19. Your satisfaction with overall value your household receives from City Parks & Recreation

Department	Number	Percent
Very satisfied	106	34.3 %
Somewhat satisfied	128	41.4 %
Neutral	48	15.5 %
Somewhat dissatisfied	17	5.5 %
Very dissatisfied	10	3.2 %
Total	309	100.0 %

Q20. Are you currently enrolled as a Clemson University student?

Q20. Are you currently enrolled as a Clemson University student	Number	Percent
Yes	7	2.1 %
No	316	96.6 %
Not provided	4	1.2 %
Total	327	100.0 %

WITHOUT NOT PROVIDED**Q20. Are you currently enrolled as a Clemson University student? (without "not provided")**

Q20. Are you currently enrolled as a Clemson University student	Number	Percent
Yes	7	2.2 %
No	316	97.8 %
Total	323	100.0 %

Q21. What is your age?

Q21. Your age	Number	Percent
18-34	57	17.4 %
35-44	62	19.0 %
45-54	62	19.0 %
55-64	66	20.2 %
65+	72	22.0 %
Not provided	8	2.4 %
Total	327	100.0 %

WITHOUT NOT PROVIDED**Q21. What is your age? (without "not provided")**

Q21. Your age	Number	Percent
18-34	57	17.9 %
35-44	62	19.4 %
45-54	62	19.4 %
55-64	66	20.7 %
65+	72	22.6 %
Total	319	100.0 %

Q22. Your gender:

<u>Q22. Your gender</u>	<u>Number</u>	<u>Percent</u>
Male	157	48.0 %
Female	165	50.5 %
I prefer to self-identify	1	0.3 %
Not provided	4	1.2 %
Total	327	100.0 %

WITHOUT NOT PROVIDED**Q22. Your gender: (without "not provided")**

<u>Q22. Your gender</u>	<u>Number</u>	<u>Percent</u>
Male	157	48.6 %
Female	165	51.1 %
I prefer to self-identify	1	0.3 %
Total	323	100.0 %

Q22-3. Self-describe your gender:

<u>Q22-3. Self-describe your gender</u>	<u>Number</u>	<u>Percent</u>
Non-binary	1	100.0 %
Total	1	100.0 %

Q23. How many years have you lived in the City of Clemson?

Q23. How many years have you lived in City of Clemson	Number	Percent
0-5	79	24.2 %
6-10	40	12.2 %
11-15	24	7.3 %
16-20	35	10.7 %
21-30	42	12.8 %
31+	88	26.9 %
Not provided	19	5.8 %
Total	327	100.0 %

WITHOUT NOT PROVIDED**Q23. How many years have you lived in the City of Clemson? (without "not provided")**

Q23. How many years have you lived in City of Clemson	Number	Percent
0-5	79	25.6 %
6-10	40	13.0 %
11-15	24	7.8 %
16-20	35	11.4 %
21-30	42	13.6 %
31+	88	28.6 %
Total	308	100.0 %

Q24. Which of the following best describes your race/ethnicity?

Q24. Your race/ethnicity	Number	Percent
Asian or Asian Indian	6	1.8 %
Black or African American	10	3.1 %
American Indian or Alaska Native	1	0.3 %
White or Caucasian	288	88.1 %
Native Hawaiian or other Pacific Islander	1	0.3 %
Hispanic, Spanish, or Latino/a/x	9	2.8 %
Other	5	1.5 %
Total	320	

Q24-7. Self-describe your race/ethnicity:

Q24-7. Self-describe your race/ethnicity	Number	Percent
Mixed	1	50.0 %
Native American	1	50.0 %
Total	2	100.0 %

Q25. Would you say your total annual household income is...

Q25. Your total annual household income	Number	Percent
Under \$30K	38	11.6 %
\$30K to \$49,999	33	10.1 %
\$50K to \$69,999	39	11.9 %
\$70K to \$89,999	34	10.4 %
\$90K to \$119,999	48	14.7 %
\$120K to \$174,999	34	10.4 %
\$175K+	39	11.9 %
Not provided	62	19.0 %
Total	327	100.0 %

WITHOUT NOT PROVIDED**Q25. Would you say your total annual household income is... (without "not provided")**

Q25. Your total annual household income	Number	Percent
Under \$30K	38	14.3 %
\$30K to \$49,999	33	12.5 %
\$50K to \$69,999	39	14.7 %
\$70K to \$89,999	34	12.8 %
\$90K to \$119,999	48	18.1 %
\$120K to \$174,999	34	12.8 %
\$175K+	39	14.7 %
Total	265	100.0 %



Open-Ended Responses

Open-Ended Question Responses

Q3a—"What is the name (or nearest cross streets) of the closest park that is within a 10-minute walk of your home?"

- Abernathy Waterfront Park **(x14 Responses)**
- Ashley Dearing **(x63 Responses)**
- Ashley dearing. but can't actually walk there with the road conditions. Old Stone Park is close, again can't walk due to busy roads
- Berkeley **(x14 Responses)**
- Catherine Smith Plaza **(x8 Responses)**
- Central-Clemson Recreation Center
- Central-Clemson Recreation Center
- Clemson Park **(x15 Responses)**
- Dawson Park **(x9 Responses)**
- Earl Anderson Park **(x13 Responses)**
- Edgewood Ave
- Folger and Dogwood
- Frontage Road
- Gateway Park **(x12 Responses)**
- Hill Pine Ct
- Issaquena Trail **(x5 Responses)**
- Jaycee Park **(x9 Responses)**
- Lancelot Dr
- Mountain View Park **(x7 Responses)**
- N. Clemson Ave.
- Near Clemson Elementary
- Nettles Park **(x19 Responses)**
- Old Stone Church Rd
- Old Stone Church Rd
- Old Stone Church Rd
- Rock Creek
- Rock Creek
- Rotary Park
- Rotary Park
- Shanklin-Sams Green Space **(x10 Responses)**
- Squire Circle and Lancelot
- Tottie's Place **(x7 Responses)**
- Twelve Mile Recreation area
- Twelve Mile Recreation area
- Vineyard Rd
- Vineyard Rd
- The ones off of College Ave.

Q6—"Which of the following reasons prevent you or other members of your household from using recreation programs offered by the City? If you currently use them, what prevents you from using them more often?"

- Cancer treatment
- child care not offered
- Child has aged out of most programs we used to participate in (non sports) and sports programs he now participates for his school
- Do not take our Medicare Ins
- Dog park at Nettles
- Don't know where they all are
- Health issues.
- I enjoy the park w/o need for programs
- I enjoying walking to events but Clemson still needs to improve on being walkable
- I keep our grandson in Anderson several days a week and am not in town during the day.
- I run through your parks and the Green Crescent Trail almost every weekend and am grateful for them, but I don't use the programs a lot.
- I work

- I would need childcare.
- I'm a walker
- Interested in other things.
- Involved in recreation programs in Greenville
- Lack of programs during Covid
- lack of time
- New to area - not familiar with what's available.
- No crosswalk at Issaquena and Berkley Dr.
- No open gyms for girls sports.
- No small children/infant programs..
- Not clean and do not like instructor in water aerobics at Rec Center.
- Not here full time
- Not lots of info about it.
- not relevant for us
- Our kid is too little to participate in the programs.
- Own a rental.
- Pool use only
- Teams get stacked by coaches.
- Teenagers hard to please.
- the high school swimmers
- Used Clemson recreation very often when my children were young. Programming was wonderful at that time. I am not sure what is offered for seniors, and retired persons.
- used to play tennis at NP a lot, but now play at Cardinal Club in Anderson since I work in Anderson
- Work
- YMCA

Q11—"How do you currently learn about the programs and services that are offered by the City of Clemson?"

- | | |
|--|--|
| • City mail booklet quarterly | • Clemson Connection |
| • city monthly book | • Clemson Connection |
| • City newsletter | • Clemson Magazine sent to my home. |
| • City newsletter | • Magazine of mayor |
| • City of Clemson newsletter/info brochure | • Notices on garbage cans. |
| • Clemson Connection | • Quarterly community mailings. |
| • Clemson Connection | • Trash can notices. |
| • Clemson Connection | • Web |
| • Clemson Connection | • Word of mouth album all the above also |

Q14—"Other": . Please indicate how well your needs for each facility or amenity.

- Adult leagues/intramurals such as pickle ball or kickball. Clemson P&R has activities for seniors and kids, but very little for young adults/adults
- Badminton classes/league for adults
- Bicycle trail
- Bike paths city wide.
- Community outdoor pool
- Dedicated pickleball courts.
- Outdoor community swimming pool
- Outdoor Olympic pool
- Outdoor pool
- Outdoor pool
- Outdoor pool
- Outdoor pool heated and covered in cold weather.
- rowing facility
- volleyball
- We need a better community pool
- With the beautiful lakes we need more access to them, even without a boat. The walking path along Larry Abernathy need improved - cleaned, maintained, cleared out and garbage removed more often. Picnic areas at 12 mile also need mulch or rocks instead of dirt. The area near the water needs more sand - not the big beach.
- Would like a greater option for indoor fitness classes at Central/Clemson rec during the day for younger (non-senior) people e.g. Zumba, Cardio etc.

8 Survey Instrument



October 2023

Dear Resident,

The City of Clemson Parks & Recreation Department needs your help!!!

We are starting the process of renewing our Parks Master Plan through Zec Eight Insights, LLC. The last Parks Master Plan was completed in 2012, so it is very important for us to get your input this time around.

The results of this survey will help to develop an essential document to establish priorities for future improvements of facilities and services in the City of Clemson park system.

The survey may take around 15 minutes or more to complete, but each question is very important. The time that you invest in completing this survey will help us to improve and develop the services and programs that you and your family desire and need the most.

We are eager for you to return your completed survey, using the enclosed postage-paid envelope or online at ClemsonParkSurvey.org. This survey is not going out to everyone, so please consider this as your unique opportunity to have an impact on the future of the City of Clemson Parks and Recreation Department.

ETC Institute, an independent, national research firm, will receive, compile and analyze the data received. Individual responses are kept confidential and will not be released to the City of Clemson.

Thank you for your participation in this important survey. If you have any questions, you are welcome to contact me at jbennett@cityofclemson.org or (864) 624-1122.

Sincerely,

A handwritten signature in black ink, appearing to read "Jay Bennett".

Jay Bennett

Clemson Parks and Recreation Director

2023 City of Clemson Community Needs Assessment Survey

The City of Clemson Parks and Recreation Department would like your input to help determine recreation priorities for the City. This survey will take 12-15 minutes to complete. When you are finished, please return your survey in the enclosed postage-paid, return-reply envelope. You may also complete this survey online at ClemsonParkSurvey.org. We greatly appreciate your time.

1. Please complete this survey with all household members in mind. Counting yourself, how many people in your household are...

Under age 5: ____ Ages 15-19: ____ Ages 35-44: ____ Ages 65-79: ____
 Ages 5-9: ____ Ages 20-24: ____ Ages 45-54: ____ Ages 80+: ____
 Ages 10-14: ____ Ages 25-34: ____ Ages 55-64: ____

2. Have you or members of your household visited any of the City of Clemson parks or recreation facilities during the past 12 months?

____(1) Yes [Answer Q2a-2b.] ____ (2) No [Go to Question Q3.]

2a. Overall, how would you rate the physical condition of the City of Clemson parks you have visited?

____(4) Excellent ____ (3) Good ____ (2) Fair ____ (1) Poor

2b. In the last 12 months, how often have you used the following parks and recreation facilities provided by the City of Clemson Parks and Recreation Department?

Facility Use	Frequently (once a week or more)	Sometimes (1-2 times a month)	Rarely (less than 5 times a year)	Never	Did Not Know Existed
01. Ashley Dearing Park or Tottie's Place	4	3	2	1	9
02. Catherine Smith Plaza	4	3	2	1	9
03. Central-Clemson Recreation Center	4	3	2	1	9
04. Clemson Park & Community Garden	4	3	2	1	9
05. Dawson Park	4	3	2	1	9
06. Earle Anderson Park	4	3	2	1	9
07. Gateway Park	4	3	2	1	9
08. Jaycee Park	4	3	2	1	9
09. Larry W. Abernathy Waterfront Park	4	3	2	1	9
10. Mountain View Park	4	3	2	1	9
11. Rotary Park	4	3	2	1	9
12. Shanklin-Sams Greenspace	4	3	2	1	9
13. Twelve Mile Recreation Area	4	3	2	1	9
14. W.C. Nettles Park	4	3	2	1	9

3. Do you live within a 10-minute walk from a park?

____(1) Yes [Answer Q3a.] ____ (2) No [Answer Q3b.]

3a. What is the name (or nearest cross streets) of the closest park that is within a 10-minute walk of your home?

3b. Approximately how long would it take for you to walk to the nearest park from your home?

____(1) 11-15 minutes ____ (2) 16-20 minutes ____ (3) 21-25 minutes ____ (4) 26 minutes or more

4. Do you have a pedestrian route (trails, sidewalks) to safely access the closest park from your home?

____(1) Yes ____ (2) Yes, but needs improvement ____ (3) No

5. Have you or other members of your household participated in any recreation programs offered by the City of Clemson Parks and Recreation Department during the past 12 months?

____(1) Yes [Answer Q5a-b.] ____ (2) No [Go to Question Q6.]

5a. Approximately how many different recreation programs offered by the City of Clemson Parks and Recreation Department have you or members of your household participated in over the past 12 months?

____(1) 1 to 3 programs ____ (3) 7 to 9 programs
____(2) 4 to 6 programs ____ (4) 10 or more programs

5b. Overall, how would you rate the quality of the City of Clemson Parks and Recreation Department programs you participated in?

____(4) Excellent ____ (3) Good ____ (2) Fair ____ (1) Poor

6. Which of the following reasons prevent you or other members of your household from using recreation programs offered by the City? If you currently use them, what prevents you from using them more often? [Check ALL that apply.]

- | | |
|--|---|
| ____(01) Not enough parking | ____(11) Use facilities of other cities/private Institutions and Non-City Programming |
| ____(02) Facilities too crowded | ____(12) Use facilities offered by Clemson University |
| ____(03) What I want to do is not offered | ____(13) Don't know what's offered/available |
| ____(04) Insufficient staffing | ____(14) Poor accessibility for persons with disabilities |
| ____(05) Too far from my home | ____(15) Not interested/too busy |
| ____(06) Don't feel safe | ____(16) Lack of transportation - I cannot get there |
| ____(07) Cost/Fees too high | ____(17) Other: _____ |
| ____(08) Lack of quality programs | ____(18) Nothing |
| ____(09) Poor customer service | |
| ____(10) Program times/facility hours not convenient | |

7. Please rate your satisfaction on a scale of 5 to 1, where 5 means "Very Satisfied" and 1 means "Very Dissatisfied," with the following recreation, parks, and cultural services provided by the City of Clemson Parks and Recreation Department.

How satisfied are you with...	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied	Don't Know / Not Applicable
01. Overall value your household receives for taxes paid	5	4	3	2	1	9
02. Maintenance of parks	5	4	3	2	1	9
03. Maintenance of trails	5	4	3	2	1	9
04. Number of parks in the city	5	4	3	2	1	9
05. Variety of different types of parks in the city	5	4	3	2	1	9
06. Security in city parks	5	4	3	2	1	9
07. Security on city trails	5	4	3	2	1	9
08. Availability of information about programs/facilities	5	4	3	2	1	9
09. Quality of programs for families with children	5	4	3	2	1	9
10. Quality of programs for adults	5	4	3	2	1	9
11. User friendliness of city website	5	4	3	2	1	9
12. Variety of programs offered by the city	5	4	3	2	1	9
13. Ease of registering for classes offered by the city	5	4	3	2	1	9
14. Ease of renting/reserving a city facility	5	4	3	2	1	9
15. Fees charged for city recreation programs	5	4	3	2	1	9
16. Program schedule (time/day)	5	4	3	2	1	9
17. How close parks are located to your home	5	4	3	2	1	9

8. Which THREE of the items from the list in Question 7 should receive the MOST EMPHASIS over the next five years? [Write in your answers below using the numbers from the list in Question 7, or circle "NONE."]

1st: ____ 2nd: ____ 3rd: ____ NONE

9. The following are some of the benefits that you and your household may receive from **PARKS, TRAILS, RECREATION FACILITIES, PROGRAMS AND SERVICES OF CLEMSON**. Please rate your agreement with each item on a scale of 5 to 1, where 5 means "Strongly Agree" and 1 means "Strongly Disagree."

Benefits	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Don't Know
01. Improves physical health and fitness	5	4	3	2	1	9
02. Helps reduce neighborhood crime	5	4	3	2	1	9
03. Makes the city a more desirable place to live	5	4	3	2	1	9
04. Preserves open space and the environment	5	4	3	2	1	9
05. Increases property values in surrounding area	5	4	3	2	1	9
06. Improves mental health and reduces stress	5	4	3	2	1	9
07. Increases opportunities for different cultures to interact	5	4	3	2	1	9
08. Helps attract new residents and businesses	5	4	3	2	1	9
09. Promotes tourism to the city	5	4	3	2	1	9
10. Provides opportunities to pursue leisure interests	5	4	3	2	1	9
11. Helps with flood control and cleans our water and air	5	4	3	2	1	9
12. Protects and restores natural habitats	5	4	3	2	1	9
13. Provides outdoor recreation	5	4	3	2	1	9
14. Provides indoor recreation	5	4	3	2	1	9

10. Which **THREE** of the benefits listed above are **MOST IMPORTANT** to you and members of your household? *[Write in your answers below using the numbers from the list in Question 9, or circle "NONE."]*

1st: _____ 2nd: _____ 3rd: _____ NONE

11. How do you currently learn about the programs and services that are offered by the City of Clemson? *[Check ALL that apply.]*

____ (01) Newspaper
 ____ (02) City or Department website
 ____ (03) Internet
 ____ (04) Email blasts/newsletters
 ____ (05) Program fliers/registration forms
 ____ (06) From friends and neighbors
 ____ (07) Social media (Facebook, Twitter, etc.)
 ____ (08) Recreation brochure/program guide
 ____ (09) Conversations with city staff
 ____ (10) Neighborhood/civic newsletters
 ____ (11) Recreation center bulletin boards
 ____ (12) Schools
 ____ (13) Other: _____

12. Which **TWO** of the sources of information do you **MOST PREFER** to use to get information about city programs and services? *[Write in your answers below using the numbers from the list in Question 11, or circle "NONE."]*

1st: _____ 2nd: _____ NONE

13. Please **CHECK ALL** the ways you typically travel to the parks and recreation areas that you use. *[Check ALL that apply.]*

____ (1) Personal vehicle (car, truck, van, SUV, motorcycle)
 ____ (2) Bike
 ____ (3) Walk
 ____ (4) Bus
 ____ (5) Dockless scooter or bikeshare
 ____ (6) Taxi or carshare (Uber, Lyft)
 ____ (7) Other: _____
 ____ (8) None, I do not visit parks or recreation areas

- 14. A variety of recreation facilities and amenities are listed below that are already offered in the community or may be offered in the future. Please indicate how well your needs for each facility or amenity are met on a scale of 4 to 1, where 4 means your needs are "Fully Met" and 1 means your needs are "Not Met" at all. If you do not have a need for one of the items listed, please circle "9" for "No Need."**

Facilities and Amenities		Fully Met	Mostly Met	Partly Met	Not Met	No Need
01.	Neighborhood parks (smaller parks within a 10 minute walking distance of your home)	4	3	2	1	9
02.	Large community parks (regional attractions that draw in users from the area)	4	3	2	1	9
03.	Natural areas/conservation areas (mostly naturally wooded, wetlands areas, or open areas without lawn areas that are left natural with little to no maintenance)	4	3	2	1	9
04.	Open green space (lawn areas that are regularly maintained for passive recreation)	4	3	2	1	9
05.	Picnic areas and park shelters	4	3	2	1	9
06.	Outdoor public art	4	3	2	1	9
07.	Playground areas	4	3	2	1	9
08.	Fishing areas	4	3	2	1	9
09.	Paved connectivity trails for bikes and pedestrians (greenways)	4	3	2	1	9
10.	Unpaved hiking trails within parks	4	3	2	1	9
11.	Paved walking trails within parks	4	3	2	1	9
12.	Off-leash dog parks	4	3	2	1	9
13.	Diamond sports fields (e.g., baseball, softball)	4	3	2	1	9
14.	Rectangular sports fields (e.g., soccer, lacrosse, etc.)	4	3	2	1	9
15.	Outdoor basketball courts	4	3	2	1	9
16.	Outdoor tennis courts	4	3	2	1	9
17.	Pickleball courts	4	3	2	1	9
18.	Extreme sports (i.e., skate parks/pump tracks)	4	3	2	1	9
19.	Splash pads/interactive water play or features	4	3	2	1	9
20.	Community recreation building/space	4	3	2	1	9
21.	Indoor sports courts or other indoor sporting practice facilities	4	3	2	1	9
22.	Indoor fitness and wellness spaces	4	3	2	1	9
23.	Indoor pool space	4	3	2	1	9
24.	Esports/gaming space	4	3	2	1	9
25.	Senior indoor and outdoor activity areas	4	3	2	1	9
26.	Teen indoor and outdoor activity areas	4	3	2	1	9
27.	Community gardens	4	3	2	1	9
28.	ADA accessible/inclusive play features and park structures	4	3	2	1	9
29.	Disc golf courses	4	3	2	1	9
30.	Motorized boat launches	4	3	2	1	9
31.	Non-motorized boat launches	4	3	2	1	9
32.	Outdoor fitness equipment	4	3	2	1	9
33.	Water access	4	3	2	1	9
34.	Other (explain): _____	4	3	2	1	9

- 15. Which FOUR of the facilities and amenities listed above do you think are MOST IMPORTANT to you and the members of your household? [Write in your answers below using the numbers from the list in Question 14. If you don't believe any of these are important, circle "NONE."]**

1st: _____ 2nd: _____ 3rd: _____ 4th: _____ NONE

16. A variety of recreation programs and activities are listed below that are already offered in the community or may be offered in the future. Please indicate how well your needs for each program or activity are met on a scale of 4 to 1, where 4 means your needs are "Fully Met" and 1 means your needs are "Not Met" at all. If you do not have a need for one of the items listed, please circle "9" for "No Need."

Programs and Activities	Fully Met	Mostly Met	Partly Met	Not Met	No Need
01. Youth learn to swim programs	4	3	2	1	9
02. Adult learn to swim programs	4	3	2	1	9
03. Water fitness programs	4	3	2	1	9
04. Tennis lessons and leagues	4	3	2	1	9
05. Pickleball lessons and leagues	4	3	2	1	9
06. Preschool programs	4	3	2	1	9
07. Before school programs	4	3	2	1	9
08. After school programs	4	3	2	1	9
09. School break camps (fall/spring/summer)	4	3	2	1	9
10. Youth athletic programs and leagues	4	3	2	1	9
11. Youth fitness and wellness programs	4	3	2	1	9
12. Adult fitness and wellness programs	4	3	2	1	9
13. Programs for teens	4	3	2	1	9
14. Programs for seniors	4	3	2	1	9
15. Youth art/dance/performing arts	4	3	2	1	9
16. Adult art/dance/performing arts	4	3	2	1	9
17. Adult organized athletic programs and leagues	4	3	2	1	9
18. Programs for people with disabilities or special needs	4	3	2	1	9
19. Special events (i.e., concerts, movies, history programs, and cultural events)	4	3	2	1	9
20. Water-based recreation programs (e.g., sailing, kayaking, etc.)	4	3	2	1	9
21. Athletic special events (i.e., cross-country or running races)	4	3	2	1	9
22. Nature programs/environmental education	4	3	2	1	9
23. Dog park programs	4	3	2	1	9
24. Science/technology programs (kids outdoor science programs/computer classes, etc.)	4	3	2	1	9
25. Other (explain):	4	3	2	1	9

17. Which **FOUR** of the programs or activities listed above do you think are **MOST IMPORTANT** to you and the members of your household? [Write in your answers below using the numbers from the list in Question 16. If you don't believe any of these are important, circle "NONE."]

1st: ____ 2nd: ____ 3rd: ____ 4th: ____ NONE

18. If you had an additional \$100, how would you allocate the funds among the parks and recreation categories listed below? [Please be sure your total adds up to \$100.]

\$_____ Develop new parks, open space, and facilities

\$_____ Develop new trails and greenways

\$_____ Expand recreation program and event offerings

\$_____ Improvement or maintenance of existing parks, trails, and facilities

\$100 TOTAL

19. Please rate your satisfaction using a scale of 5 to 1, where 5 means "Very Satisfied" and 1 means "Very Dissatisfied," with the overall value your household receives from the City of Clemson Parks and Recreation Department.

____(5) Very satisfied

____(3) Neutral

____(1) Very dissatisfied

____(4) Somewhat satisfied

____(2) Somewhat dissatisfied

____(9) Don't know

Demographics

*Our final questions are about you and the members of your household.
Your individual responses will remain anonymous.*

20. Are you currently enrolled as a Clemson University student? ____ (1) Yes ____ (2) No
21. What is your age? ____ years
22. Your gender: ____ (1) Male ____ (2) Female ____ (3) I prefer to self-identify: _____
23. How many years have you lived in the City of Clemson? ____ years
24. Which of the following best describes your race/ethnicity? *[Check all that apply.]*
 ____ (01) Asian or Asian Indian ____ (05) Native Hawaiian or other Pacific Islander
 ____ (02) Black or African American ____ (06) Hispanic, Spanish, or Latino/a/x
 ____ (03) American Indian or Alaska Native ____ (99) Other: _____
 ____ (04) White or Caucasian
25. Would you say your total annual household income is...
 ____ (1) Under \$30,000 ____ (4) \$70,000 to \$89,999 ____ (7) \$175,000 or more
 ____ (2) \$30,000 to \$49,999 ____ (5) \$90,000 to \$119,999
 ____ (3) \$50,000 to \$69,999 ____ (6) \$120,000 to \$174,999
26. Would you be willing to participate in future surveys sponsored by the City of Clemson?
 ____ (1) Yes *[Please answer Q26a.]* ____ (2) No
- 26a. Please provide your contact information.
- Mobile Phone Number: _____
- Email Address: _____

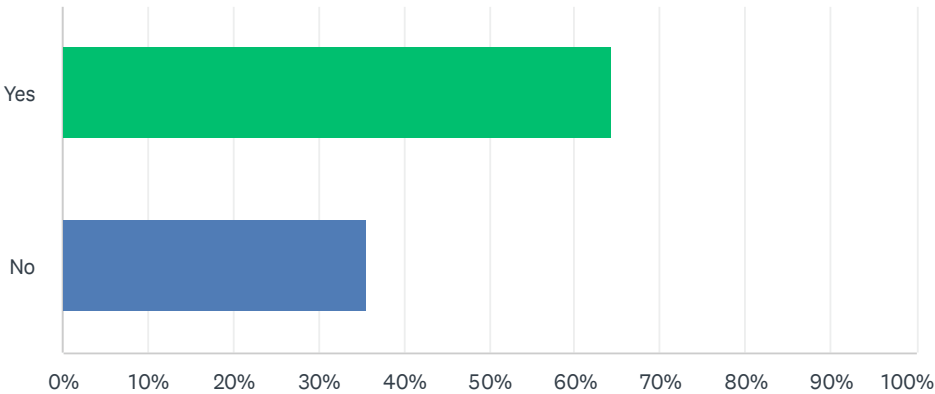
This concludes the survey. Thank you for your time!

Please return your completed survey in the enclosed return-reply envelope addressed to:
ETC Institute, 725 W. Frontier Circle, Olathe, KS 66061

Your response will remain completely confidential.
The address information printed to the right will
ONLY be used to help identify areas with special
interests. Thank you.

Q1 Are you a Clemson, SC resident?

Answered: 177 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	64.41%	114
No	35.59%	63
TOTAL		177

Q2 What is your 5-digit zipcode?

Answered: 63 Skipped: 114

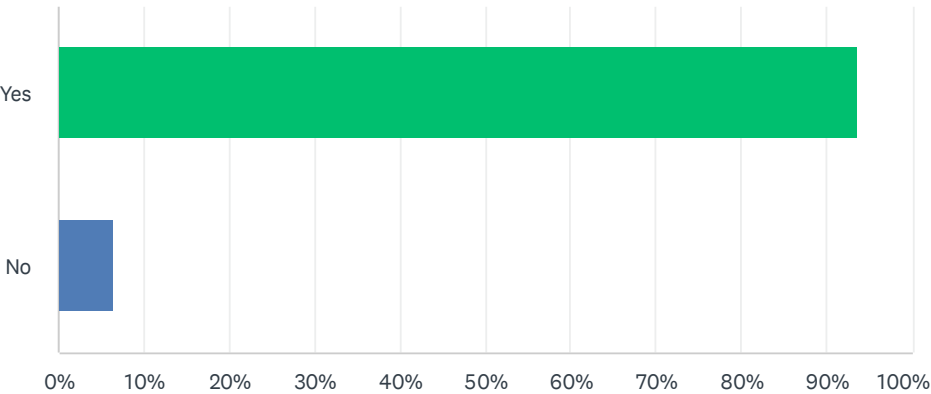
#	RESPONSES	DATE
1	29657	2/27/2024 1:54 PM
2	29630	2/26/2024 1:58 PM
3	29676	2/25/2024 10:24 AM
4	29657	2/22/2024 7:32 PM
5	29630	2/21/2024 5:25 PM
6	29676	2/21/2024 2:14 PM
7	29464	2/21/2024 12:18 PM
8	29670	2/21/2024 11:41 AM
9	29678	2/21/2024 11:34 AM
10	29630	2/21/2024 11:21 AM
11	29630	2/21/2024 11:15 AM
12	29640	2/21/2024 10:59 AM
13	29657	2/21/2024 10:22 AM
14	29323	2/21/2024 9:37 AM
15	29657	2/21/2024 8:25 AM
16	29682	2/21/2024 8:08 AM
17	296	2/21/2024 8:01 AM
18	29630	2/21/2024 7:55 AM
19	29672	2/21/2024 7:45 AM
20	29621	2/21/2024 5:57 AM
21	95118	2/20/2024 11:08 PM
22	29672	2/20/2024 9:04 PM
23	29672	2/20/2024 9:02 PM
24	29630	2/20/2024 8:47 PM
25	29672	2/20/2024 8:46 PM
26	29609	2/20/2024 8:40 PM
27	29630	2/20/2024 8:36 PM
28	29672	2/20/2024 3:59 PM
29	29630	2/20/2024 3:31 PM
30	29642	2/20/2024 12:15 PM
31	29672	2/20/2024 9:21 AM
32	29625	2/20/2024 9:18 AM
33	29678	2/20/2024 8:57 AM

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34	29676	2/20/2024 8:53 AM
35	29671	2/20/2024 8:47 AM
36	29676	2/20/2024 8:43 AM
37	29672	2/20/2024 8:41 AM
38	29678	2/20/2024 8:39 AM
39	29696	2/14/2024 9:29 PM
40	29630	2/14/2024 9:16 PM
41	29627	2/12/2024 10:05 AM
42	29670	2/10/2024 9:57 PM
43	29689	2/10/2024 6:54 PM
44	29630	1/31/2024 1:03 PM
45	29670	1/30/2024 11:14 AM
46	29682	1/28/2024 4:18 PM
47	29630	1/28/2024 7:39 AM
48	29621	1/27/2024 9:45 PM
49	29609	1/27/2024 10:01 AM
50	29670	1/27/2024 12:10 AM
51	29673	1/26/2024 10:43 PM
52	29630	1/26/2024 10:14 PM
53	29693	1/26/2024 10:00 PM
54	29682	1/26/2024 7:20 PM
55	29609	1/26/2024 4:57 PM
56	29630	1/26/2024 4:36 PM
57	29630	1/26/2024 3:01 PM
58	29630	1/26/2024 2:41 PM
59	29630	1/26/2024 2:12 PM
60	29630	1/26/2024 12:41 PM
61	29630	1/26/2024 12:18 PM
62	28625	1/26/2024 12:07 PM
63	29670	1/26/2024 12:02 PM

Q3 Have you or members of your household visited any of the City of Clemson parks or recreation facilities during the past 12 months?

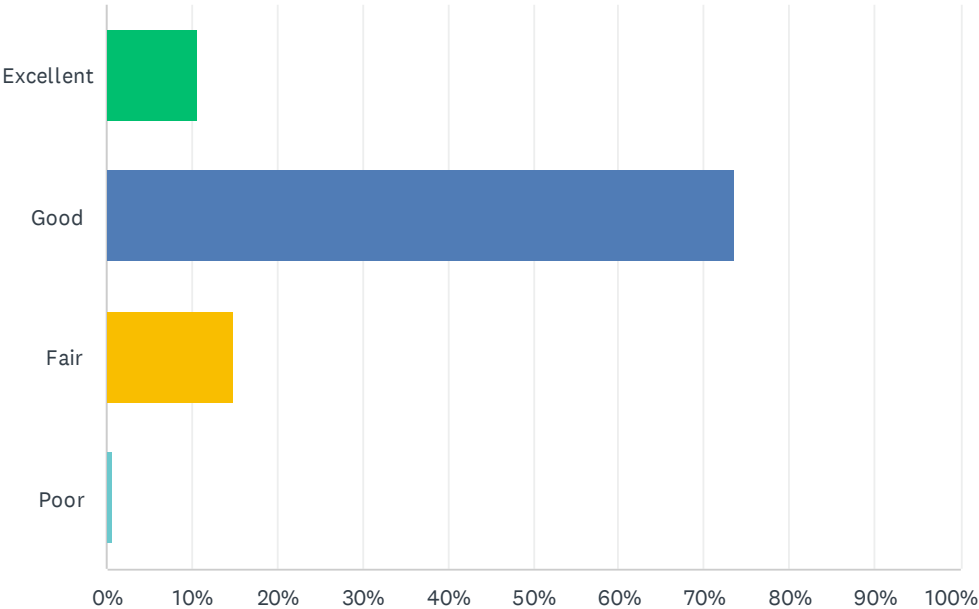
Answered: 173 Skipped: 4



ANSWER CHOICES	RESPONSES	
Yes	93.64%	162
No	6.36%	11
TOTAL		173

Q4 Overall, how would you rate the physical condition of the City of Clemson parks you have visited?

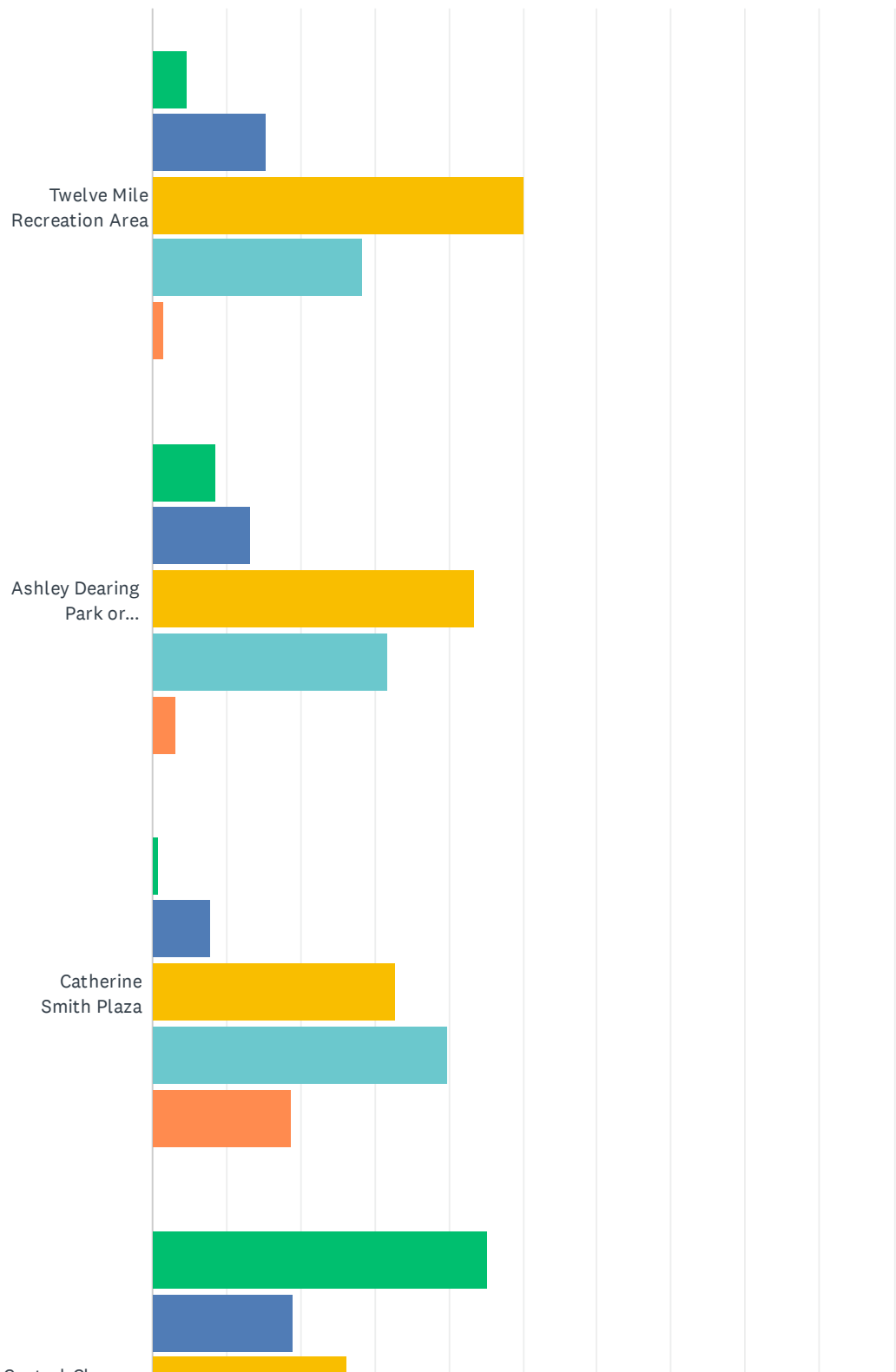
Answered: 140 Skipped: 37



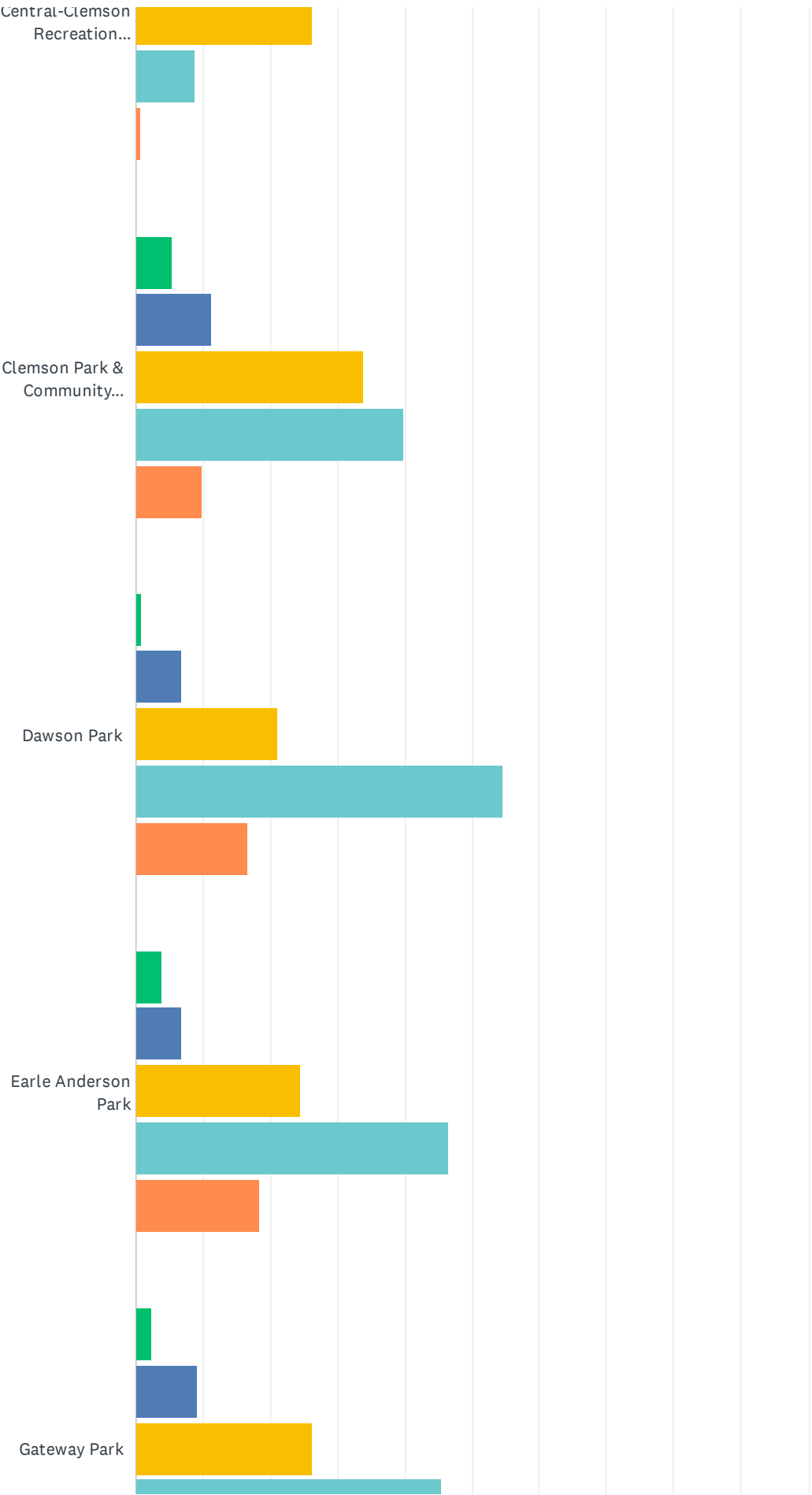
ANSWER CHOICES	RESPONSES	
Excellent	10.71%	15
Good	73.57%	103
Fair	15.00%	21
Poor	0.71%	1
TOTAL		140

Q5 In the last 12 months, how often have you used the following parks and recreation facilities provided by the City of Clemson Parks and Recreation Department?

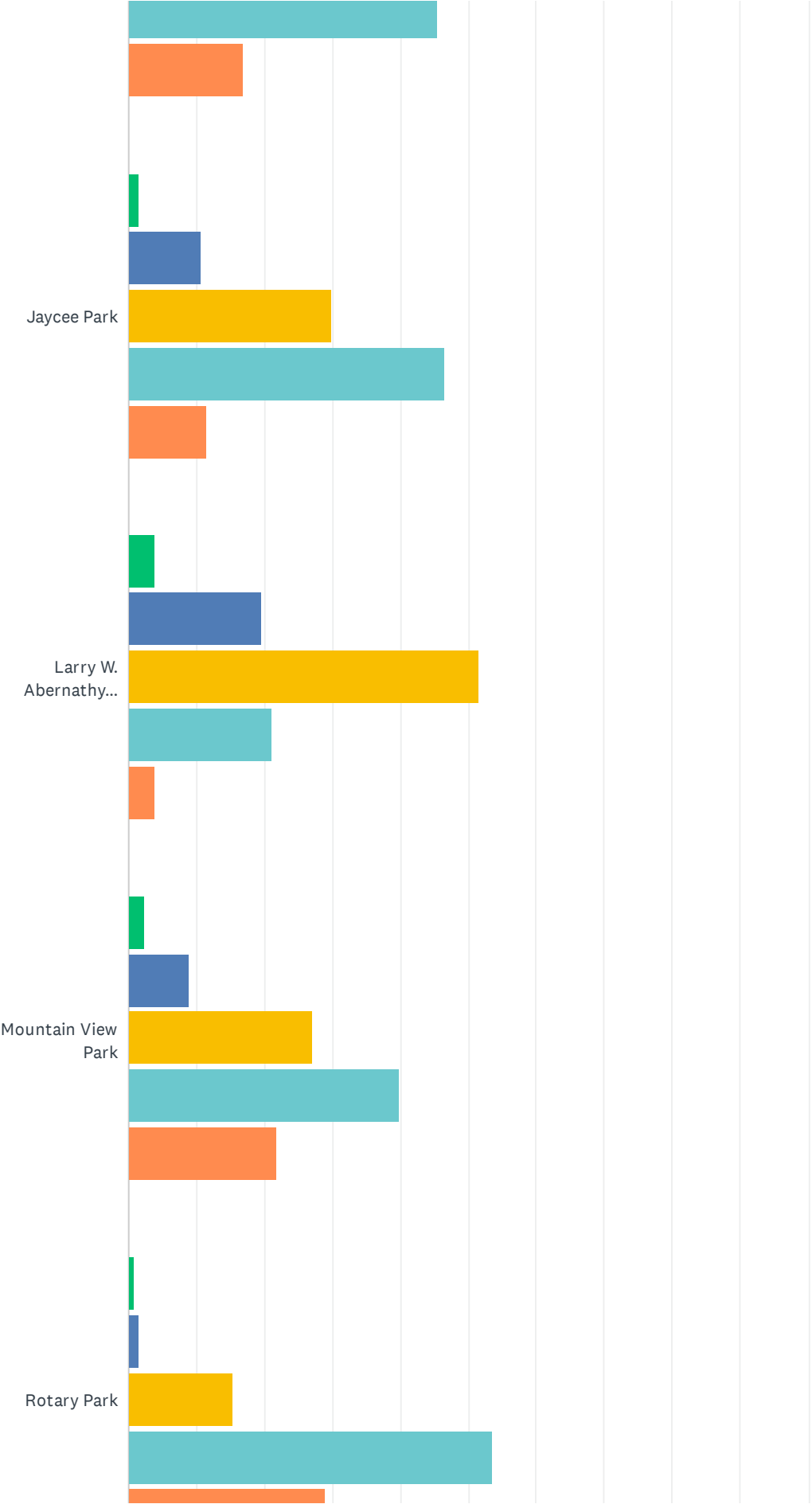
Answered: 140 Skipped: 37



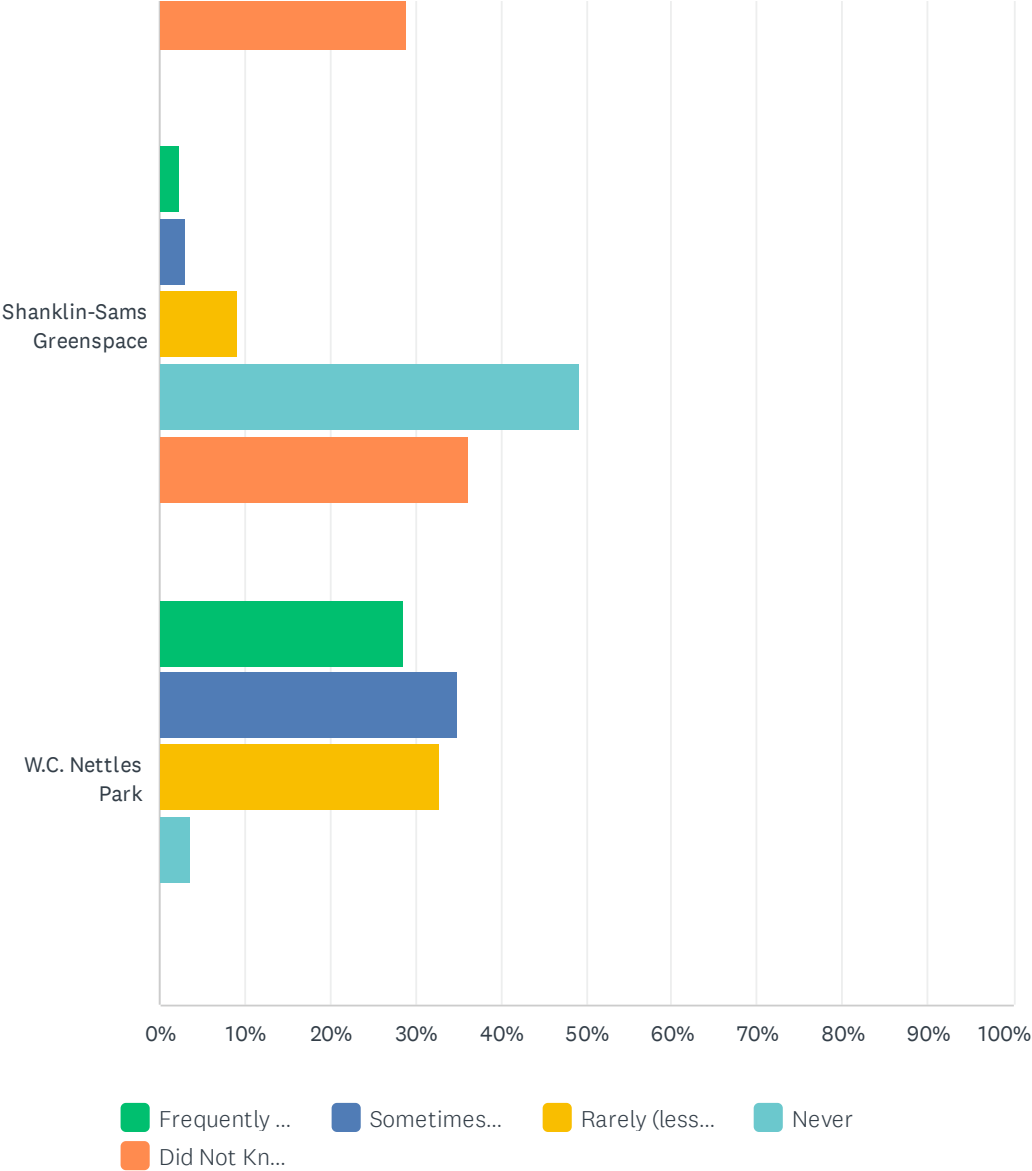
Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey



Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey



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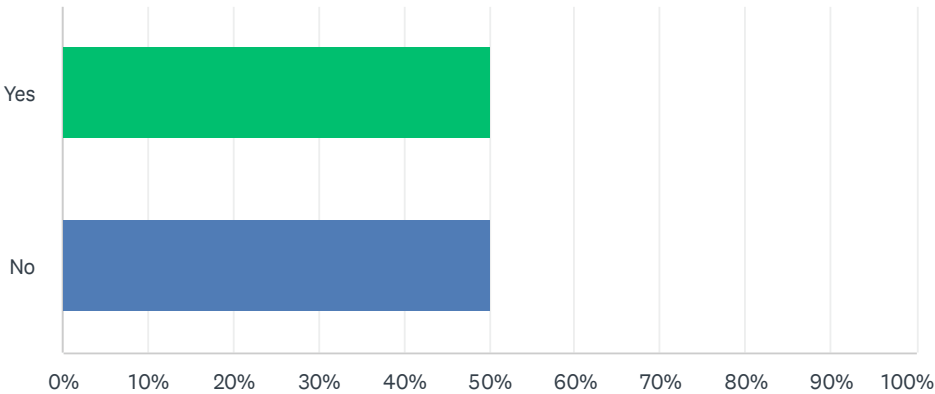


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	FREQUENTLY (ONCE A WEEK OR MORE)	SOMETIMES (1- 2 TIMES A MONTH)	RARELY (LESS THAN 5 TIMES A YEAR)	NEVER	DID NOT KNOW EXISTED	TOTAL	WEIGHTED AVERAGE
Twelve Mile Recreation Area	4.62% 6	15.38% 20	50.00% 65	28.46% 37	1.54% 2	130	2.93
Ashley Dearing Park or Tottie's Place	8.53% 11	13.18% 17	43.41% 56	31.78% 41	3.10% 4	129	2.92
Catherine Smith Plaza	0.78% 1	7.81% 10	32.81% 42	39.84% 51	18.75% 24	128	2.32
Central-Clemson Recreation Center	45.26% 62	18.98% 26	26.28% 36	8.76% 12	0.73% 1	137	3.99
Clemson Park & Community Garden	5.26% 7	11.28% 15	33.83% 45	39.85% 53	9.77% 13	133	2.62
Dawson Park	0.76% 1	6.82% 9	21.21% 28	54.55% 72	16.67% 22	132	2.20
Earle Anderson Park	3.82% 5	6.87% 9	24.43% 32	46.56% 61	18.32% 24	131	2.31
Gateway Park	2.31% 3	9.23% 12	26.15% 34	45.38% 59	16.92% 22	130	2.35
Jaycee Park	1.53% 2	10.69% 14	29.77% 39	46.56% 61	11.45% 15	131	2.44
Larry W. Abernathy Waterfront Park	3.79% 5	19.70% 26	51.52% 68	21.21% 28	3.79% 5	132	2.98
Mountain View Park	2.26% 3	9.02% 12	27.07% 36	39.85% 53	21.80% 29	133	2.30
Rotary Park	0.76% 1	1.53% 2	15.27% 20	53.44% 70	29.01% 38	131	1.92
Shanklin-Sams Greenspace	2.31% 3	3.08% 4	9.23% 12	49.23% 64	36.15% 47	130	1.86
W.C. Nettles Park	28.47% 39	35.04% 48	32.85% 45	3.65% 5	0.00% 0	137	3.88

Q6 Do you live within a 10-minute walk from a park?

Answered: 152 Skipped: 25



ANSWER CHOICES	RESPONSES	
Yes	50.00%	76
No	50.00%	76
TOTAL		152

Q7 What is the name (or nearest cross streets) of the closest park that is within a 10-minute walk of your home?

Answered: 71 Skipped: 106

#	RESPONSES	DATE
1	Nettles Park	3/9/2024 8:34 AM
2	Ashley dearing	3/8/2024 6:45 PM
3	Dawson Park	3/8/2024 12:59 PM
4	Ashley Dearing	3/8/2024 11:34 AM
5	isaqueena	3/8/2024 7:14 AM
6	Gateway	3/7/2024 7:36 PM
7	Nettles	3/1/2024 3:48 PM
8	Dawson	2/27/2024 10:49 AM
9	Ashley Deering	2/21/2024 5:23 PM
10	Ashley Dearing/ totties place	2/21/2024 2:57 PM
11	12 mile recreation area	2/21/2024 11:22 AM
12	Earl Anderson Park	2/21/2024 11:08 AM
13	ashly D	2/21/2024 8:22 AM
14	Ashley Dearing	2/21/2024 7:08 AM
15	Na	2/20/2024 11:09 PM
16	Ashley dearing	2/20/2024 10:30 PM
17	Nettles	2/20/2024 9:36 PM
18	South Cove	2/20/2024 9:06 PM
19	Catherine smith plaza	2/20/2024 8:43 PM
20	Clemson Park, Gateway Park	2/20/2024 8:42 PM
21	Catherine Smith Plaza	2/20/2024 8:41 PM
22	Nettles	2/20/2024 8:38 PM
23	Earl Anderson	2/20/2024 3:00 PM
24	WC Nettles Park	2/20/2024 1:18 PM
25	Jaycees	2/20/2024 12:24 PM
26	Berkely, abd turn right at stop sign	2/20/2024 11:36 AM
27	Nettles	2/20/2024 10:38 AM
28	Berkley	2/20/2024 9:20 AM
29	Ashley Dearing	2/14/2024 8:09 PM
30	Ashley Deering	2/12/2024 3:51 PM
31	Nettles Park	2/12/2024 12:18 PM

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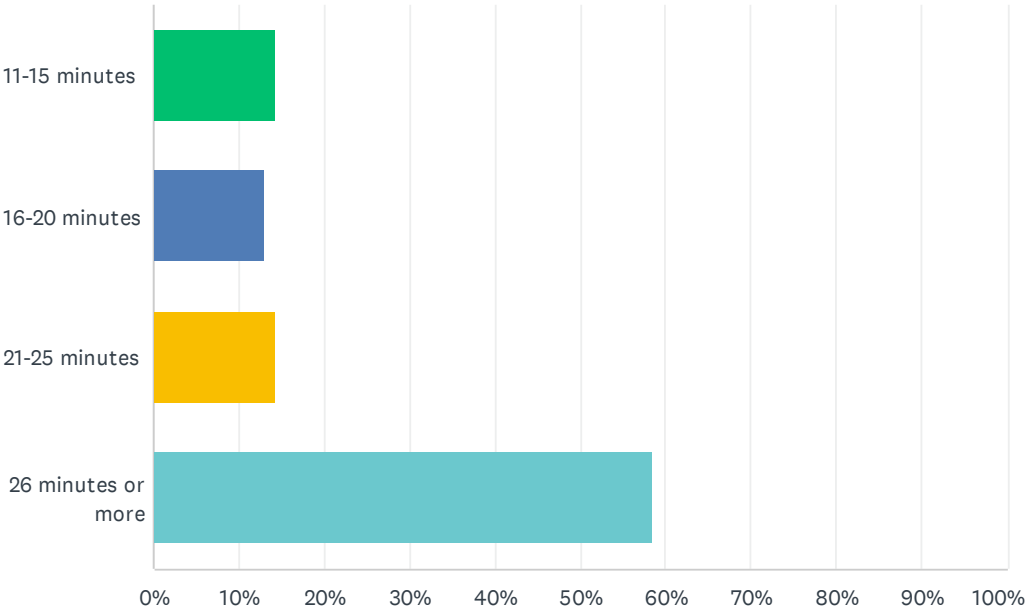
32	Jaycee Park, Abernathy Park, and Catherine Smith Plaza	2/12/2024 9:26 AM
33	College Ave and Strode Cir	2/12/2024 9:13 AM
34	Ashley Dearing Park or Tottie's Place	2/11/2024 4:27 PM
35	Ashley Dearing	2/10/2024 11:28 PM
36	Earl Anderson Park	2/10/2024 9:14 PM
37	Ashley Deering	2/2/2024 3:59 PM
38	Nettles Park	1/30/2024 2:11 PM
39	Ashley Dearing	1/28/2024 5:08 PM
40	Ashley Dearing	1/27/2024 11:58 PM
41	Ashley dearing	1/27/2024 10:42 PM
42	Darwin Park (in Anderson)	1/27/2024 9:47 PM
43	Ashley Dearing	1/27/2024 6:47 PM
44	Ashley Derring and Nettles	1/27/2024 6:14 PM
45	Catherine Smith Plaza	1/27/2024 8:20 AM
46	Nettles	1/27/2024 8:14 AM
47	Berkeley	1/27/2024 7:54 AM
48	Ashley Dearing	1/27/2024 6:40 AM
49	The park off of old stone church road	1/27/2024 6:17 AM
50	Clemson Park	1/26/2024 11:37 PM
51	Clemson Park	1/26/2024 10:53 PM
52	Ashley Deering	1/26/2024 10:30 PM
53	Jaycee Park	1/26/2024 10:15 PM
54	Ashley Dearing	1/26/2024 10:03 PM
55	Mountain View	1/26/2024 9:09 PM
56	Rockcreek	1/26/2024 7:26 PM
57	Berkeley Drive	1/26/2024 6:56 PM
58	Ashley Dearing	1/26/2024 5:49 PM
59	Dawson	1/26/2024 5:12 PM
60	Berkeley Drive	1/26/2024 5:01 PM
61	Holmes Park	1/26/2024 4:59 PM
62	Nettles Park	1/26/2024 4:19 PM
63	Clemson Park	1/26/2024 3:22 PM
64	Nettles	1/26/2024 2:06 PM
65	Earle Anderson	1/26/2024 1:38 PM
66	Ashley Dearing Park	1/26/2024 1:19 PM
67	Berkeley Drive	1/26/2024 1:13 PM
68	Ashley Dearing	1/26/2024 12:52 PM
69	Ashley Dearing	1/26/2024 12:51 PM

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70	Shanklin-Sams Greenspace	1/26/2024 11:33 AM
71	Ashley Dearing	1/24/2024 11:00 PM

Q8 Approximately, how long would it take for you to walk to the nearest park from your home?

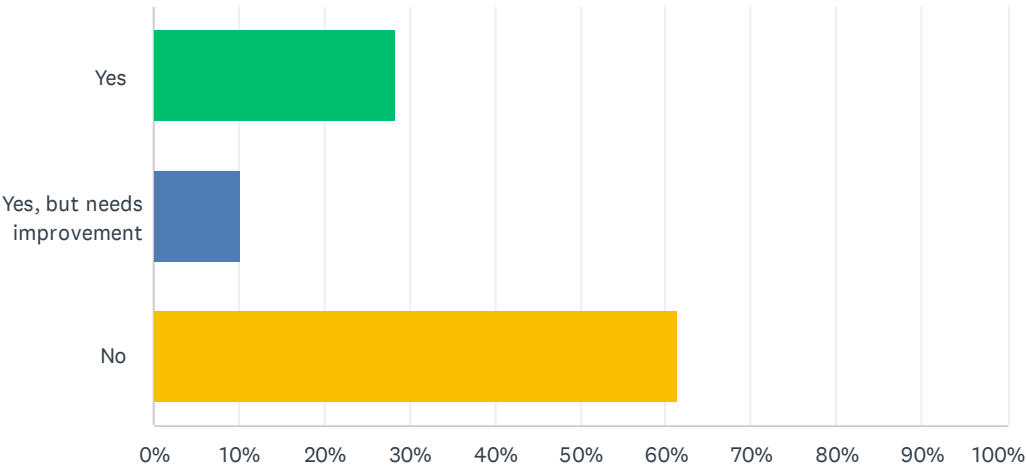
Answered: 77 Skipped: 100



ANSWER CHOICES	RESPONSES	
11-15 minutes	14.29%	11
16-20 minutes	12.99%	10
21-25 minutes	14.29%	11
26 minutes or more	58.44%	45
TOTAL		77

Q9 Do you have a pedestrian route (trails, sidewalks) to safely access the closest park from your home?

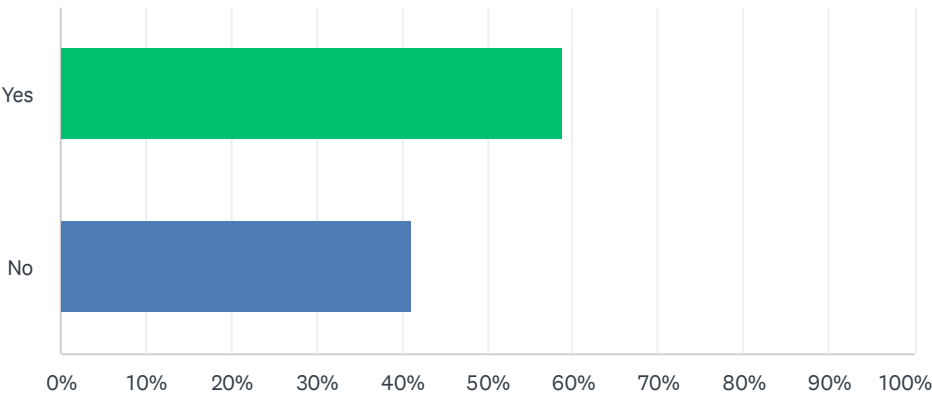
Answered: 148 Skipped: 29



ANSWER CHOICES		RESPONSES	
Yes		28.38%	42
Yes, but needs improvement		10.14%	15
No		61.49%	91
TOTAL			148

Q10 Have you or other members of your household participated in any recreation programs offered by the City of Clemson Parks and Recreation Department during the past 12 months?

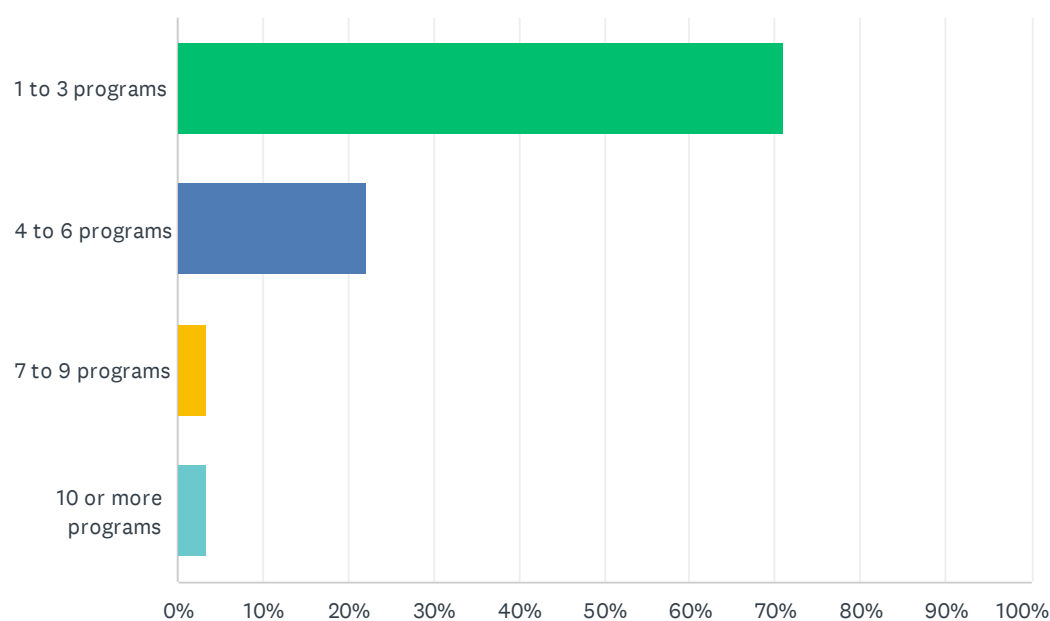
Answered: 146 Skipped: 31



ANSWER CHOICES		RESPONSES
Yes		58.90% 86
No		41.10% 60
TOTAL		146

Q11 Approximately, how many different recreation programs offered by the City of Clemson Parks and Recreation Department have you or members of your household participated in over the past 12 months?

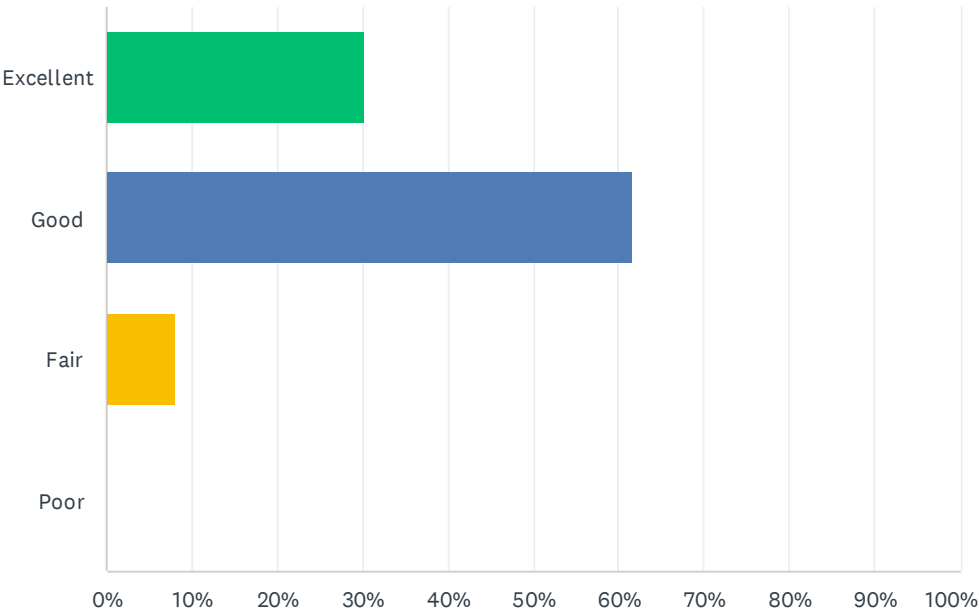
Answered: 86 Skipped: 91



ANSWER CHOICES	RESPONSES	
1 to 3 programs	70.93%	61
4 to 6 programs	22.09%	19
7 to 9 programs	3.49%	3
10 or more programs	3.49%	3
TOTAL		86

Q12 Overall, how would you rate the quality of the City of Clemson Parks and Recreation Department programs you participated in?

Answered: 86 Skipped: 91

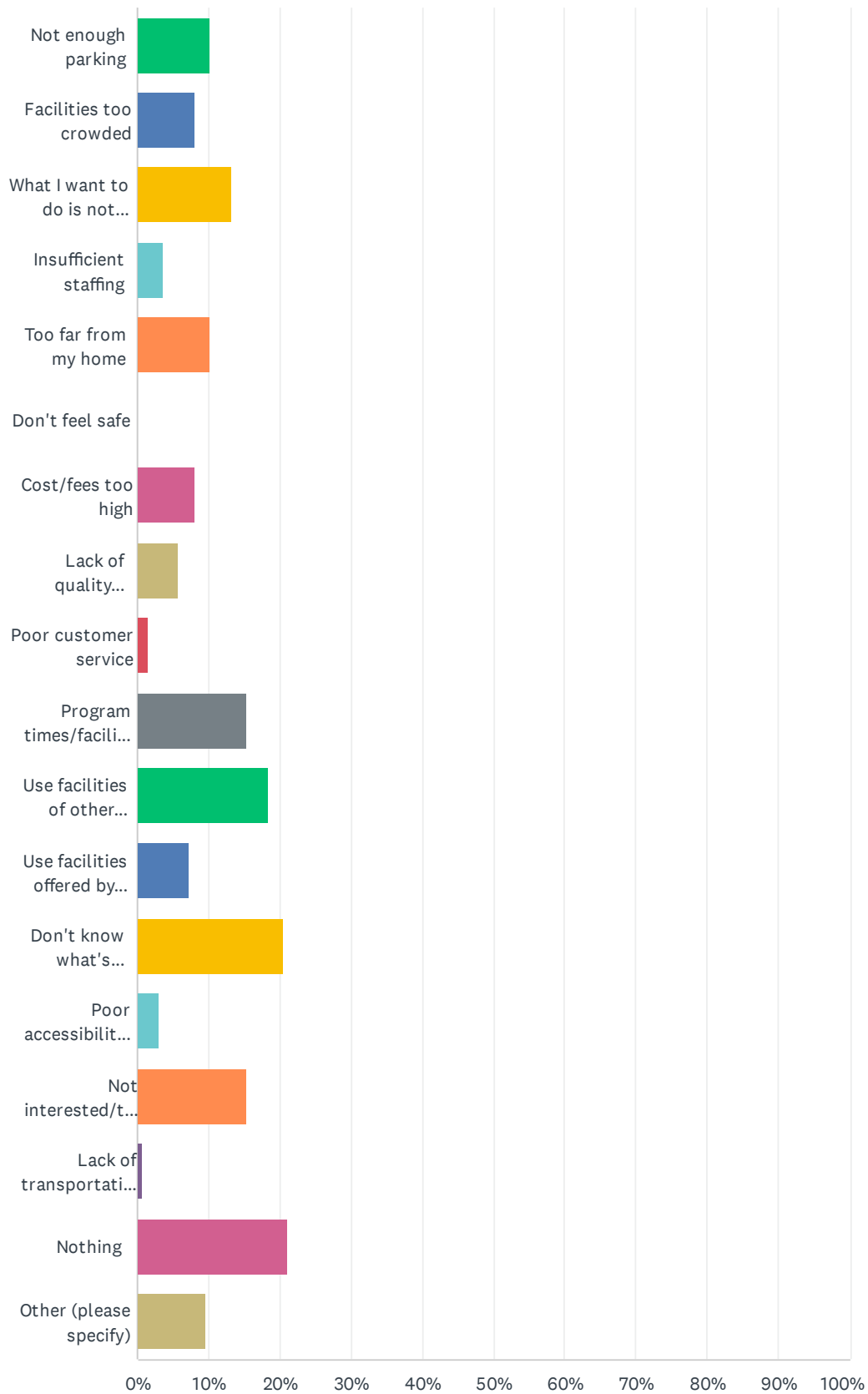


ANSWER CHOICES	RESPONSES	
Excellent	30.23%	26
Good	61.63%	53
Fair	8.14%	7
Poor	0.00%	0
TOTAL		86

Q13 Which of the following reasons prevent you or other members of your household from using recreation programs offered by the City? If you currently use them, what prevents you from using them more often? Select all that apply.

Answered: 137 Skipped: 40

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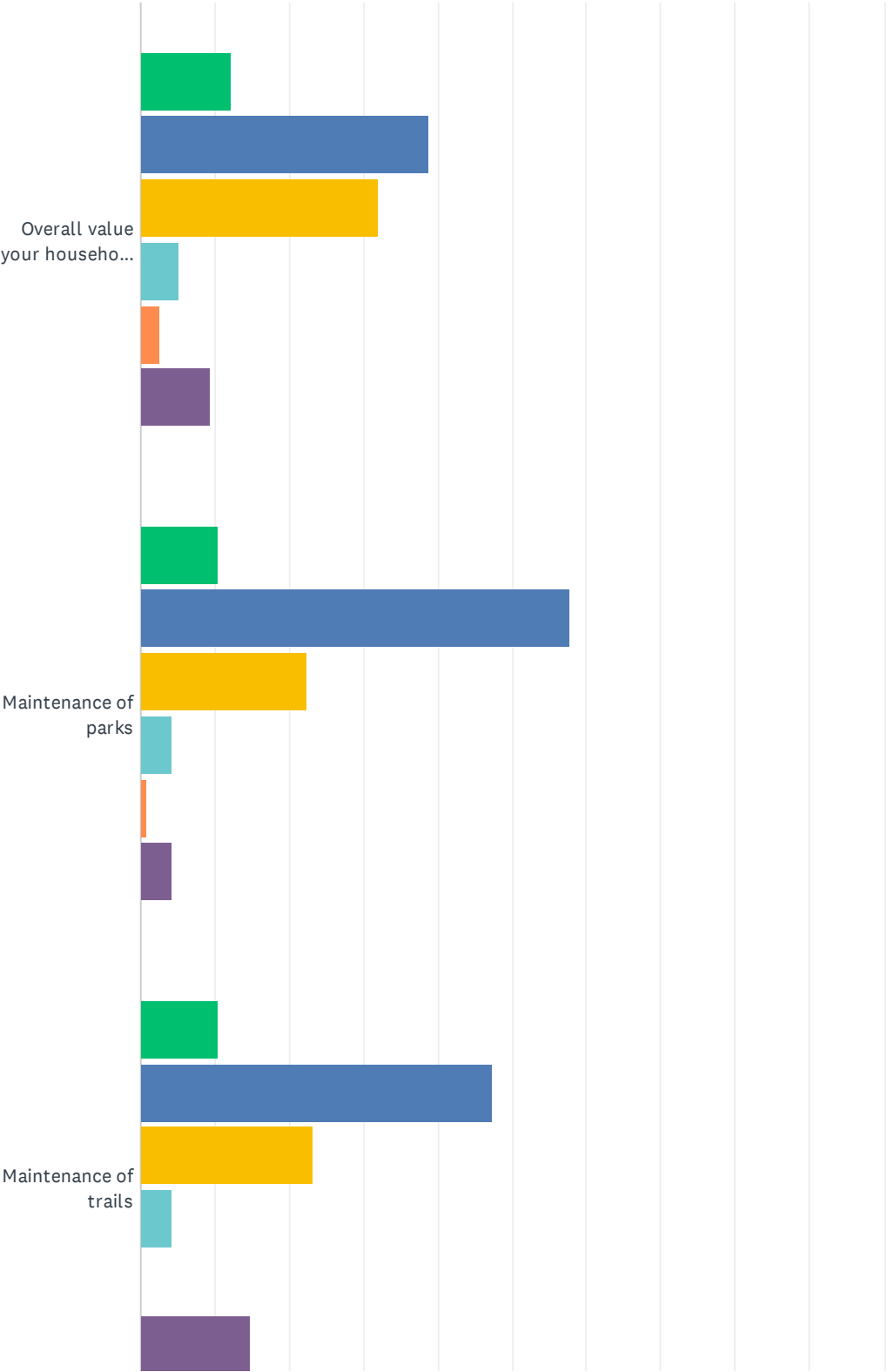
Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey

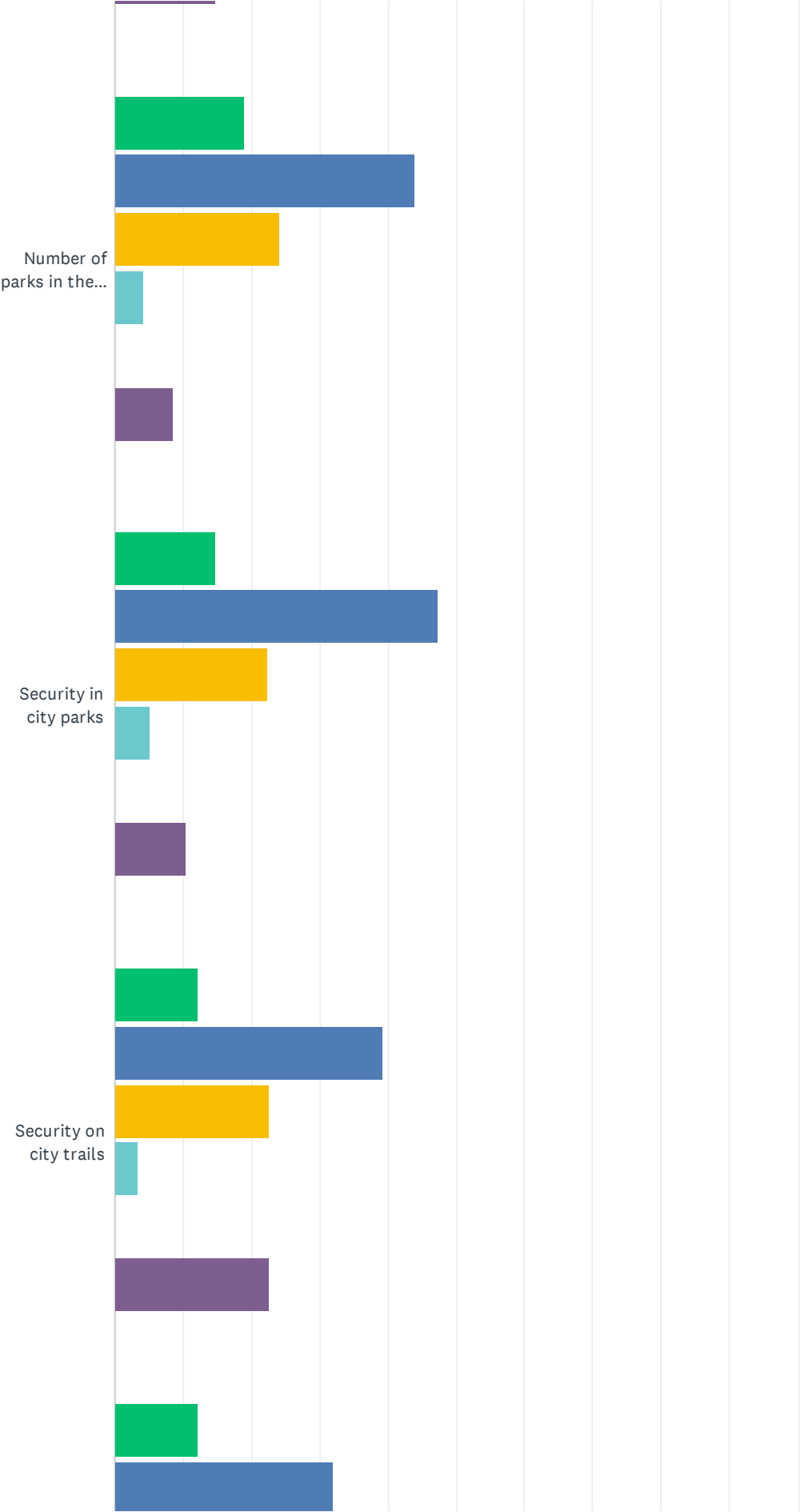
ANSWER CHOICES	RESPONSES	
Not enough parking	10.22%	14
Facilities too crowded	8.03%	11
What I want to do is not offered	13.14%	18
Insufficient staffing	3.65%	5
Too far from my home	10.22%	14
Don't feel safe	0.00%	0
Cost/fees too high	8.03%	11
Lack of quality programs	5.84%	8
Poor customer service	1.46%	2
Program times/facility hours not convenient	15.33%	21
Use facilities of other cities, private institutions, and non-city programming	18.25%	25
Use facilities offered by Clemson University	7.30%	10
Don't know what's offered/available	20.44%	28
Poor accessibility for persons with disabilities	2.92%	4
Not interested/too busy	15.33%	21
Lack of transportation - I cannot get there	0.73%	1
Nothing	21.17%	29
Other (please specify)	9.49%	13
Total Respondents: 137		

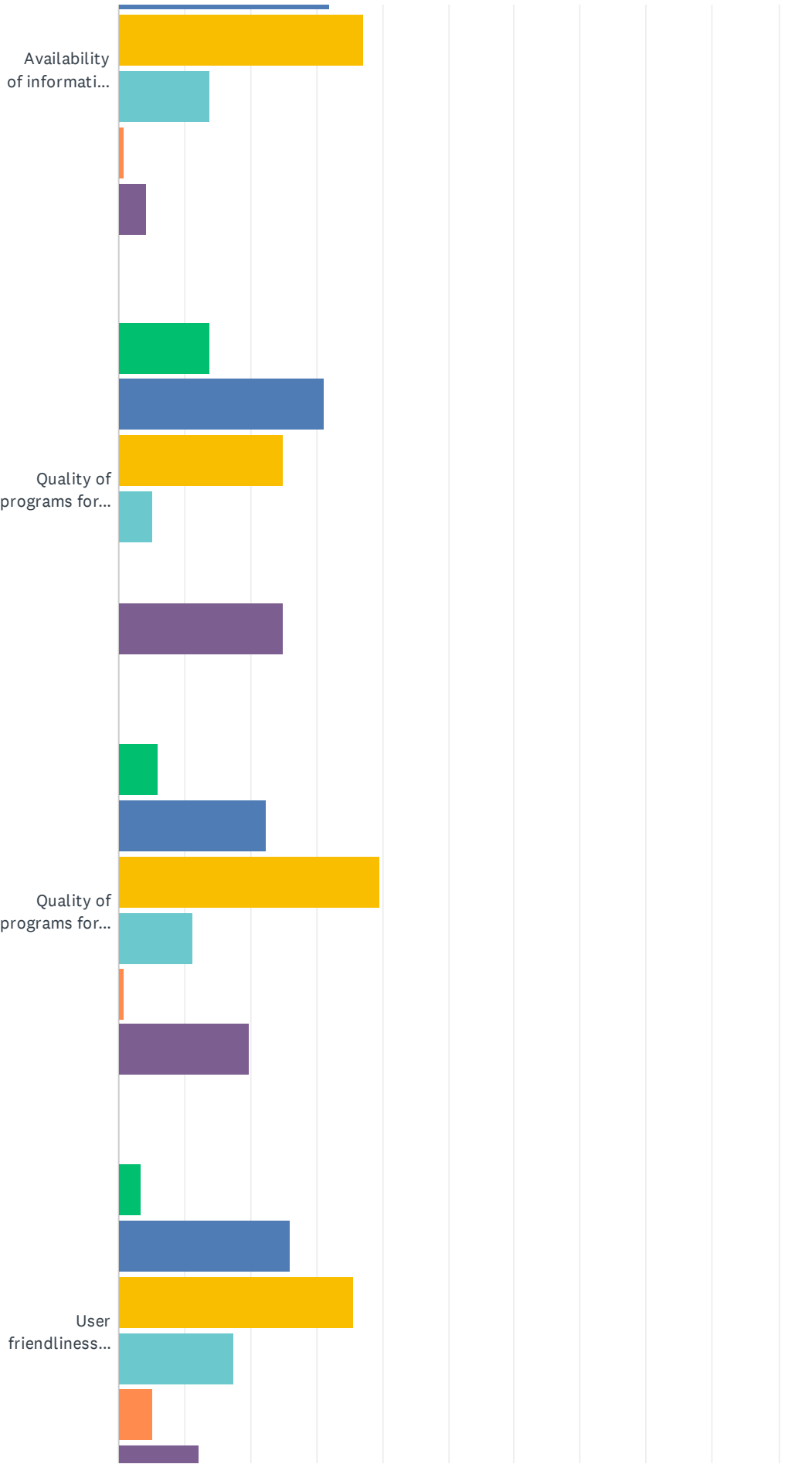
#	OTHER (PLEASE SPECIFY)	DATE
1	Would like to see more classes at various times of day at Clemson -Central Rec	3/9/2024 8:35 AM
2	Not aware of any programs offered for girls over 12 that my kids like.	3/8/2024 1:02 PM
3	Facilities occupied/taken over by Clemson university students	3/1/2024 3:50 PM
4	Pickleball courts at Nettles are modified tennis courts and not great for pickleball	2/21/2024 5:26 PM
5	no longer have young children which is when we used to use these	2/21/2024 11:36 AM
6	When my children were younger, we often used the parks and programs. We also lived in Clemson at that time.	2/21/2024 8:28 AM
7	Too many Clemson Univ students using city pickleball courts.	2/20/2024 8:48 AM
8	Can't walk there	2/17/2024 10:03 PM
9	Some kids sporting programs are too competitive and not instructional enough	2/10/2024 9:16 PM
10	More bike lanes and pedestrian paths critically needed	1/28/2024 2:18 PM
11	Too busy with Daniel sports currently.	1/27/2024 8:23 AM
12	We have teenage kids and other activities prohibit but our kids did all rec programs available when they were elementary age.	1/27/2024 6:19 AM
13	Pool isn't adequate to hold swim meets	1/26/2024 5:00 PM

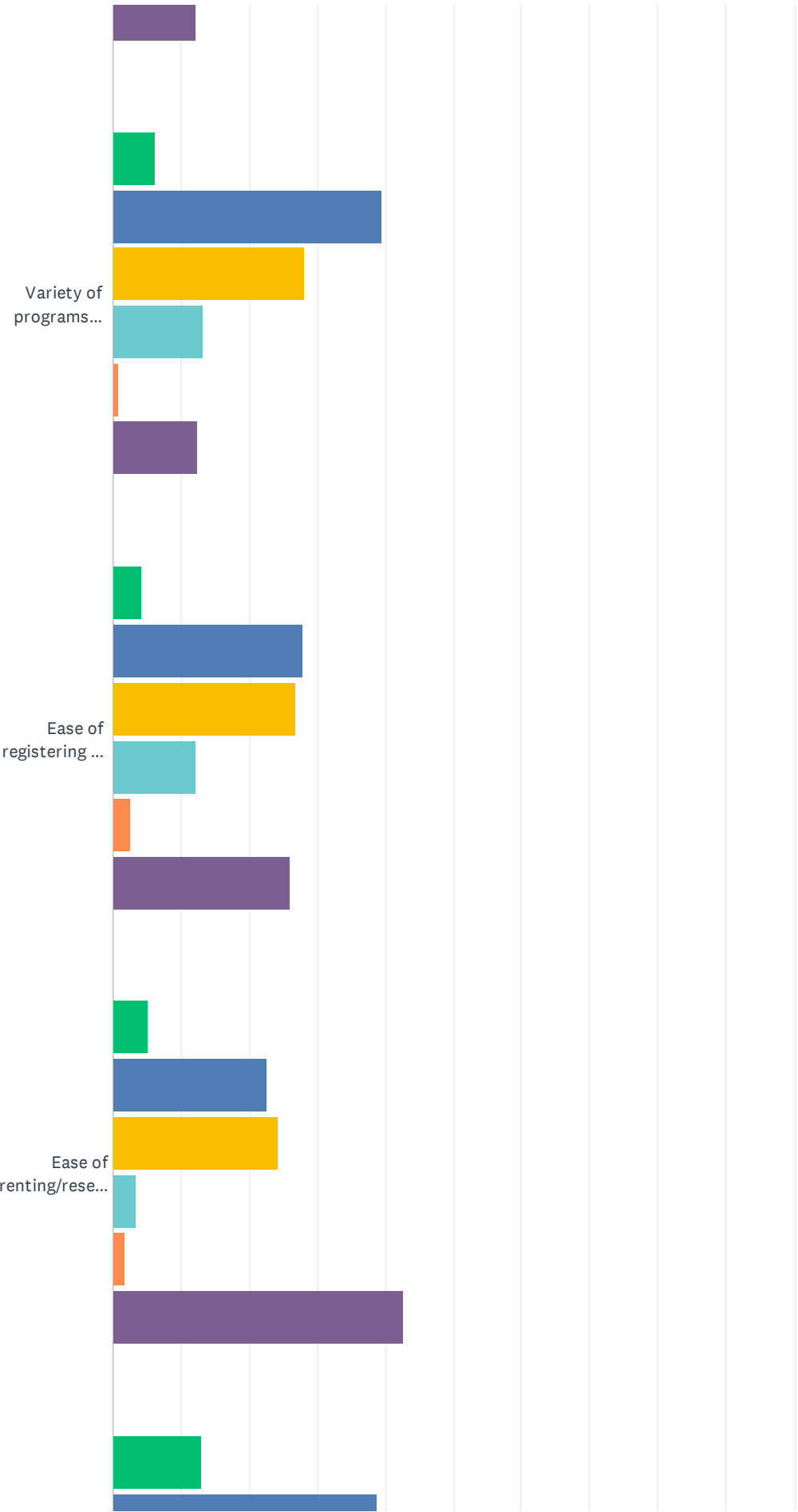
Q14 Please rate your satisfaction with the following recreation, parks, and cultural services provided by the City of Clemson Parks and Recreation Department.

Answered: 117 Skipped: 60

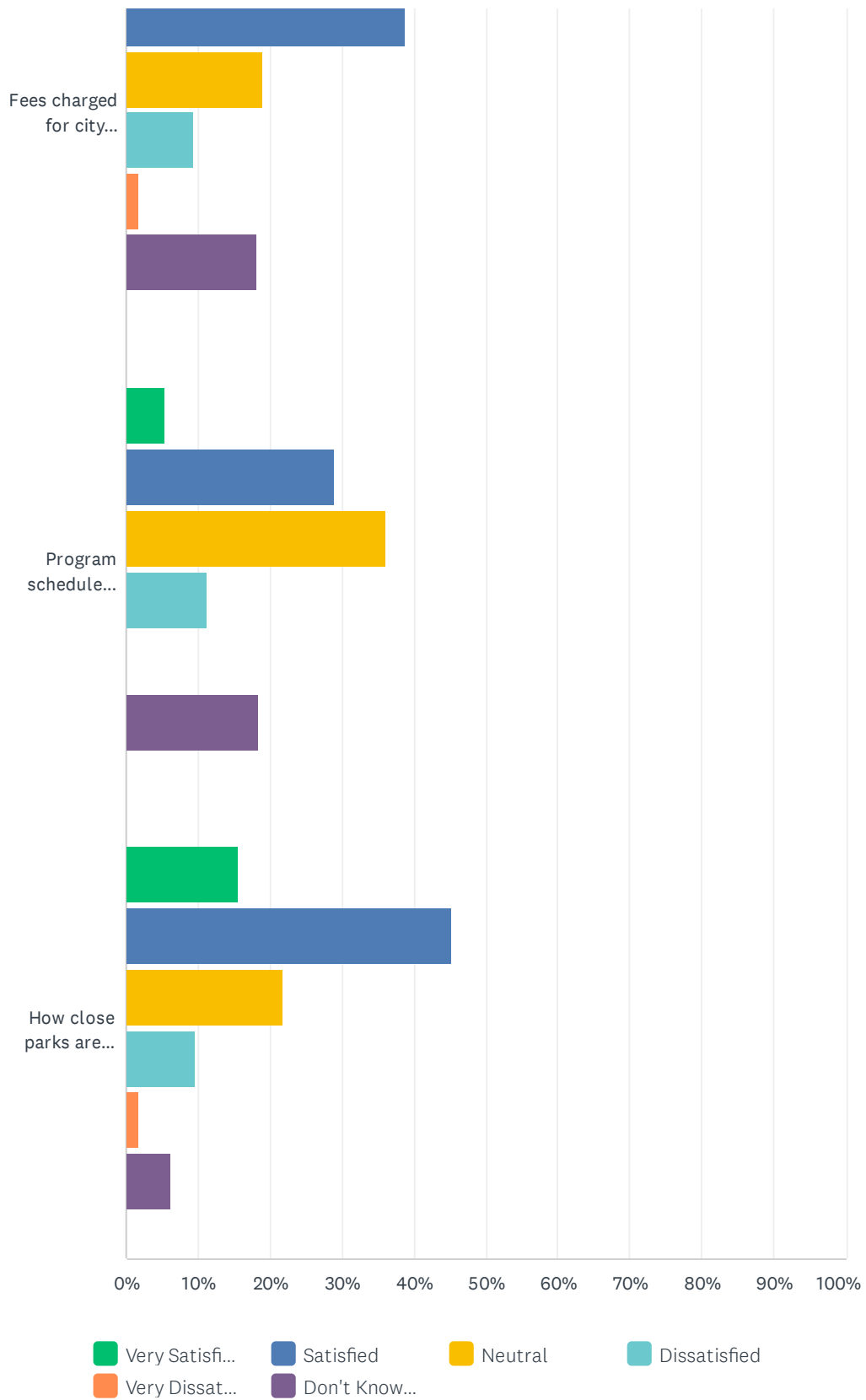








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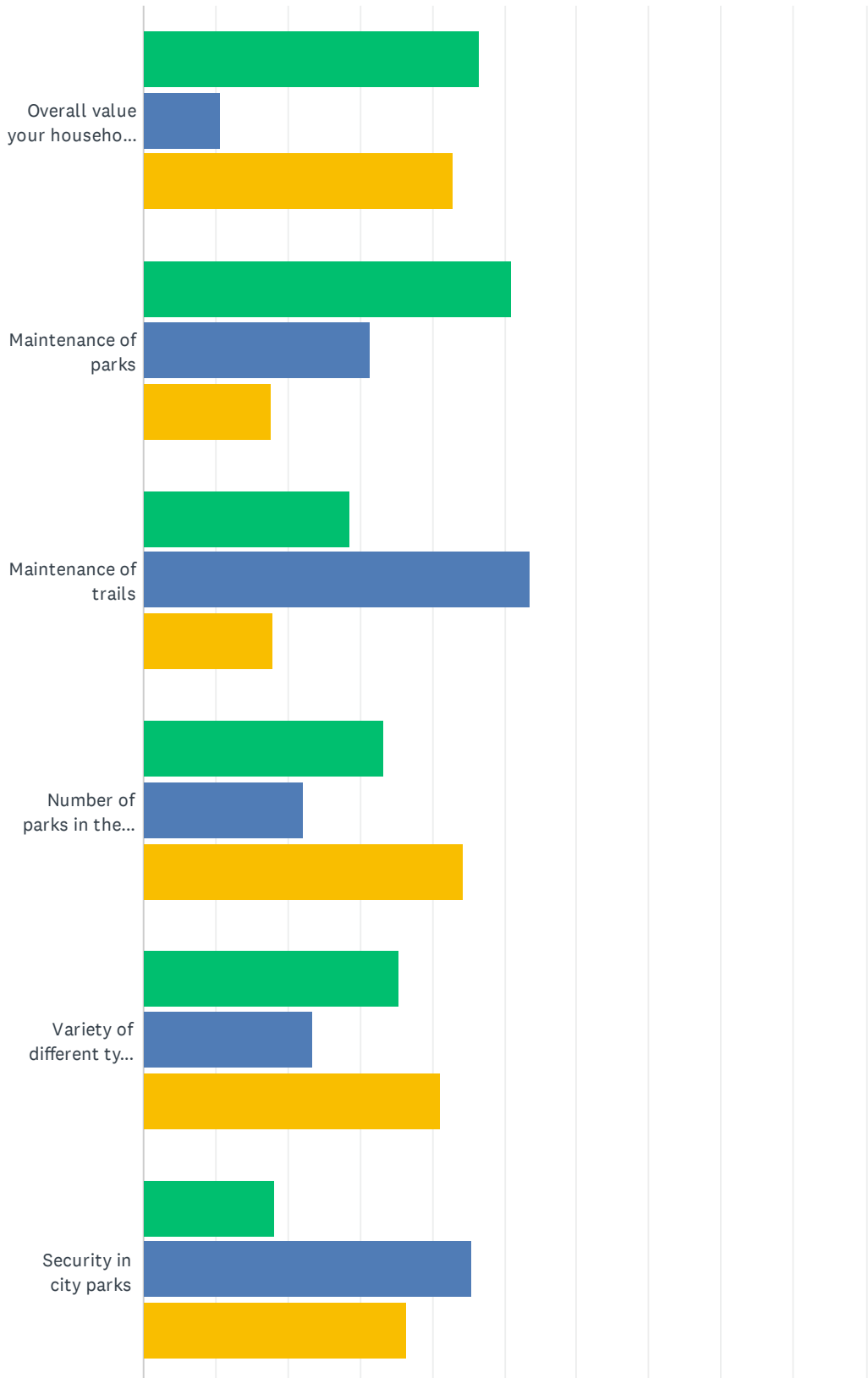


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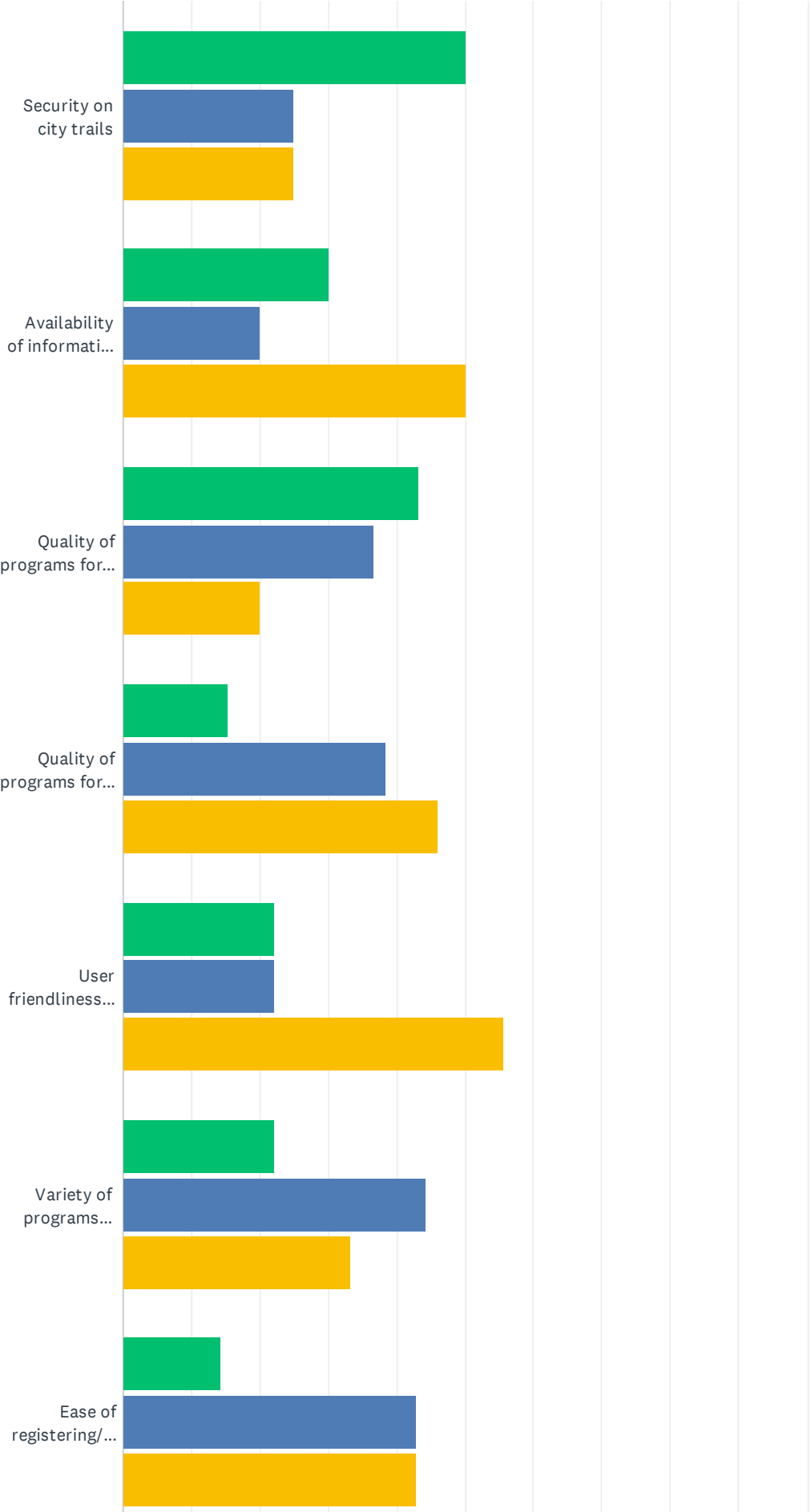
	VERY SATISFIED	SATISFIED	NEUTRAL	DISSATISFIED	VERY DISSATISFIED	DON'T KNOW/NOT APPLICABLE	TOTAL	WEIGHTED AVERAGE
Overall value your household receives for taxes paid	12.07% 14	38.79% 45	31.90% 37	5.17% 6	2.59% 3	9.48% 11	116	
Maintenance of parks	10.34% 12	57.76% 67	22.41% 26	4.31% 5	0.86% 1	4.31% 5	116	
Maintenance of trails	10.34% 12	47.41% 55	23.28% 27	4.31% 5	0.00% 0	14.66% 17	116	
Number of parks in the city	18.97% 22	43.97% 51	24.14% 28	4.31% 5	0.00% 0	8.62% 10	116	
Security in city parks	14.66% 17	47.41% 55	22.41% 26	5.17% 6	0.00% 0	10.34% 12	116	
Security on city trails	12.17% 14	39.13% 45	22.61% 26	3.48% 4	0.00% 0	22.61% 26	115	
Availability of information about programs/facilities	12.07% 14	31.90% 37	37.07% 43	13.79% 16	0.86% 1	4.31% 5	116	
Quality of programs for families with children	13.79% 16	31.03% 36	25.00% 29	5.17% 6	0.00% 0	25.00% 29	116	
Quality of programs for adults	6.03% 7	22.41% 26	39.66% 46	11.21% 13	0.86% 1	19.83% 23	116	
User friendliness of city website	3.48% 4	26.09% 30	35.65% 41	17.39% 20	5.22% 6	12.17% 14	115	
Variety of programs offered by the city	6.14% 7	39.47% 45	28.07% 32	13.16% 15	0.88% 1	12.28% 14	114	
Ease of registering for classes offered by the city	4.35% 5	27.83% 32	26.96% 31	12.17% 14	2.61% 3	26.09% 30	115	
Ease of renting/reserving a city facility	5.22% 6	22.61% 26	24.35% 28	3.48% 4	1.74% 2	42.61% 49	115	
Fees charged for city recreation programs	12.93% 15	38.79% 45	18.97% 22	9.48% 11	1.72% 2	18.10% 21	116	
Program schedule (time/day)	5.26% 6	28.95% 33	35.96% 41	11.40% 13	0.00% 0	18.42% 21	114	
How close parks are located to your home	15.65% 18	45.22% 52	21.74% 25	9.57% 11	1.74% 2	6.09% 7	115	

Q15 Which three items from the list in Question 7 should receive the most emphasis over the next five years?

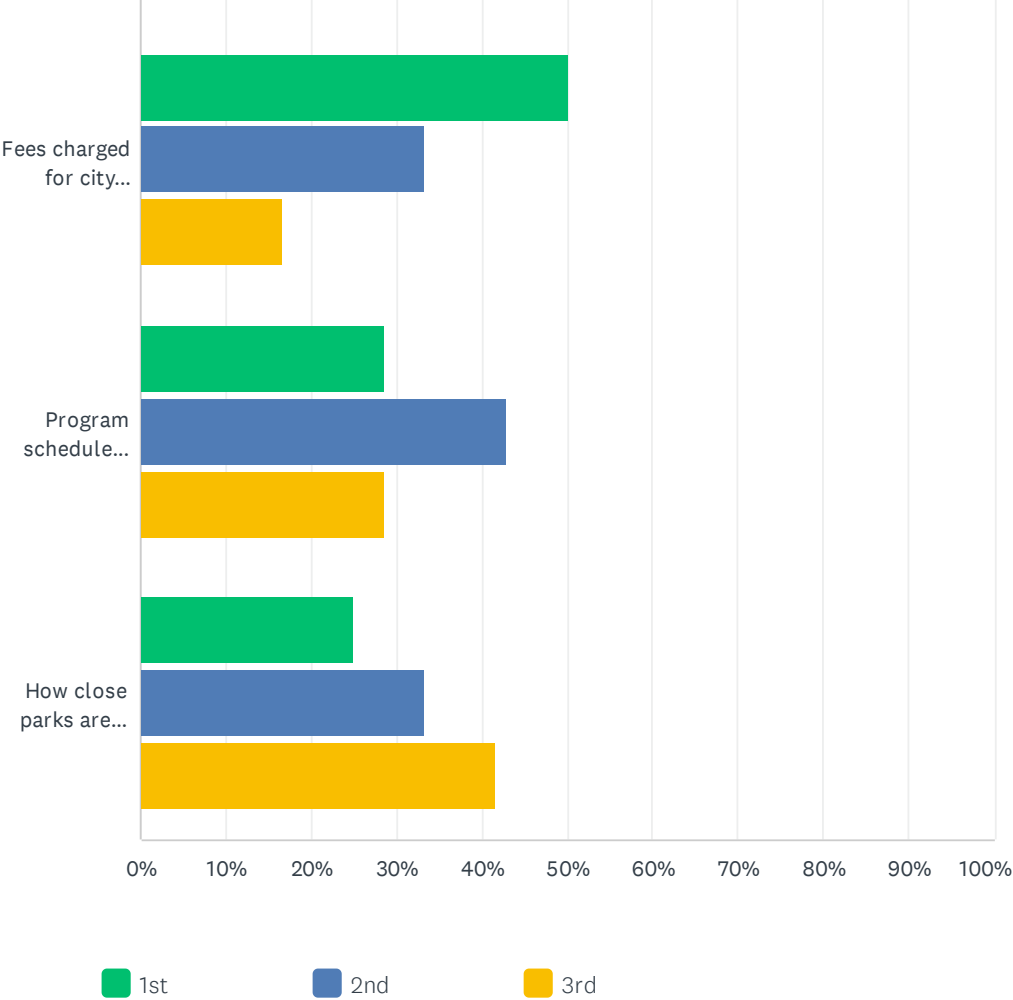
Answered: 111 Skipped: 66



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Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey

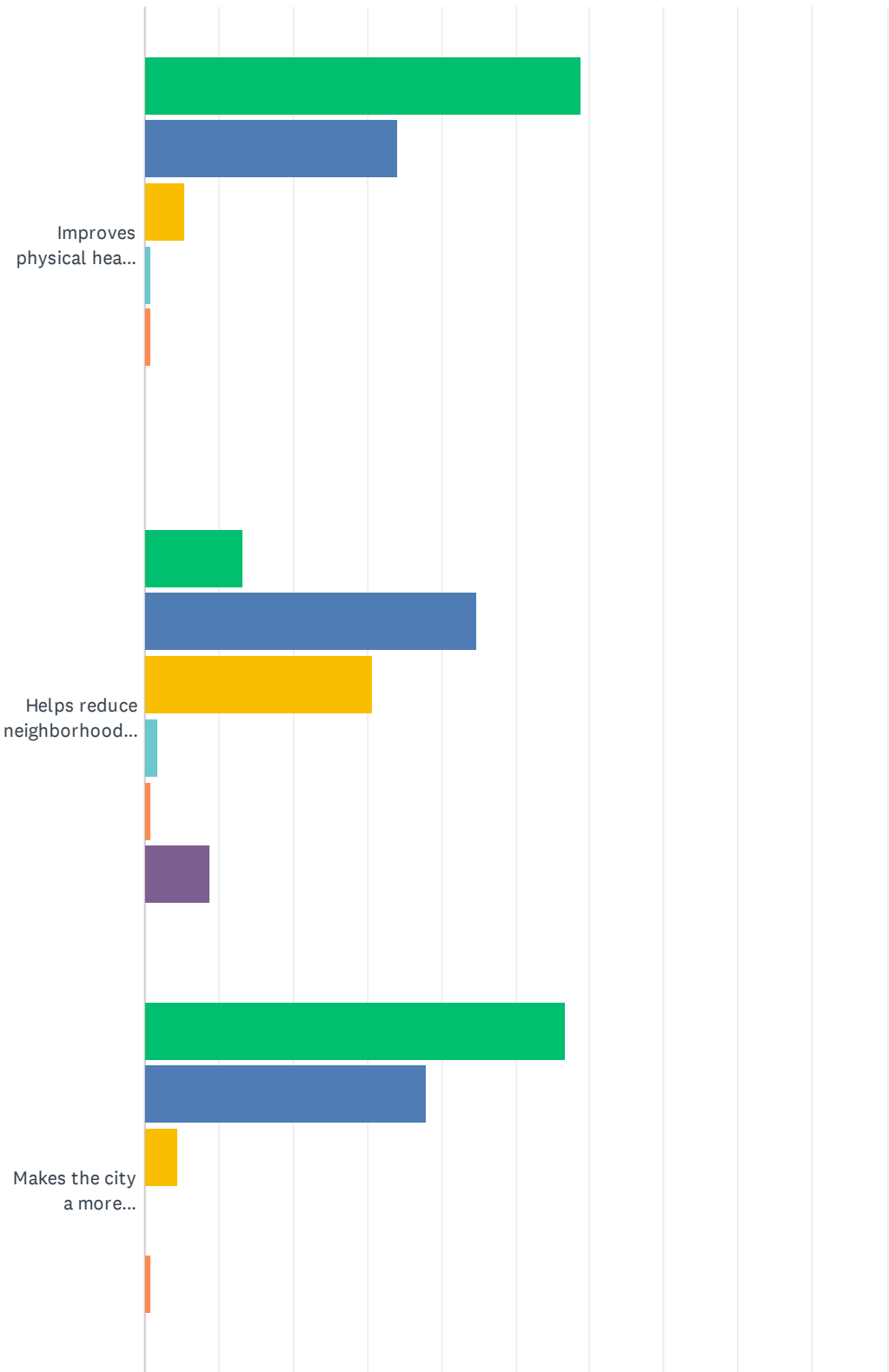


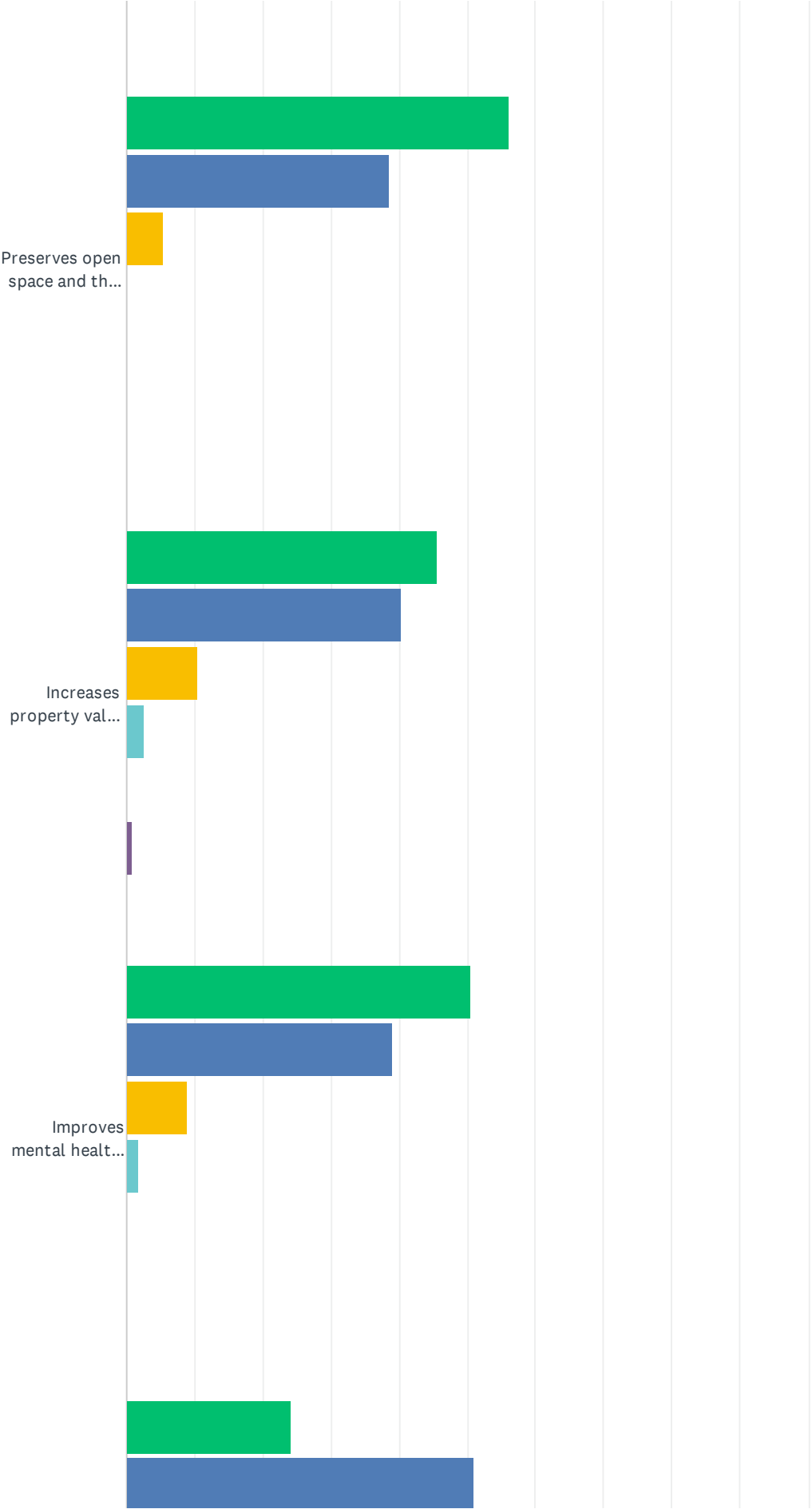
Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey

	1ST	2ND	3RD	TOTAL	WEIGHTED AVERAGE
Overall value your household receives for taxes paid	46.43% 13	10.71% 3	42.86% 12	28	1.96
Maintenance of parks	50.98% 26	31.37% 16	17.65% 9	51	1.67
Maintenance of trails	28.57% 8	53.57% 15	17.86% 5	28	1.89
Number of parks in the city	33.33% 3	22.22% 2	44.44% 4	9	2.11
Variety of different types of parks in the city	35.29% 12	23.53% 8	41.18% 14	34	2.06
Security in city parks	18.18% 2	45.45% 5	36.36% 4	11	2.18
Security on city trails	50.00% 2	25.00% 1	25.00% 1	4	1.75
Availability of information about programs/facilities	30.00% 6	20.00% 4	50.00% 10	20	2.20
Quality of programs for families with children	43.33% 13	36.67% 11	20.00% 6	30	1.77
Quality of programs for adults	15.38% 4	38.46% 10	46.15% 12	26	2.31
User friendliness of city website	22.22% 2	22.22% 2	55.56% 5	9	2.33
Variety of programs offered by the city	22.22% 6	44.44% 12	33.33% 9	27	2.11
Ease of registering/reserving a city facility	14.29% 1	42.86% 3	42.86% 3	7	2.29
Fees charged for city recreation programs	50.00% 6	33.33% 4	16.67% 2	12	1.67
Program schedule (time/day)	28.57% 4	42.86% 6	28.57% 4	14	2.00
How close parks are located to your home	25.00% 3	33.33% 4	41.67% 5	12	2.17

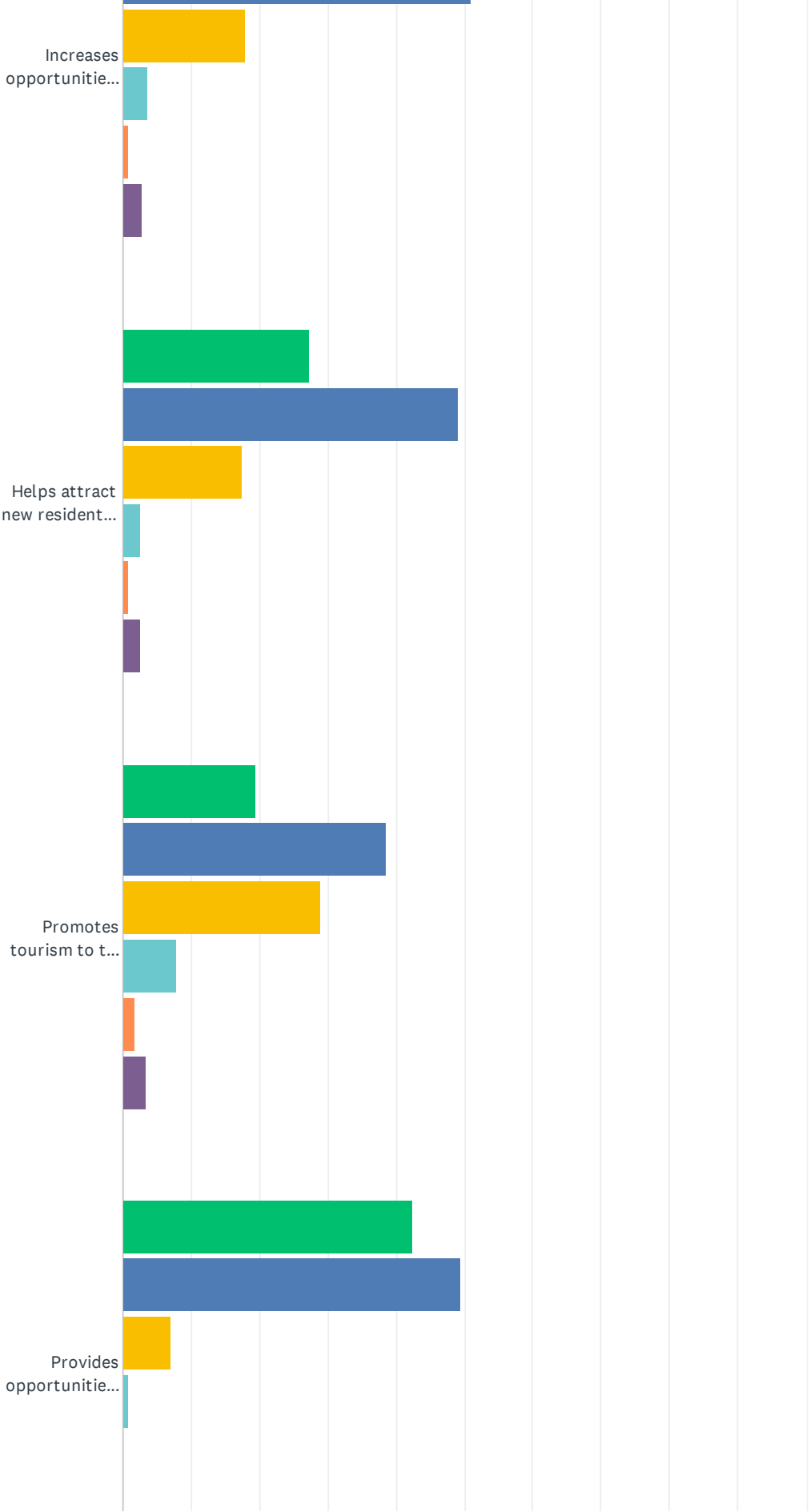
Q16 The following are some of the benefits that you and your household may receive from parks, trails, recreation facilities, programs, and services of Clemson. Please rate your agreement with each item.

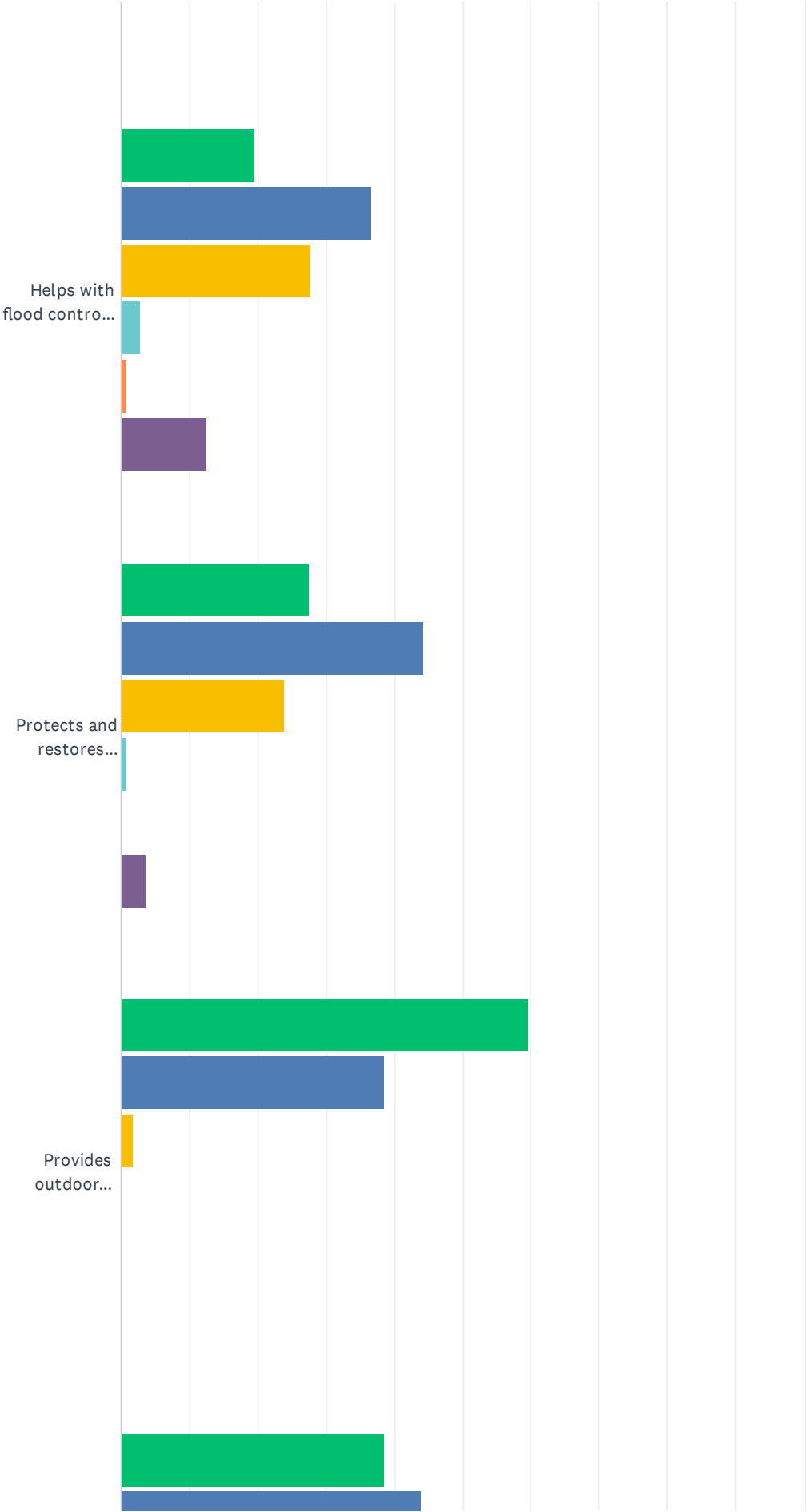
Answered: 114 Skipped: 63



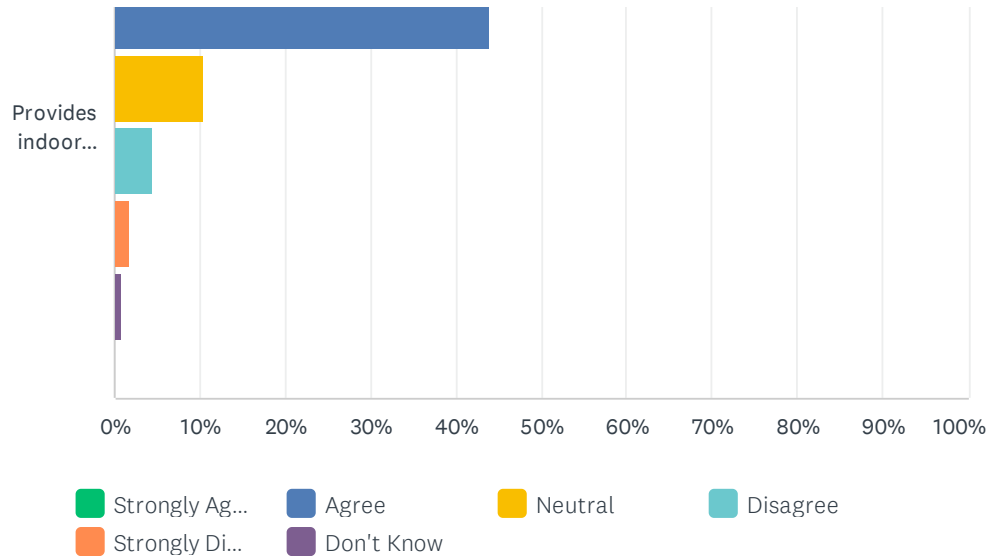


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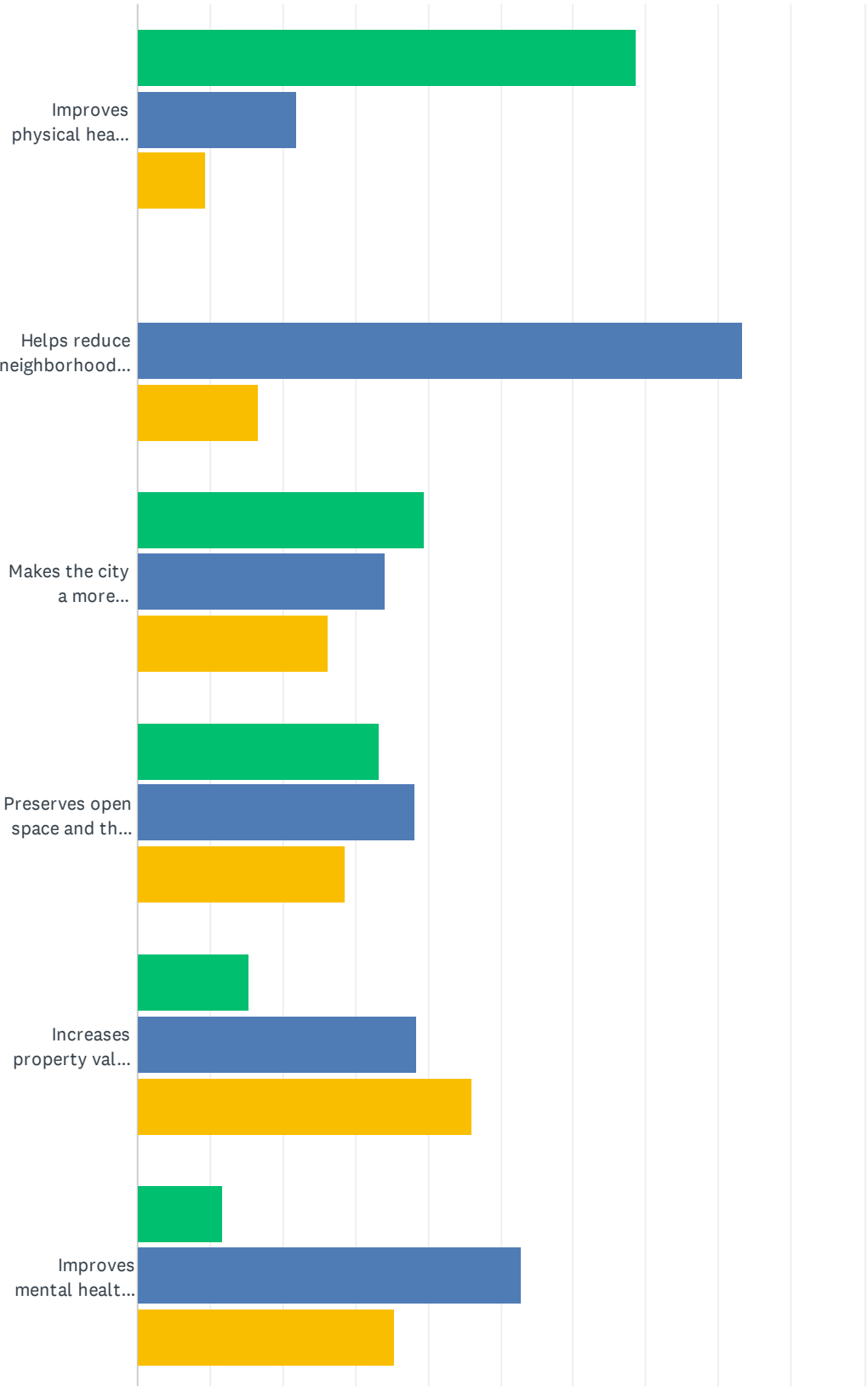
Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey



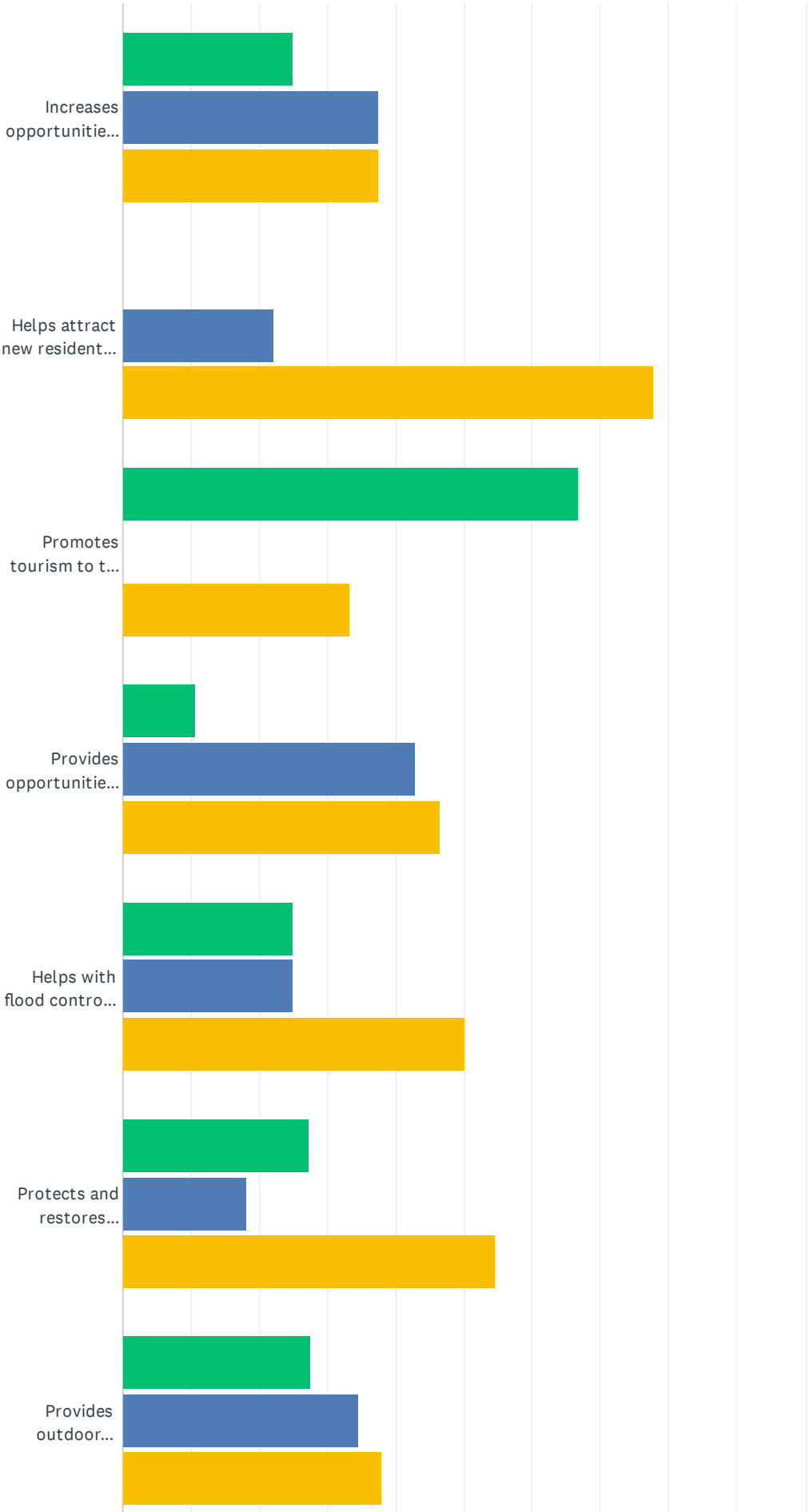
	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE	DON'T KNOW	TOTAL	WEIGHTED AVERAGE
Improves physical health and fitness	58.77% 67	34.21% 39	5.26% 6	0.88% 1	0.88% 1	0.00% 0	114	4.49
Helps reduce neighborhood crime	13.16% 15	44.74% 51	30.70% 35	1.75% 2	0.88% 1	8.77% 10	114	3.74
Makes the city a more desirable place to live	56.64% 64	38.05% 43	4.42% 5	0.00% 0	0.88% 1	0.00% 0	113	4.50
Preserves open space and the environment	56.14% 64	38.60% 44	5.26% 6	0.00% 0	0.00% 0	0.00% 0	114	4.51
Increases property values in surrounding area	45.61% 52	40.35% 46	10.53% 12	2.63% 3	0.00% 0	0.88% 1	114	4.30
Improves mental health and reduces stress	50.44% 57	38.94% 44	8.85% 10	1.77% 2	0.00% 0	0.00% 0	113	4.38
Increases opportunities for different cultures to interact	24.11% 27	50.89% 57	17.86% 20	3.57% 4	0.89% 1	2.68% 3	112	3.96
Helps attract new residents and businesses	27.19% 31	49.12% 56	17.54% 20	2.63% 3	0.88% 1	2.63% 3	114	4.02
Promotes tourism to the city	19.30% 22	38.60% 44	28.95% 33	7.89% 9	1.75% 2	3.51% 4	114	3.68
Provides opportunities to pursue leisure interests	42.48% 48	49.56% 56	7.08% 8	0.88% 1	0.00% 0	0.00% 0	113	4.34
Helps with flood control and cleans our water and air	19.64% 22	36.61% 41	27.68% 31	2.68% 3	0.89% 1	12.50% 14	112	3.82
Protects and restores natural habitats	27.43% 31	44.25% 50	23.89% 27	0.88% 1	0.00% 0	3.54% 4	113	4.02
Provides outdoor recreation	59.65% 68	38.60% 44	1.75% 2	0.00% 0	0.00% 0	0.00% 0	114	4.58
Provides indoor recreation	38.60% 44	43.86% 50	10.53% 12	4.39% 5	1.75% 2	0.88% 1	114	4.14

Q17 Which three of the benefits listed are most important to you and members of your household?

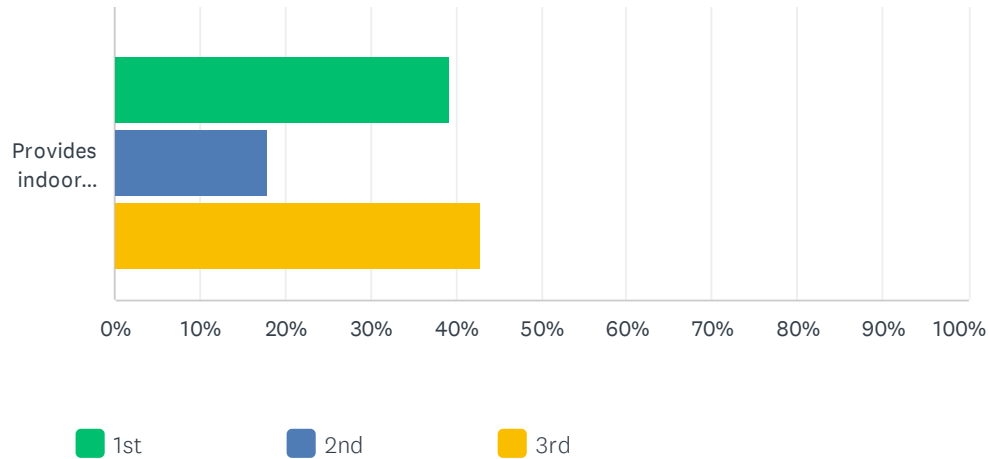
Answered: 112 Skipped: 65



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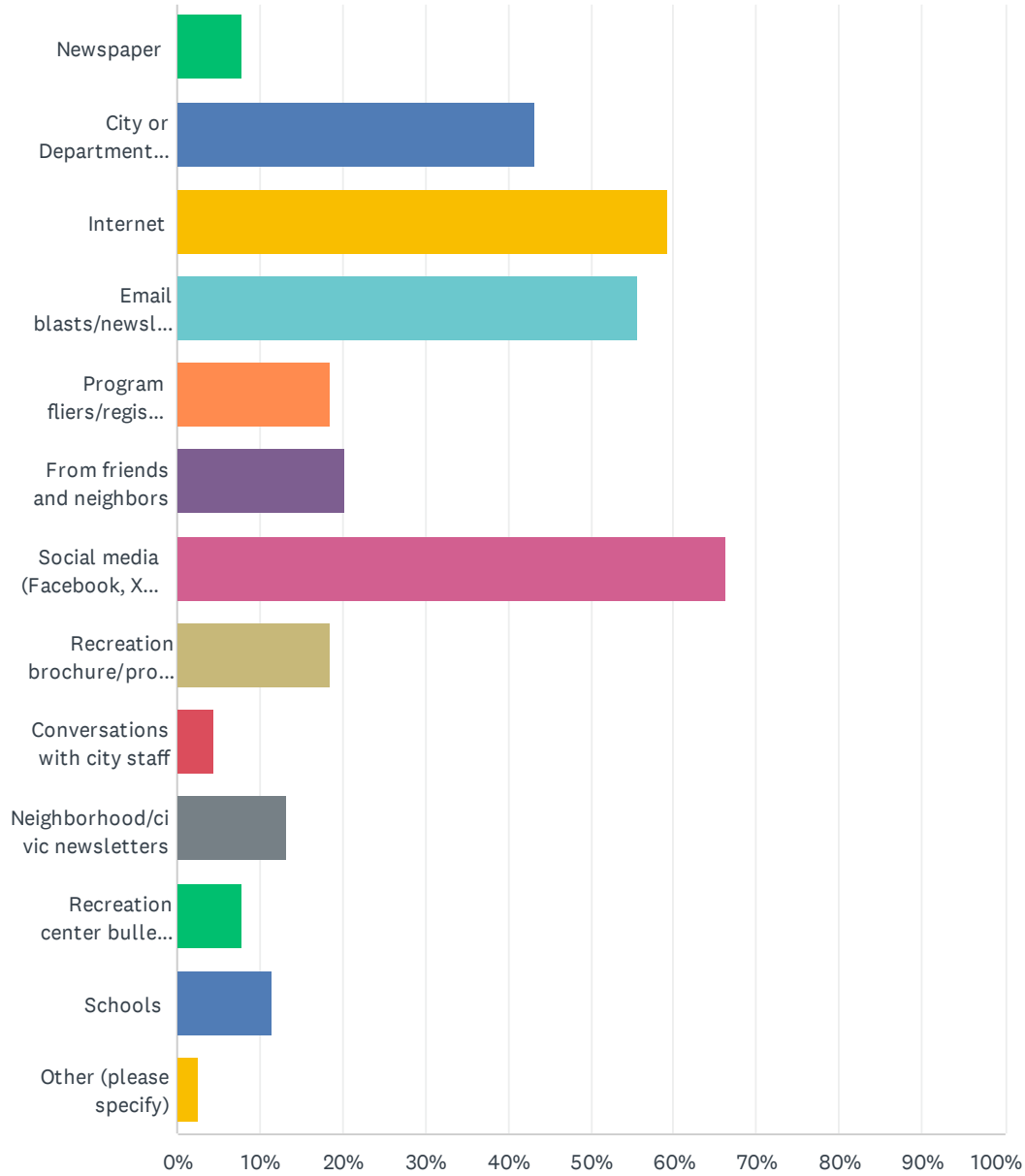
Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey



	1ST	2ND	3RD	TOTAL	WEIGHTED AVERAGE
Improves physical health and fitness	68.75% 44	21.88% 14	9.38% 6	64	1.41
Helps reduce neighborhood crime	0.00% 0	83.33% 5	16.67% 1	6	2.17
Makes the city a more desirable place to live	39.47% 15	34.21% 13	26.32% 10	38	1.87
Preserves open space and the environment	33.33% 14	38.10% 16	28.57% 12	42	1.95
Increases property values in surrounding area	15.38% 2	38.46% 5	46.15% 6	13	2.31
Improves mental health and reduces stress	11.76% 4	52.94% 18	35.29% 12	34	2.24
Increases opportunities for different cultures to interact	25.00% 2	37.50% 3	37.50% 3	8	2.13
Helps attract new residents and businesses	0.00% 0	22.22% 2	77.78% 7	9	2.78
Promotes tourism to the city	66.67% 2	0.00% 0	33.33% 1	3	1.67
Provides opportunities to pursue leisure interests	10.71% 3	42.86% 12	46.43% 13	28	2.36
Helps with flood control and cleans our water and air	25.00% 1	25.00% 1	50.00% 2	4	2.25
Protects and restores natural habitats	27.27% 6	18.18% 4	54.55% 12	22	2.27
Provides outdoor recreation	27.59% 8	34.48% 10	37.93% 11	29	2.10
Provides indoor recreation	39.29% 11	17.86% 5	42.86% 12	28	2.04

Q18 How do you prefer to get information about city programs and services? Select all that apply.

Answered: 113 Skipped: 64



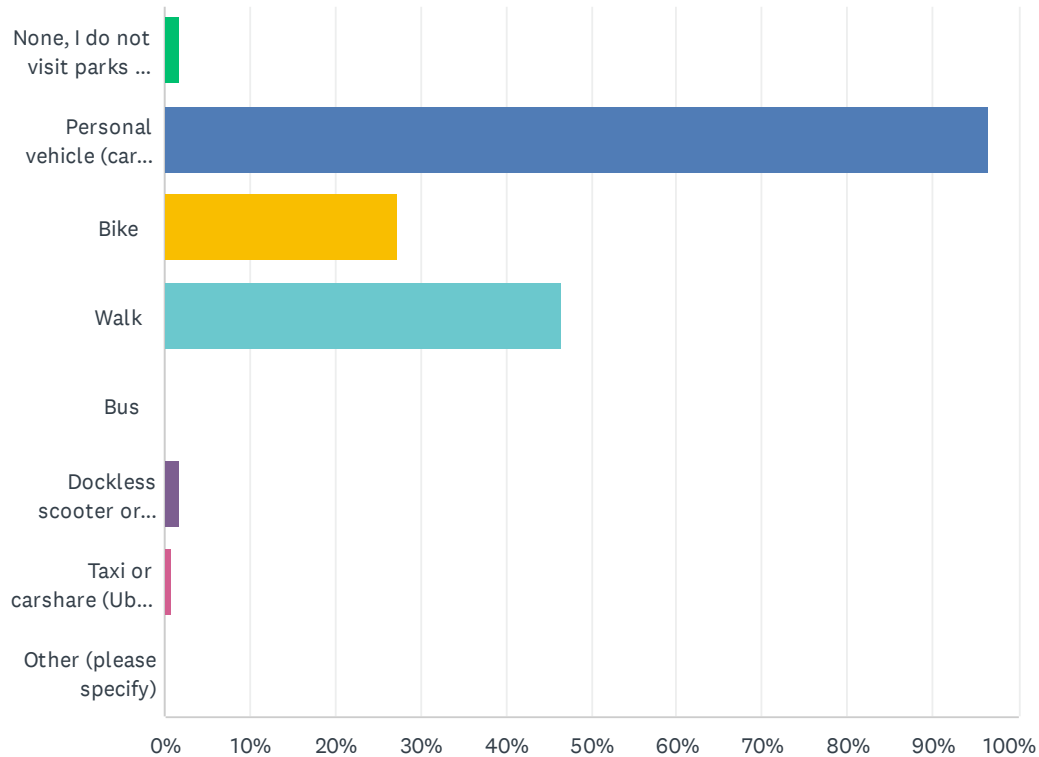
Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey

ANSWER CHOICES	RESPONSES	
Newspaper	7.96%	9
City or Department website	43.36%	49
Internet	59.29%	67
Email blasts/newsletters	55.75%	63
Program fliers/registration forms	18.58%	21
From friends and neighbors	20.35%	23
Social media (Facebook, X, etc.)	66.37%	75
Recreation brochure/program guide	18.58%	21
Conversations with city staff	4.42%	5
Neighborhood/civic newsletters	13.27%	15
Recreation center bulletin boards	7.96%	9
Schools	11.50%	13
Other (please specify)	2.65%	3
Total Respondents: 113		

#	OTHER (PLEASE SPECIFY)	DATE
1	City magazine	2/12/2024 9:18 AM
2	I don't	1/26/2024 9:41 PM
3	Other swim teams - Team Greenville	1/26/2024 5:24 PM

Q19 Please select all the ways you typically travel to the parks and recreation areas that you use.

Answered: 114 Skipped: 63

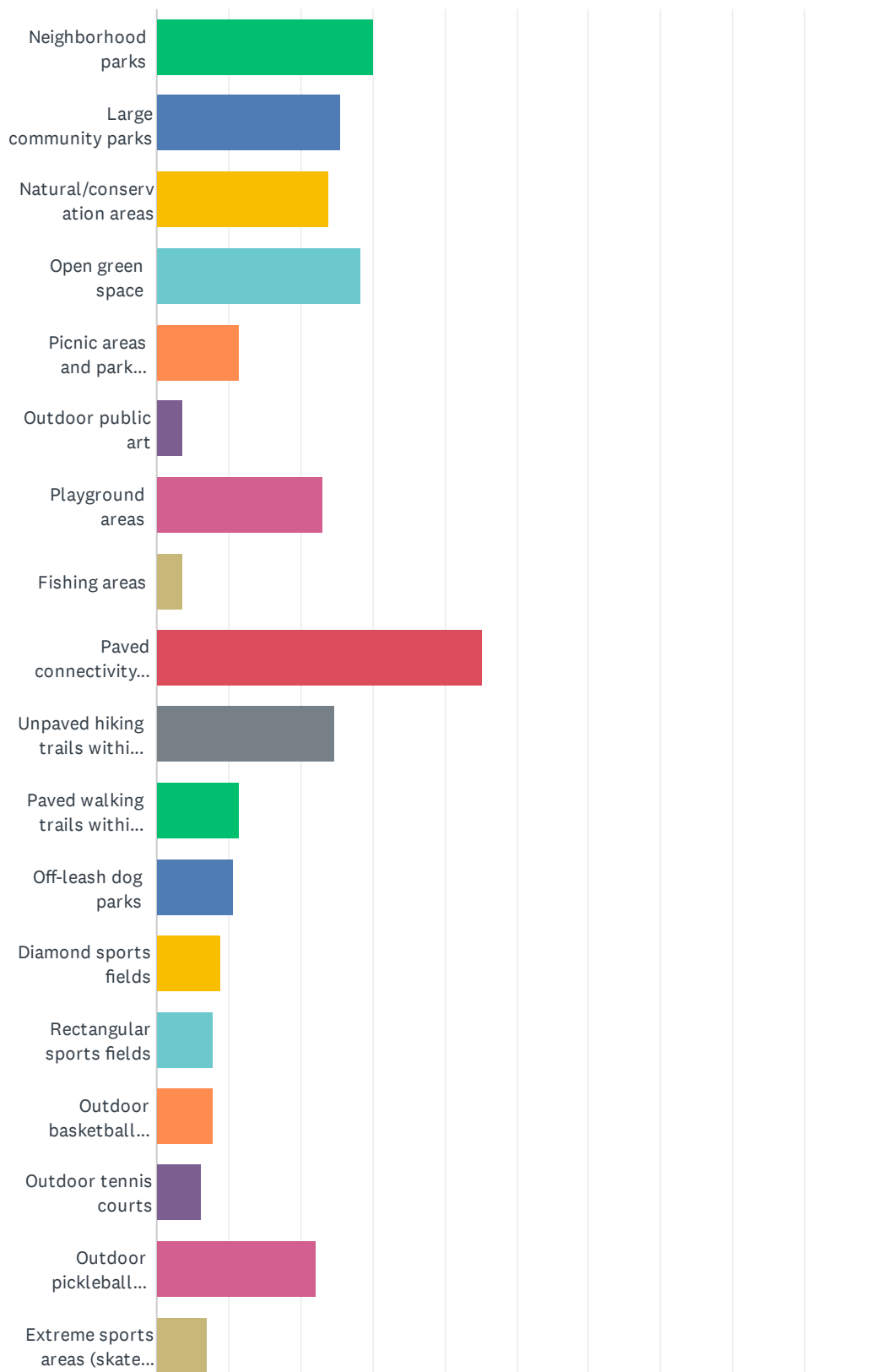


ANSWER CHOICES	RESPONSES	
None, I do not visit parks or recreation areas	1.75%	2
Personal vehicle (car, truck, van, SUV, motorcycle, etc.)	96.49%	110
Bike	27.19%	31
Walk	46.49%	53
Bus	0.00%	0
Dockless scooter or bikeshare	1.75%	2
Taxi or carshare (Uber, Lyft)	0.88%	1
Other (please specify)	0.00%	0
Total Respondents: 114		

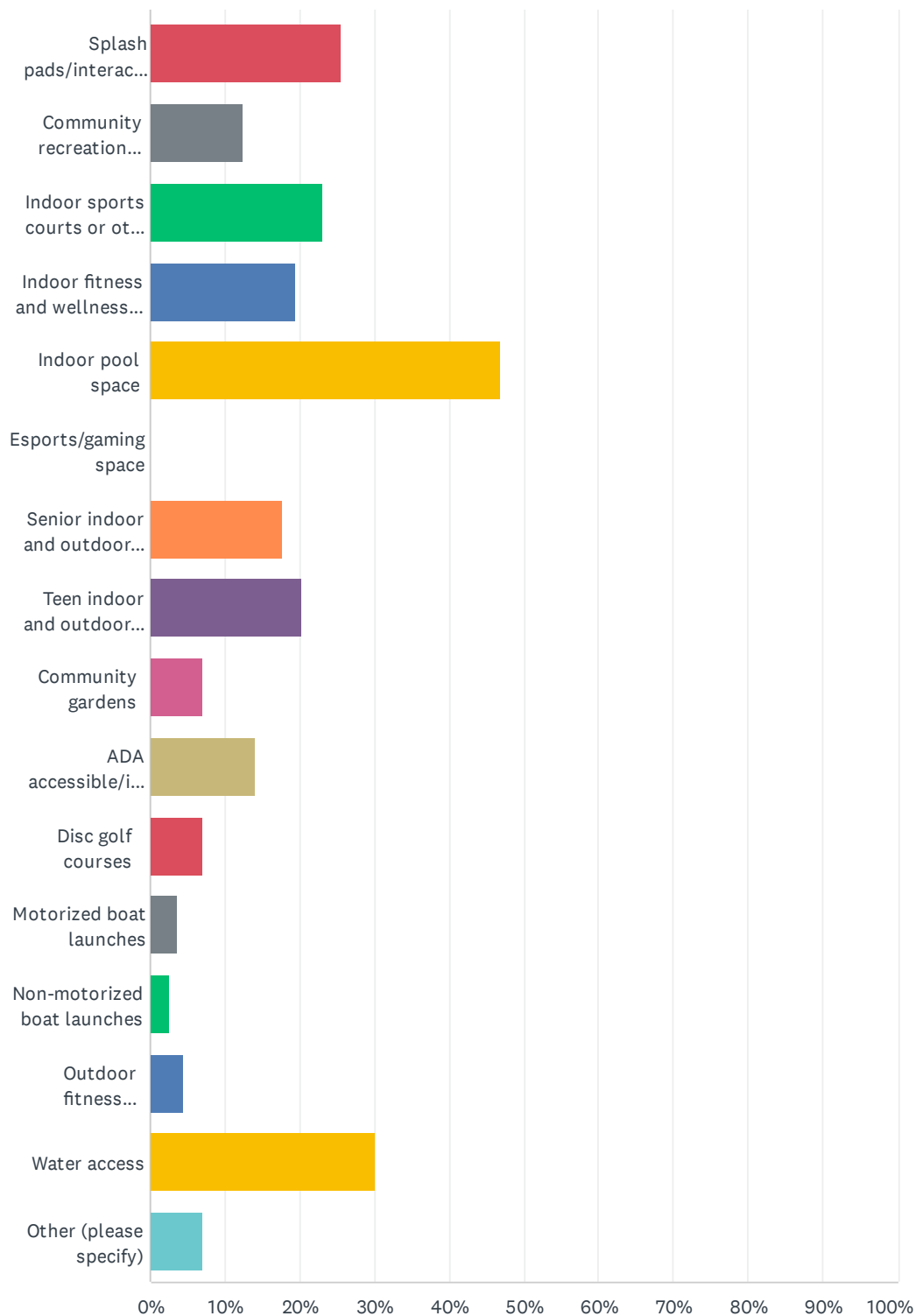
#	OTHER (PLEASE SPECIFY)	DATE
	There are no responses.	

Q20 What are the six most important recreation facilities and amenities to have in Clemson?

Answered: 113 Skipped: 64



Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey



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ANSWER CHOICES	RESPONSES	
Neighborhood parks	30.09%	34
Large community parks	25.66%	29
Natural/conservation areas	23.89%	27
Open green space	28.32%	32
Picnic areas and park shelters	11.50%	13
Outdoor public art	3.54%	4
Playground areas	23.01%	26
Fishing areas	3.54%	4
Paved connectivity trails for bikes and pedestrians (greenways)	45.13%	51
Unpaved hiking trails within parks	24.78%	28
Paved walking trails within parks	11.50%	13
Off-leash dog parks	10.62%	12
Diamond sports fields	8.85%	10
Rectangular sports fields	7.96%	9
Outdoor basketball courts	7.96%	9
Outdoor tennis courts	6.19%	7
Outdoor pickleball courts	22.12%	25
Extreme sports areas (skate parks/pump tracks)	7.08%	8
Splash pads/interactive water play or features	25.66%	29
Community recreation building/space	12.39%	14
Indoor sports courts or other indoor sporting practice facilities	23.01%	26
Indoor fitness and wellness spaces	19.47%	22
Indoor pool space	46.90%	53
Esports/gaming space	0.00%	0
Senior indoor and outdoor activity areas	17.70%	20
Teen indoor and outdoor activity areas	20.35%	23
Community gardens	7.08%	8
ADA accessible/inclusive play features and park structures	14.16%	16
Disc golf courses	7.08%	8
Motorized boat launches	3.54%	4
Non-motorized boat launches	2.65%	3
Outdoor fitness equipment	4.42%	5

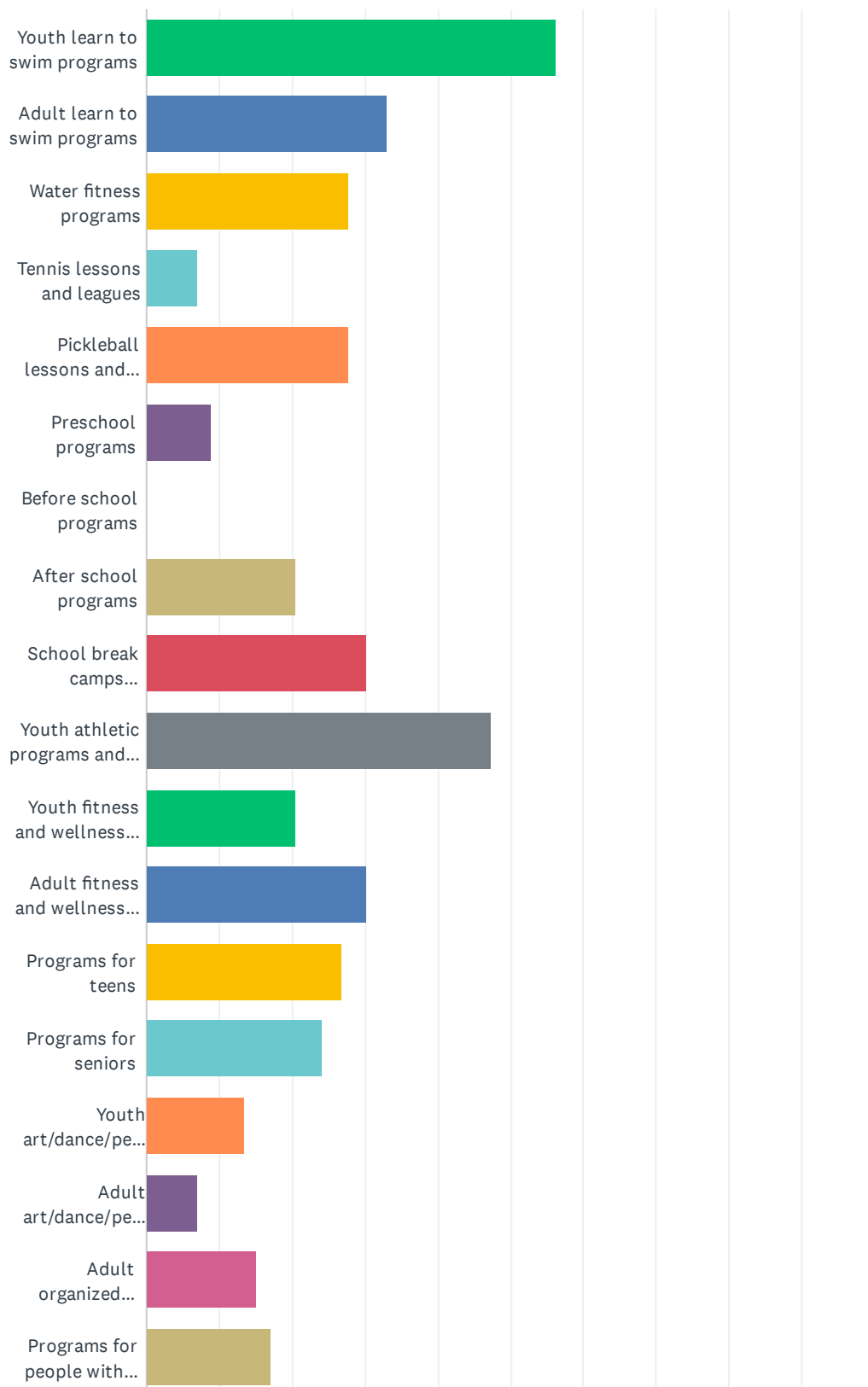
Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey

Water access	30.09%	34
Other (please specify)	7.08%	8
Total Respondents: 113		

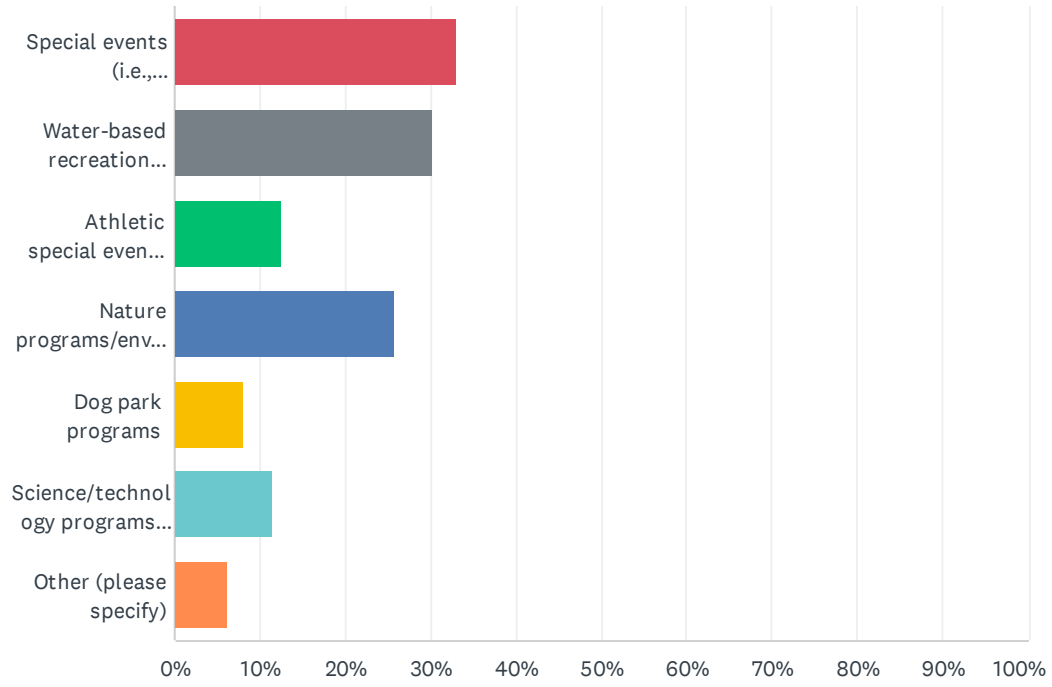
#	OTHER (PLEASE SPECIFY)	DATE
1	Trees	3/8/2024 7:21 AM
2	Covered outdoor Pickleball courts	2/19/2024 10:23 AM
3	outdoor pool space	2/12/2024 10:13 AM
4	outdoor pool space	1/28/2024 5:12 PM
5	Outdoor pool	1/27/2024 12:19 AM
6	Indoor and/or outdoor shooting range	1/26/2024 10:40 PM
7	Outdoor lap pool	1/26/2024 4:37 PM
8	Outdoor Pool	1/26/2024 1:20 PM

Q21 What are the six most important recreation programs and services to have in Clemson?

Answered: 112 Skipped: 65



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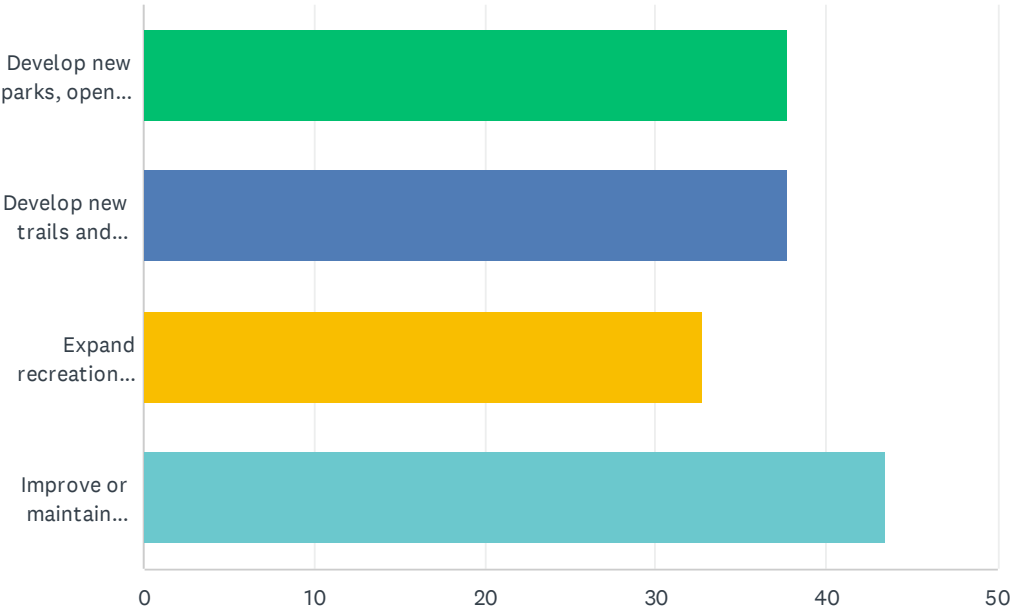
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ANSWER CHOICES	RESPONSES	
Youth learn to swim programs	56.25%	63
Adult learn to swim programs	33.04%	37
Water fitness programs	27.68%	31
Tennis lessons and leagues	7.14%	8
Pickleball lessons and leagues	27.68%	31
Preschool programs	8.93%	10
Before school programs	0.00%	0
After school programs	20.54%	23
School break camps (fall/spring/summer)	30.36%	34
Youth athletic programs and leagues	47.32%	53
Youth fitness and wellness programs	20.54%	23
Adult fitness and wellness programs	30.36%	34
Programs for teens	26.79%	30
Programs for seniors	24.11%	27
Youth art/dance/performing arts	13.39%	15
Adult art/dance/performing arts	7.14%	8
Adult organized athletic programs and leagues	15.18%	17
Programs for people with disabilities or special needs	16.96%	19
Special events (i.e., concerts, movies, history programs, and cultural events)	33.04%	37
Water-based recreation programs (e.g., sailing, kayaking, etc.)	30.36%	34
Athletic special events (i.e., cross-country or running races)	12.50%	14
Nature programs/environmental education	25.89%	29
Dog park programs	8.04%	9
Science/technology programs (kids outdoor science programs/computer classes, etc.)	11.61%	13
Other (please specify)	6.25%	7
Total Respondents: 112		

#	OTHER (PLEASE SPECIFY)	DATE
1	Clemson Aquatic Swim Team	2/20/2024 9:15 PM
2	Pickleball Open Sessions or round robins	2/19/2024 10:25 AM
3	Swim team and competition pool	1/27/2024 10:04 AM
4	Please do a sat. Morn farmers market	1/26/2024 9:45 PM
5	Swimming for kids/teens/CAT	1/26/2024 7:06 PM
6	Open space/green space/ conservation- NOT Programming	1/26/2024 1:47 PM

Q22 If you had an additional \$100, how would you allocate the funds among the parks and recreation categories listed below? Please be sure your total adds up to \$100.

Answered: 106 Skipped: 71



ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
Develop new parks, open space, and facilities	38	2,531	67
Develop new trails and greenways	38	2,604	69
Expand recreation program and event offerings	33	2,026	62
Improve or maintain existing parks, trails, and facilities	44	3,439	79
Total Respondents: 106			

#	DEVELOP NEW PARKS, OPEN SPACE, AND FACILITIES	DATE
1	25	3/8/2024 6:51 PM
2	25	3/7/2024 9:07 PM
3	50	3/1/2024 4:03 PM
4	15	2/27/2024 11:09 AM
5	20	2/23/2024 9:16 AM
6	100	2/22/2024 7:36 PM
7	30	2/22/2024 9:36 AM
8	100	2/21/2024 3:03 PM
9	10	2/21/2024 1:21 PM

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10	20	2/21/2024 11:47 AM
11	25	2/21/2024 11:45 AM
12	25	2/21/2024 10:30 AM
13	20	2/21/2024 8:32 AM
14	40	2/21/2024 8:28 AM
15	5	2/20/2024 11:27 PM
16	25	2/20/2024 10:44 PM
17	20	2/20/2024 10:40 PM
18	100	2/20/2024 8:59 PM
19	20	2/20/2024 8:53 PM
20	25	2/20/2024 8:52 PM
21	30	2/20/2024 8:50 PM
22	50	2/20/2024 3:47 PM
23	25	2/20/2024 3:17 PM
24	100	2/20/2024 2:22 PM
25	20	2/20/2024 1:26 PM
26	34	2/20/2024 10:48 AM
27	50	2/20/2024 9:30 AM
28	50	2/20/2024 9:29 AM
29	100	2/20/2024 9:07 AM
30	97	2/20/2024 8:58 AM
31	25	2/17/2024 10:08 PM
32	25	2/14/2024 8:27 PM
33	20	2/14/2024 8:18 PM
34	10	2/14/2024 8:17 PM
35	20	2/12/2024 3:59 PM
36	75	2/12/2024 10:16 AM
37	10	2/12/2024 9:34 AM
38	50	2/12/2024 9:28 AM
39	25	2/11/2024 4:33 PM
40	10	2/10/2024 9:22 PM
41	25	2/10/2024 7:04 PM
42	100	2/10/2024 5:25 PM
43	20	1/28/2024 5:13 PM
44	50	1/28/2024 8:08 AM
45	25	1/28/2024 12:27 AM
46	10	1/27/2024 6:52 PM
47	25	1/27/2024 6:11 PM

Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey

48	20	1/27/2024 1:42 PM
49	25	1/27/2024 8:36 AM
50	10	1/27/2024 8:25 AM
51	30	1/27/2024 6:49 AM
52	50	1/27/2024 6:27 AM
53	25	1/26/2024 11:49 PM
54	50	1/26/2024 10:42 PM
55	25	1/26/2024 10:37 PM
56	10	1/26/2024 9:22 PM
57	15	1/26/2024 8:28 PM
58	25	1/26/2024 7:07 PM
59	100	1/26/2024 5:26 PM
60	0	1/26/2024 5:13 PM
61	50	1/26/2024 4:38 PM
62	5	1/26/2024 3:29 PM
63	20	1/26/2024 3:07 PM
64	90	1/26/2024 1:55 PM
65	100	1/26/2024 1:22 PM
66	100	1/26/2024 1:01 PM
67	0	1/26/2024 12:08 PM
#	DEVELOP NEW TRAILS AND GREENWAYS	DATE
1	50	3/9/2024 8:42 AM
2	75	3/8/2024 1:19 PM
3	70	3/8/2024 11:55 AM
4	50	3/7/2024 9:07 PM
5	30	3/1/2024 4:03 PM
6	20	2/27/2024 11:09 AM
7	25	2/23/2024 9:16 AM
8	30	2/22/2024 9:36 AM
9	45	2/21/2024 1:21 PM
10	20	2/21/2024 11:47 AM
11	15	2/21/2024 11:45 AM
12	50	2/21/2024 10:30 AM
13	20	2/21/2024 8:32 AM
14	35	2/21/2024 8:28 AM
15	5	2/20/2024 11:27 PM
16	25	2/20/2024 10:44 PM
17	35	2/20/2024 10:40 PM

Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey

18	20	2/20/2024 8:53 PM
19	25	2/20/2024 8:52 PM
20	30	2/20/2024 8:50 PM
21	20	2/20/2024 3:47 PM
22	30	2/20/2024 3:17 PM
23	60	2/20/2024 1:26 PM
24	50	2/20/2024 12:16 PM
25	33	2/20/2024 10:48 AM
26	0	2/20/2024 9:30 AM
27	30	2/20/2024 9:29 AM
28	1	2/20/2024 8:58 AM
29	50	2/17/2024 10:08 PM
30	100	2/15/2024 9:01 PM
31	50	2/14/2024 9:25 PM
32	25	2/14/2024 8:27 PM
33	20	2/14/2024 8:18 PM
34	10	2/14/2024 8:17 PM
35	40	2/12/2024 3:59 PM
36	10	2/12/2024 10:16 AM
37	50	2/12/2024 9:34 AM
38	25	2/12/2024 9:28 AM
39	25	2/11/2024 4:33 PM
40	50	2/10/2024 11:39 PM
41	40	2/10/2024 9:22 PM
42	25	1/31/2024 1:16 PM
43	50	1/30/2024 12:41 PM
44	20	1/28/2024 5:13 PM
45	100	1/28/2024 2:22 PM
46	35	1/28/2024 8:08 AM
47	25	1/28/2024 12:27 AM
48	70	1/27/2024 6:52 PM
49	25	1/27/2024 6:11 PM
50	70	1/27/2024 1:42 PM
51	25	1/27/2024 8:36 AM
52	20	1/27/2024 8:25 AM
53	50	1/27/2024 8:02 AM
54	50	1/27/2024 7:23 AM
55	30	1/27/2024 6:49 AM

Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey

56	50	1/27/2024 6:27 AM
57	25	1/26/2024 11:49 PM
58	50	1/26/2024 10:42 PM
59	50	1/26/2024 10:24 PM
60	100	1/26/2024 9:45 PM
61	20	1/26/2024 9:22 PM
62	25	1/26/2024 8:28 PM
63	25	1/26/2024 7:07 PM
64	25	1/26/2024 5:13 PM
65	50	1/26/2024 4:38 PM
66	25	1/26/2024 3:29 PM
67	20	1/26/2024 3:07 PM
68	50	1/26/2024 12:39 PM
69	100	1/26/2024 12:08 PM
#	EXPAND RECREATION PROGRAM AND EVENT OFFERINGS	DATE
1	25	3/9/2024 8:42 AM
2	25	3/8/2024 6:51 PM
3	0	3/7/2024 9:07 PM
4	100	3/7/2024 7:41 PM
5	15	2/27/2024 11:09 AM
6	25	2/23/2024 9:16 AM
7	30	2/22/2024 9:36 AM
8	35	2/21/2024 1:21 PM
9	10	2/21/2024 11:47 AM
10	10	2/21/2024 11:45 AM
11	30	2/21/2024 8:32 AM
12	25	2/21/2024 8:28 AM
13	50	2/21/2024 7:14 AM
14	20	2/20/2024 11:27 PM
15	25	2/20/2024 10:44 PM
16	10	2/20/2024 10:40 PM
17	50	2/20/2024 10:28 PM
18	60	2/20/2024 8:53 PM
19	20	2/20/2024 8:52 PM
20	100	2/20/2024 8:50 PM
21	20	2/20/2024 3:17 PM
22	30	2/20/2024 9:30 AM
23	20	2/20/2024 9:29 AM

Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey

24	50	2/20/2024 9:05 AM
25	1	2/20/2024 8:58 AM
26	25	2/14/2024 8:27 PM
27	10	2/14/2024 8:18 PM
28	20	2/12/2024 3:59 PM
29	30	2/12/2024 9:34 AM
30	5	2/12/2024 9:28 AM
31	30	2/11/2024 4:33 PM
32	20	2/10/2024 9:22 PM
33	25	1/31/2024 1:16 PM
34	50	1/30/2024 12:41 PM
35	40	1/28/2024 5:13 PM
36	25	1/28/2024 12:27 AM
37	10	1/27/2024 6:52 PM
38	25	1/27/2024 6:11 PM
39	10	1/27/2024 1:42 PM
40	100	1/27/2024 10:05 AM
41	25	1/27/2024 8:36 AM
42	50	1/27/2024 8:25 AM
43	50	1/27/2024 8:02 AM
44	50	1/27/2024 7:23 AM
45	10	1/27/2024 6:49 AM
46	0	1/26/2024 11:49 PM
47	25	1/26/2024 10:37 PM
48	20	1/26/2024 9:22 PM
49	10	1/26/2024 8:28 PM
50	25	1/26/2024 7:31 PM
51	25	1/26/2024 7:07 PM
52	50	1/26/2024 5:57 PM
53	50	1/26/2024 5:13 PM
54	50	1/26/2024 4:26 PM
55	20	1/26/2024 3:29 PM
56	20	1/26/2024 3:07 PM
57	10	1/26/2024 1:55 PM
58	100	1/26/2024 1:26 PM
59	100	1/26/2024 1:01 PM
60	75	1/26/2024 1:00 PM
61	50	1/26/2024 12:35 PM

Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey

62	0	1/26/2024 12:08 PM
#	IMPROVE OR MAINTAIN EXISTING PARKS, TRAILS, AND FACILITIES	DATE
1	25	3/9/2024 8:42 AM
2	50	3/8/2024 6:51 PM
3	25	3/8/2024 1:19 PM
4	30	3/8/2024 11:55 AM
5	100	3/8/2024 7:23 AM
6	25	3/7/2024 9:07 PM
7	20	3/1/2024 4:03 PM
8	50	2/27/2024 11:09 AM
9	30	2/23/2024 9:16 AM
10	10	2/22/2024 9:36 AM
11	100	2/21/2024 5:39 PM
12	10	2/21/2024 1:21 PM
13	50	2/21/2024 11:47 AM
14	50	2/21/2024 11:45 AM
15	100	2/21/2024 11:27 AM
16	25	2/21/2024 10:30 AM
17	30	2/21/2024 8:32 AM
18	50	2/21/2024 7:14 AM
19	70	2/20/2024 11:27 PM
20	25	2/20/2024 10:44 PM
21	35	2/20/2024 10:40 PM
22	50	2/20/2024 10:28 PM
23	100	2/20/2024 9:44 PM
24	100	2/20/2024 9:16 PM
25	30	2/20/2024 8:52 PM
26	40	2/20/2024 8:50 PM
27	100	2/20/2024 8:05 PM
28	30	2/20/2024 3:47 PM
29	25	2/20/2024 3:17 PM
30	20	2/20/2024 1:26 PM
31	50	2/20/2024 12:16 PM
32	100	2/20/2024 11:40 AM
33	33	2/20/2024 10:48 AM
34	20	2/20/2024 9:30 AM
35	50	2/20/2024 9:05 AM
36	1	2/20/2024 8:58 AM

Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey

37	25	2/17/2024 10:08 PM
38	50	2/14/2024 9:25 PM
39	25	2/14/2024 8:27 PM
40	50	2/14/2024 8:18 PM
41	80	2/14/2024 8:17 PM
42	20	2/12/2024 3:59 PM
43	15	2/12/2024 10:16 AM
44	10	2/12/2024 9:34 AM
45	20	2/12/2024 9:28 AM
46	20	2/11/2024 4:33 PM
47	50	2/10/2024 11:39 PM
48	30	2/10/2024 9:22 PM
49	75	2/10/2024 7:04 PM
50	50	1/31/2024 1:16 PM
51	20	1/28/2024 5:13 PM
52	15	1/28/2024 8:08 AM
53	25	1/28/2024 12:27 AM
54	10	1/27/2024 6:52 PM
55	25	1/27/2024 6:11 PM
56	0	1/27/2024 1:42 PM
57	25	1/27/2024 8:36 AM
58	20	1/27/2024 8:25 AM
59	30	1/27/2024 6:49 AM
60	100	1/27/2024 12:21 AM
61	50	1/26/2024 11:49 PM
62	100	1/26/2024 11:00 PM
63	50	1/26/2024 10:37 PM
64	50	1/26/2024 10:24 PM
65	50	1/26/2024 9:22 PM
66	50	1/26/2024 8:28 PM
67	75	1/26/2024 7:31 PM
68	25	1/26/2024 7:07 PM
69	50	1/26/2024 5:57 PM
70	25	1/26/2024 5:13 PM
71	50	1/26/2024 4:26 PM
72	50	1/26/2024 3:29 PM
73	40	1/26/2024 3:07 PM
74	100	1/26/2024 1:47 PM

Clemson (SC) Parks and Recreation Strategic Master Plan Community Survey

75	25	1/26/2024 1:00 PM
76	50	1/26/2024 12:39 PM
77	50	1/26/2024 12:35 PM
78	0	1/26/2024 12:08 PM
79	100	1/24/2024 11:07 PM

Q23 Please rate your level of satisfaction with the overall value that your household receives from the City of Clemson Parks and Recreation Department.

Answered: 108 Skipped: 69

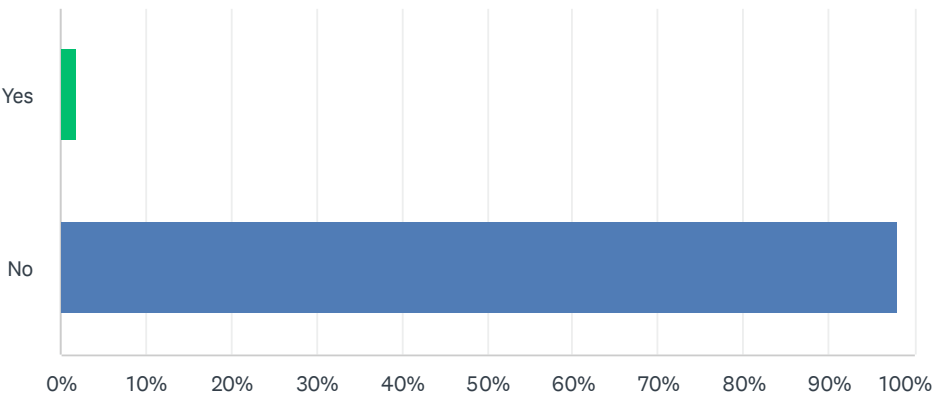
4.0★
average rating



	VERY DISSATISFIED	SOMEWHAT DISSATISFIED	NEUTRAL	SOMEWHAT SATISFIED	VERY SATISFIED	DON'T KNOW/NO OPINION	TOTAL	WEIGHTED AVERAGE
☆	0.00% 0	10.19% 11	8.33% 9	46.30% 50	28.70% 31	6.48% 7	108	4.00

Q24 Are you currently enrolled as a Clemson University student?

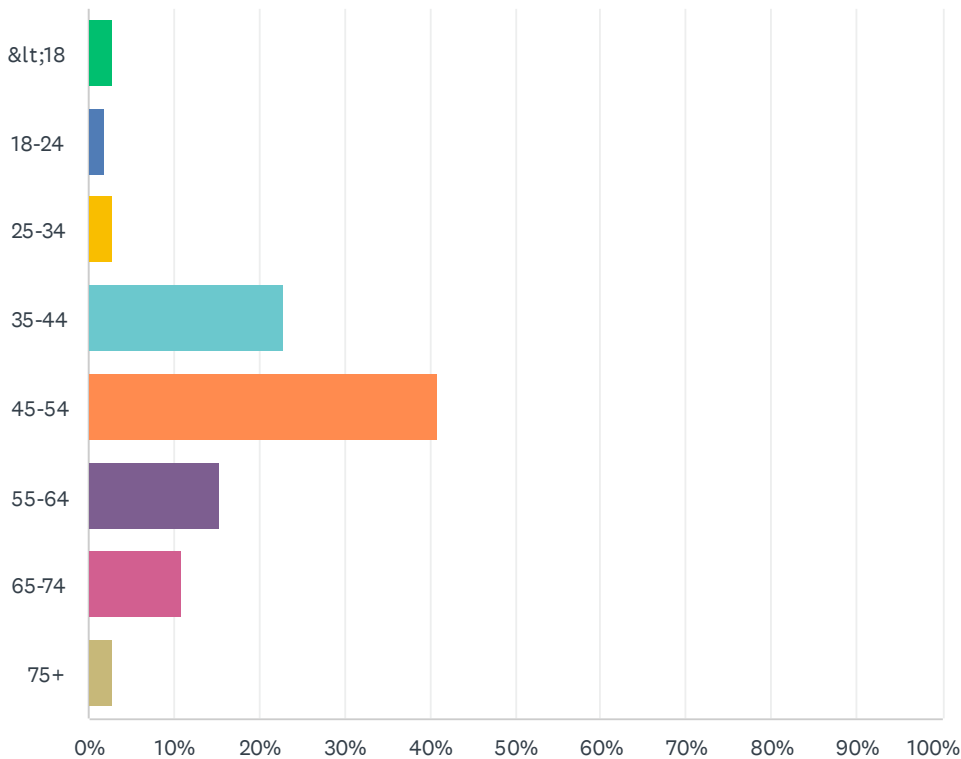
Answered: 109 Skipped: 68



ANSWER CHOICES	RESPONSES	
Yes	1.83%	2
No	98.17%	107
TOTAL		109

Q25 What is your age?

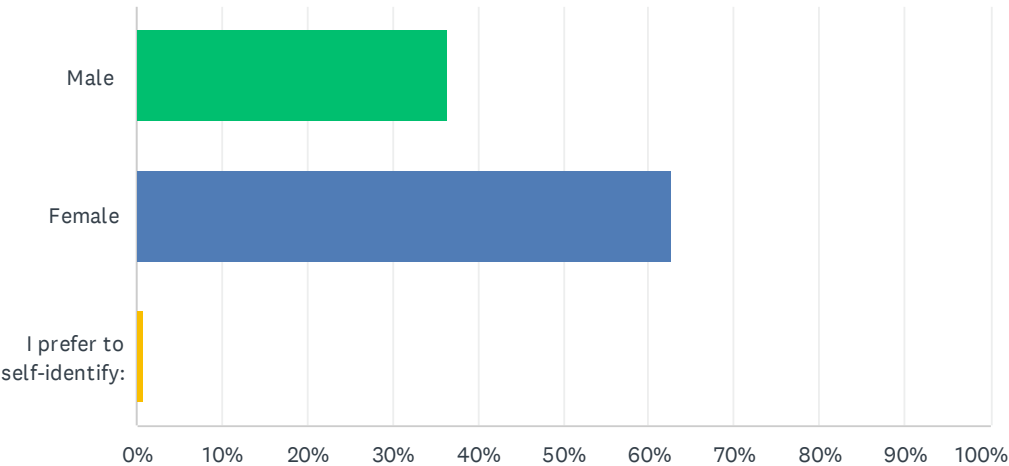
Answered: 110 Skipped: 67



ANSWER CHOICES	RESPONSES	
<18	2.73%	3
18-24	1.82%	2
25-34	2.73%	3
35-44	22.73%	25
45-54	40.91%	45
55-64	15.45%	17
65-74	10.91%	12
75+	2.73%	3
TOTAL		110

Q26 What is your gender?

Answered: 110 Skipped: 67

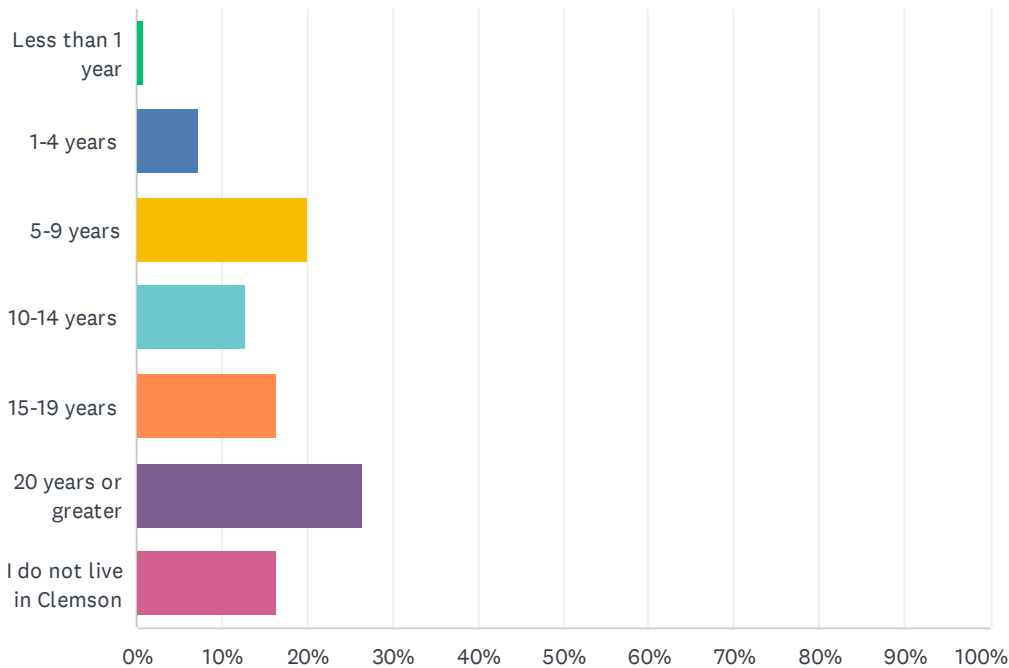


ANSWER CHOICES		RESPONSES	
Male		36.36%	40
Female		62.73%	69
I prefer to self-identify:		0.91%	1
TOTAL			110

#	I PREFER TO SELF-IDENTIFY:	DATE
1	Non-binary	2/14/2024 8:20 PM

Q27 How many years have you lived in Clemson?

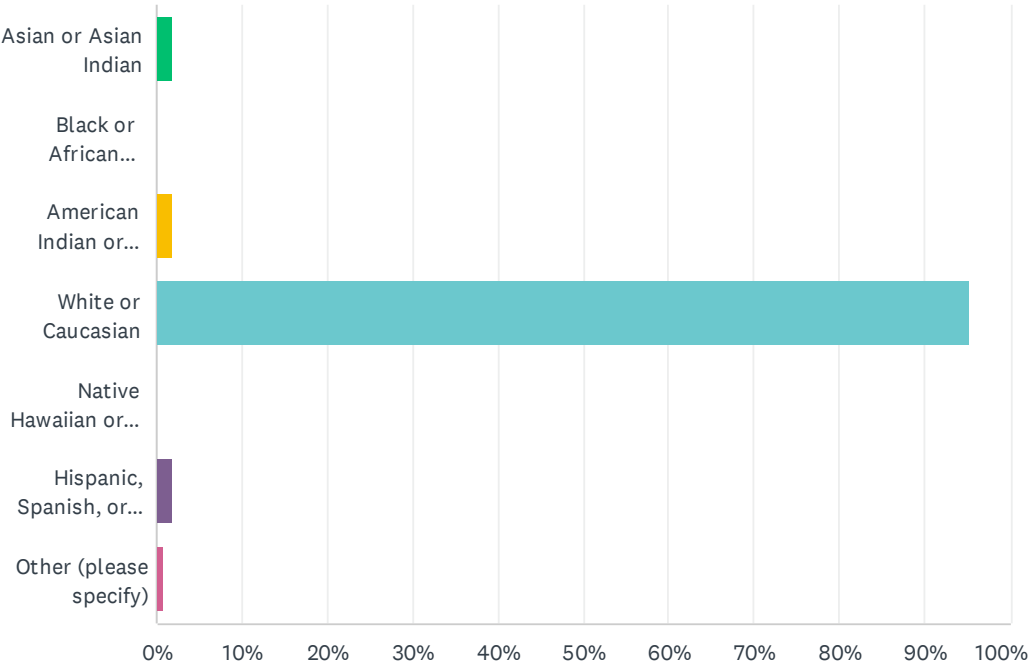
Answered: 110 Skipped: 67



ANSWER CHOICES	RESPONSES	
Less than 1 year	0.91%	1
1-4 years	7.27%	8
5-9 years	20.00%	22
10-14 years	12.73%	14
15-19 years	16.36%	18
20 years or greater	26.36%	29
I do not live in Clemson	16.36%	18
TOTAL		110

Q28 Which of the following best describes your race/ethnicity? Select all that apply.

Answered: 107 Skipped: 70

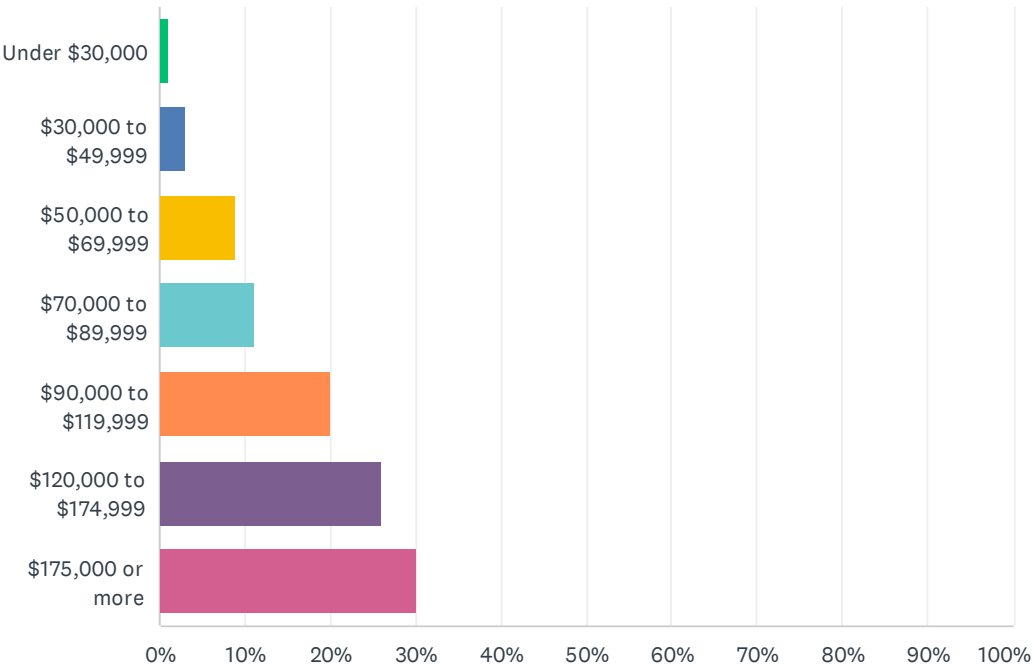


ANSWER CHOICES		RESPONSES	
Asian or Asian Indian		1.87%	2
Black or African American		0.00%	0
American Indian or Alaska Native		1.87%	2
White or Caucasian		95.33%	102
Native Hawaiian or other Pacific Islander		0.00%	0
Hispanic, Spanish, or Latino/a/x		1.87%	2
Other (please specify)		0.93%	1
Total Respondents: 107			

#	OTHER (PLEASE SPECIFY)	DATE
1	American!	2/20/2024 11:41 AM

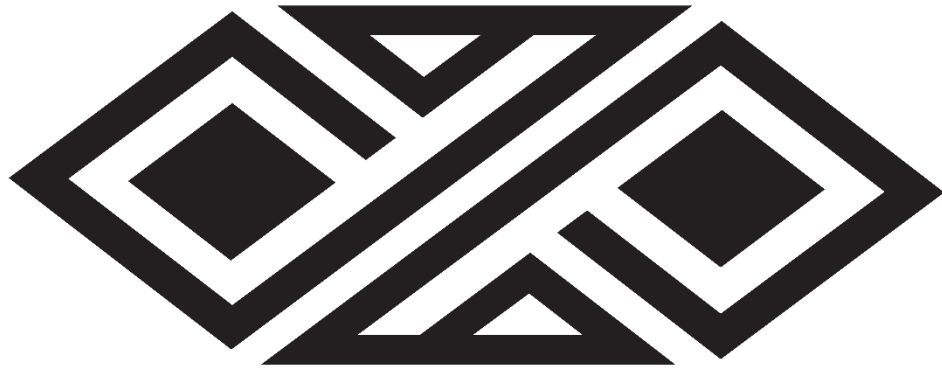
Q29 Would you say your total household annual income is...

Answered: 100 Skipped: 77



ANSWER CHOICES	RESPONSES	
Under \$30,000	1.00%	1
\$30,000 to \$49,999	3.00%	3
\$50,000 to \$69,999	9.00%	9
\$70,000 to \$89,999	11.00%	11
\$90,000 to \$119,999	20.00%	20
\$120,000 to \$174,999	26.00%	26
\$175,000 or more	30.00%	30
TOTAL		100

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CITY OF
Clemson
PLANNING &
DEVELOPMENT

NOTICE OF PUBLIC HEARING

The City of Clemson City Council will hold a public hearing beginning at **5:30 p.m.** on **July 15, 2024**, on the following matter:

2024-R-02 Proposed Text Amendment (Non-residential Setbacks and PD Acreage)

As currently drafted, minimum side setbacks in the C (General Commercial), CM (Commercial Mixed-Use), CP-1 (Neighborhood Business), CP-2 (Community Business), CP-3 (Highway Service), and OP (Office-Professional) Districts would be amended to fifteen (15) feet; and the minimum area for new planned developments (PD's) would be amended to four (4) contiguous acres, excepting those adjoined solely by the R-20 or R-12 Single-family Residential Districts, which would be required to have a minimum area of five (5) acres.

The public hearing will be held in the **Council Chambers at City Hall, 1250 Tiger Boulevard, Clemson, SC**, and will also be livestreamed on the City of Clemson's YouTube channel.

Copies of documents can be obtained through links on the City Website's Calendar of Events. Comments may be submitted in person during the session; or in advance on the City's MyCivic App. Contact the Planning and Development Department (864-653-2050) for more information.

At their meeting on April 15, 2024, City Council referred the following proposed amendments to current non-residential setbacks and planned development acreage requirements to the Planning Commission for discussion and consideration. The Commission took the matter up for discussion at their May 13, 2024 meeting; and on June 10, 2024 voted 5–0 to not recommend the proposed changes. Proposed changes are shown in **RED** font.

CODE OF ORDINANCES

CHAPTER 19 ZONING

ARTICLE IV. NON-RESIDENTIAL DISTRICTS AND DISTRICT REGULATIONS

Sec. 19-404. Density, bulk, and dimensional requirements for principal and accessory uses and/or structures in the non-residential districts.

Table 19-404-1. Density, Bulk, and Dimensional Requirements for Principal and Accessory Uses and/or Structures in the Non-residential Districts

USE	Districts									
	C	CM	CP-1	CP-2	CP-3	OP	RIL	OR	M	
A. MINIMUM DIMENSIONAL AND/OR BULK STANDARDS FOR ALL NON-RESIDENTIAL DISTRICTS										
1. Front <u>setback</u> , max.	3'/15' ¹	15' ²	15' ¹⁴	35'	35'	25'	35'			See Section 19-404-1. Endnotes 1, 2, 14
2. Front setback, min.	0'	10'/12' ²	8'	8'	15'	8'	35'	25'	50' ³	See Section 19-404-1. Endnotes 2 & 3
3. Side setback, min.	0' ^{15'}	0' ^{15'}	0' ^{15'}	0' ^{15'}	0' ^{15'}	0' ^{15'}	25'	10'	50' ³	See Section 19-404-1. Endnote 3
4. Side setback, max.	0' ⁴	0' ⁴								See Section 19-404-1. Endnote 4
5. Rear setback, min.	10'	10' ⁵	25'	25' ⁶	25'	25'	35'	25'	100' ³	See Section 19-404-1. Endnotes 3, 5, 6

ARTICLE V. PLANNED DEVELOPMENT (PD) DISTRICT REGULATIONS

Sec. 19-503. District regulations.

The following regulations apply to designated uses and development in PD districts, other provisions in this article to the contrary notwithstanding:

- A. A PD shall encompass a minimum of ~~two~~ **four** contiguous acres; however, a PD must be a minimum of ~~four~~ **five** contiguous acres when adjoined solely by the R-20 or R-12 districts. Locations across a street or alley are considered to be adjoining.



CITY OF **Clemson** SOUTH CAROLINA

NOTICE OF PUBLIC HEARING

The City of Clemson City Council will hold a public hearing beginning at 5:00 p.m. on July 15, 2024 on the passage of a proposed ordinance entitled:

AUTHORIZING THE EXECUTION AND DELIVERY OF AN INTERGOVERNMENTAL WASTEWATER CAPACITY AND SERVICES AGREEMENT AND A PROJECT MANAGEMENT AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION IN CONNECTION WITH THE EXPANSION OF THE PENDLETON/CLEMSON REGIONAL WASTEWATER TREATMENT PLANT; AND OTHER MATTERS RELATING THERETO.

The public hearing will be held in the
Council Chambers at City Hall,
1250 Tiger Boulevard,
Clemson, SC

All interested persons may appear and be heard at the public hearing.

INTERGOVERNMENTAL
WASTEWATER CAPACITY AND SERVICES
AGREEMENT

among the

Town of Pendleton, South Carolina

and

City of Clemson, South Carolina, and
Anderson County, South Carolina

_____, 2024

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EXHIBIT B – Current Bonds and Debt Service

EXHIBIT C – Service Areas Map

This **INTERGOVERNMENTAL WASTEWATER CAPACITY AND SERVICES AGREEMENT** (the “**Agreement**”) is made this ____ day of _____, 2024 (the “**Effective Date**”), by and among the **CITY OF CLEMSON, SOUTH CAROLINA** (“**Clemson**”), **ANDERSON COUNTY, SOUTH CAROLINA** (“**Anderson**”) (collectively the “**Purchasers**” and each, individually, a “**Purchaser**”), and the **TOWN OF PENDLETON, SOUTH CAROLINA** (“**Pendleton**,” or the “**Seller**,” as the context requires). Each entity may hereinafter be referred to as a “**Party**” or collectively as the “**Parties**.”

BACKGROUND AND FINDINGS

(A) Capitalized terms used in this Agreement shall have the meanings given to such terms in Section 1.1 of this Agreement. In the event that a capitalized term is defined elsewhere in this Agreement and is also defined in Section 1.1 of this Agreement, and there is any inconsistency between such definitions, the definition in Section 1.1 of this Agreement shall control.

(B) Clemson is a municipal corporation and a political subdivision of the State of South Carolina (the “**State**”) and possesses all general powers granted by the Constitution of the State of South Carolina 1895, as amended (the “**State Constitution**”) and statutes of the State to municipal corporations. Clemson has heretofore lawfully established and now operates a municipal water and wastewater system, which generally serves the entire area of the City of Clemson and certain populated areas adjacent to its corporate limits.

(C) Anderson is a county and a political subdivision of the State, and possesses all general powers granted by the State Constitution and statutes of the State to counties thereof. Anderson has heretofore lawfully established and now operates a wastewater system, which generally serves portions of the unincorporated area of Anderson, and certain areas within the municipalities of Iva, Anderson, and Pendleton by agreement, however Anderson’s Designated Service Area (as defined herein) consists of the entire unincorporated area of Anderson, except as depicted in Exhibit C hereto and as set forth herein.

(D) Pendleton is a municipal corporation and a political subdivision of the State and possesses all general powers granted by the State Constitution and statutes of the State to municipal corporations. Pendleton has heretofore lawfully established and now operates a municipal water and wastewater system, which generally serves the entire area of Pendleton and certain populated areas adjacent to its corporate limits. Pendleton has lawfully established and now operates a wastewater treatment and disposal system that provides service to the wastewater systems operated by Clemson and Anderson.

(E) Pursuant to agreements dated as of May 19, 1978, and June 7, 1978, Clemson and Pendleton jointly constructed a wastewater treatment plant (the “**Plant**”) located on S.C. Highway 279 within the municipal limits of Pendleton. By agreements dated December 19, 1988, and July 21, 2015, Anderson obtained certain capacity in the Plant by agreement with Pendleton.

(F) The current permitted treatment capacity of the Plant is 2,000,000 gallons per day (“**GPD**”), which has been allocated 50% to Clemson, 40% to Pendleton, and 10% to Anderson. The Parties seek to expand the treatment capacity of the Plant to 5,000,000 GPD (the “**Project**”) in order to meet existing and anticipated future wastewater treatment needs of the Parties, to promote economic growth, to provide cost effective sewer service to the Parties’ respective customers, and prepare for continued population growth in and around the Parties. Capacity in the Plant following the Date of Substantial Completion (as defined herein) of the Project shall be as set forth at Exhibit A hereof.

(G) Through a separate project agreement (the “**Project Agreement**”) of even date herewith, the Parties have memorialized the procurement, management, and cost-sharing responsibility of each Party related to the Project. The total cost of the Project is \$64,328,198.00. The Parties expect the Project Agreement to provide for a Project cost allocation of 43.33% to Anderson, 23.33% to Pendleton, and 33.34% to Clemson, and further provide that any grant funds that have or will be obtained shall reduce the overall Project cost prior to allocation, except that the first \$600,000 of the initial grant funds received shall be paid or applied against amounts due by Pendleton.

(H) Through this Agreement, the Parties seek to memorialize each Party’s right to capacity in the Plant, the payment obligations of the Parties, and various other matters necessary to provide a comprehensive agreement whereby the Parties join together to provide wastewater services from the Plant for their mutual benefit. Each Party (i) has found this Agreement to be in the best interest of the public, the Parties, and the consumers to be served; and (ii) has been duly authorized by its respective governing body to sign this Agreement. The undersigned officers have been duly authorized to sign on behalf of their respective Parties.

NOW, THEREFORE, in consideration of the premises hereinabove set forth and the agreements of the Parties hereunder, the Parties agree as follows:

ARTICLE I

DEFINITIONS

Section 1.1 Definitions. In addition to any words and terms elsewhere defined in this Agreement, the following words and terms shall have the following meanings unless some other meaning is plainly intended:

“**2009 SRF Loan**” means the obligation issued by Pendleton and purchased by the South Carolina Water Quality Revolving Fund Authority (loan assistance number F1-123-09-472-05) to finance improvements to the Plant, issued in the original principal amount of approximately \$1,620,850, dated November 12, 2009, with final maturity on January 1, 2031.

“**Accounting Principles**” means generally accepted accounting principles (“**GAAP**”) and practices applicable to governmental entities in the United States, including those applicable to enterprise funds that relate to governmentally owned and operated utility systems, as may be amended or revised from time to time.

“Advisory Board” means the three-member board comprised of the County Administrator of Anderson, the City Administrator of Clemson, and the Town Administrator of Pendleton, and any person acting in an interim capacity as one of the foregoing. Each member shall serve on an *ex officio* basis while employed in such capacity and no person shall serve on the Advisory Board in a holdover capacity.

“Agreement” has the meaning given such term in the preamble to this Agreement.

“Allocated Capacity” or **“Allocated Capacities”** means, for the applicable period, the amount of the capacity of the Plant granted to Purchasers or retained by Seller. The Allocated Capacity for each Party, including the timeframe in which such Allocated Capacity is in effect, is set forth in Exhibit A to this Agreement. Allocated Capacity may be amended from time-to-time in accordance with Article III hereof. Allocated Capacity is expressed in MGD and is the maximum amount of wastewater that Seller is committed to accept from the holder of such Allocated Capacity in a day, as that term is defined in this Agreement.

“Allocated Percentage” or **“Allocated Percentages”** means, for the applicable period, the percentage derived by dividing each Purchaser’s or Seller’s Allocated Capacity by the capacity in the Plant. The Allocated Percentage for each Party, including the timeframe in which such Allocated Percentage is in effect, is set forth in Exhibit A to this Agreement.

“Anderson” has the meaning given such term in the preamble to this Agreement.

“Anderson’s System” means Anderson’s system for the collection and transmission of wastewater.

“Annual Budget” means, with respect to any given Fiscal Year, the budget prepared for the revenues and expenses of the Plant, exclusive of Seller’s System, for such Fiscal Year. The Annual Budget shall contain detail comparable to the utility fund portion of Pendleton’s annual budget for such Fiscal Year, and shall include a projection of the Revenue Requirement (including a line-item projection of the components thereof) for such Fiscal Year.

“Bonds” means any bonds, notes, loans, or other debt obligations issued or incurred by or on behalf of the Seller for purposes of financing or refinancing capital improvements to the Plant to the extent such capital improvements are necessary in order to provide the Wastewater Services to the Parties. Such term shall include only those Bonds listed on Exhibit B to this Agreement and such additional Bonds as may be authorized as provided in Sections 3.6 and 3.7 of this Agreement.

“Business Day” means any day other than a Saturday, Sunday, federal holiday in the United States of America, or day on which banking institutions in the State of New York are authorized or required by law or other governmental action to close.

“Capital Charge” means 1/12 of a charge calculated to recover from a Party its share of Capital Component for a given Fiscal Year, computed in compliance with the terms of this Agreement, it being understood that the Future Capital Component for a given Fiscal Year may

be allocated by agreement among the Parties on a basis other than the then applicable Allocated Percentages.

“Capital Component” means, with respect to a given Fiscal Year, an amount equal to the sum of the Current Capital Component and the Future Capital Component described below:

- (1) **“Current Capital Component”** means the Current Capital Costs for such Fiscal Year; and
- (2) **“Future Capital Component”** means the Future Capital Improvement Costs for such Fiscal Year that are not defrayed by Bonds.

“Clemson” has the meaning given such term in the preamble to this Agreement.

“Clemson’s System” means Clemson’s system for the collection and transmission of wastewater.

“Connecting Meters” means the meters at the point or points of connection from Purchasers’ Systems to Seller’s System. Connecting Meters shall be installed or configured so as to accurately measure flow from each Party individually.

“Contingency Fund” means the fund of that name established and maintained by Seller for purposes of meeting contingency requirements during a given Fiscal Year, as described in Section 3.4(I) of this Agreement.

“Contingency Fund Amount” means, with respect to any Fiscal Year, an amount equal to that percentage of the aggregate Operation and Maintenance Expenses for the immediately preceding Fiscal Year as approved by a unanimous determination of the Advisory Board as part of the Annual Budget, as may be amended from time to time. Initially, for the first Fiscal Year, such amount shall be 0%.

“Current Capital Costs” means all capital costs treated as capital expenditures under Accounting Principles required in a given Fiscal Year to enable Seller to maintain the Plant’s capability to accept the Parties’ wastewater for treatment and to comply with all applicable regulatory standards, except for those capital expenses and costs that constitute Future Capital Improvement Costs.

“Date of Substantial Completion” means the date on which the Project is completed and is legally and actually capable of providing 5 MGD of Wastewater Services to the Parties.

“Debt Service Charge” means 1/12 of a charge calculated to recover from a Party its share of Debt Service Expenses for a Fiscal Year, computed in compliance with the terms of this Agreement.

“Debt Service Expenses” means an amount equal to the sum of the components described below:

- (1) **“Prior Bonds Component”** means the amount of Debt Service Expenses associated with the 2009 SRF Loan listed on Exhibit B. Each Purchaser’s share of the Prior Bonds Component is listed on Exhibit B.
- (2) **“New Bonds Component”** means the amount of Debt Service Expenses associated with each series of Bonds (other than those Bonds listed on Exhibit B on the Effective Date) issued to defray the cost of Future Capital Improvement Costs as authorized by Sections 3.6 and 3.7 of this Agreement. Each Purchaser’s share of the New Bonds Component shall be allocated as provided in Sections 3.6 and 3.7.
- (3) **“Debt Service Coverage Component”** means an additional percentage applied proportionally to the Debt Service Expenses associated with each series of Bonds for which a Party is responsible for paying, that shall be sufficient to allow the Seller to comply with the reasonable debt service coverage ratios imposed in the authorizing documents under which those Bonds are issued. The Debt Service Coverage Component shall not exceed 20% of the Prior Bonds Component plus the New Bonds Component.

“Depreciation Charge” means 1/12 of a charge calculated to recover from a Party its share of the Depreciation Component for a given Fiscal Year, computed in compliance with the terms of this Agreement.

“Depreciation Component” means, with respect to any given Fiscal Year, the amount set forth in Seller’s Annual Budget as the amount necessary and sufficient to fund the Plant Renewal and Replacement Fund for such Fiscal Year. The Depreciation Component shall be calculated to provide funds necessary and sufficient to provide a reasonable reserve for the repair, renewal, and replacement of the Plant.

“Designated Service Area” has the meaning given such term in Section 5-7-60 of the South Carolina Code and also includes the area within the municipal limits of the applicable municipality.

“DHEC” means the South Carolina Department of Health and Environmental Control, or any successor agency of the State with jurisdiction over the Plant.

“Effective Date” has the meaning given such term in the preamble to this Agreement.

“Fiscal Year” means the fiscal year of the Seller as it may be officially established or changed from time to time. The current Fiscal Year of the Seller begins each July 1 and ends on the following June 30.

“Force Majeure” means, to the extent beyond the control of the Party claiming an event of Force Majeure, any of the following: acts of God or nature; strikes, lockouts, or other industrial disturbances; acts of a public enemy; orders of any kind of the government of the United States or the State or the courts thereof, or any civil or military authority; insurrections, riots, epidemics, pandemics, landslides, lightning, earthquakes, fires, hurricanes, storms, floods, washouts, droughts, arrests, restraint of government and people, civil disturbances, and

explosions; malfunctions of machinery and pipe lines; partial or entire failure of electric supply; or the inability of Seller to receive wastewater or operate the Plant hereunder, or a Purchaser to control wastewater flows hereunder, on account of any other causes not reasonably within the control of the Party claiming such inability.

“Future Capital Improvement Costs” means all capital costs treated as capital expenditures under Accounting Principles to be completed in the then subsequent Fiscal Years, whether or not expenses are incurred in the then current Fiscal year, for projects needed to maintain or expand the capacity of the Plant as provided for in Sections 3.6 and 3.7 of this Agreement.

“Good Utility Practices” means any of the practices, methods, and acts engaged in or approved by a significant portion of the wastewater treatment industry in the United States during the relevant time period, or any of the practices, methods, and acts that, in the exercise of reasonable judgment in light of the facts known at the time the decision was made, could have been expected to accomplish the desired results at a reasonable cost consistent with good business practices, reliability, safety, and expedition. Good Utility Practices do not require use of the optimum or a specific practice, method, or act, but only require use of practices, methods, or acts generally accepted in the wastewater treatment industry in the United States.

“Independent Consultants” means such firm or firms, consisting of or employing registered engineers, architects, rate consultants, accountants, or other professionals having skill and experience in utility financing and rate design, maintenance, operation, or evaluation of the costs and appropriate charges therefor of facilities such as Seller’s System, and which are engaged by Seller in its discretion to perform such services.

“Metered Flow” means the actual measured flow of a Party’s wastewater treated at the Plant.

“MGD” means millions of gallons per day, with the term “day” being understood to refer to the 24-hour period commencing at 12:00 a.m. (midnight) Eastern Time of a given calendar day.

“Operation and Maintenance Charge” means 1/12 of a charge calculated to recover from a Party its share of Operation and Maintenance Expenses for a Fiscal Year, computed in compliance with the terms of this Agreement.

“Operation and Maintenance Expenses” means reasonable and necessary direct expenses required (i) to operate the Plant for the provision of Wastewater Services; (ii) to maintain the Plant so that it will have a reasonable useful life; (iii) to defray the costs of current repairs to the Plant necessary for the delivery of Wastewater Services; (iv) to provide accounting, auditing, clerical and other related services relating to the foregoing, including the determination of and invoicing for all charges and expenses set forth in this Agreement; and (v) to replenish and maintain the Contingency Fund, all in accordance with this Agreement, and all as calculated in accordance with Accounting Principles. Operation and Maintenance Expenses do not include expenses that can be recovered as Depreciation Charges, Capital Charges, or Debt Service Charges.

“Party” or **“Parties”** has the meaning given such term in the preamble to this Agreement.

“Pendleton” has the meaning given such term in the preamble to this Agreement.

“Plant” has the meaning given such term in the preamble to this Agreement, as the same may be improved or expanded from time to time in accordance herewith.

“Plant Renewal and Replacement Fund” means the fund established by Seller to account for payments of Depreciation Charges and any analogous charges paid by the Parties.

“Prior Agreements” means the following agreements:

- (1) June 7, 1978 agreement between Pendleton and Clemson regarding the construction of the Plant;
- (2) June 7, 1978 agreement between Pendleton and Clemson regarding the operation of the Plant;
- (3) June 2, 1980 agreement between Pendleton and Clemson regarding the operation of the Plant;
- (4) May 19, 1988 agreement between Pendleton and Clemson regarding the Plant;
- (5) December 19, 1988 agreement among Pendleton, Clemson, and Anderson regarding Anderson’s capacity in the Plant;
- (6) November 17, 1989 agreement between Pendleton and Clemson regarding capacity allocation in the Plant and other matters;
- (7) March 10, 1992 agreement between Pendleton and Clemson regarding certain reimbursements;
- (8) May 31, 2001 letter of understanding between Pendleton and Clemson regarding staffing at the Plant and other matters;
- (9) July 1, 2001 agreement among Pendleton, Clemson, and Anderson regarding capacity leasing;
- (10) November 12, 2009 agreement among Pendleton, Clemson, and Anderson regarding debt service payments in connection with the Plant; and
- (11) July 21, 2015 agreement between Pendleton and Anderson regarding capacity in the Plant, service areas, and related matters.

“**Purchaser**” means, together or individually as the context requires, Anderson or Clemson, or both, and their respective successors and assigns.

“**Purchaser’s System**” or “**Purchasers’ Systems**” means, individually or collectively, as the context requires, Anderson’s System or Clemson’s System, or both.

“**Revenue Requirement**” means, for each Fiscal Year or period in question, all revenue necessary to recover the Operation and Maintenance Expenses, Debt Service Expenses, Capital Component, and Depreciation Component. An illustrative calculation of the Revenue Requirement in the detail required to be provided to the Advisory Board is attached as Exhibit D.

“**Seller**” means the Town of Pendleton, South Carolina.

“**Seller’s System**” means Seller’s entire system for the collection, transmission, treatment, discharge, management, and disposal of wastewater, including the Plant.

“**Service Area**” means, with respect to each Party, the area within which each Party is permitted by applicable law to provide wastewater services. The Service Areas of the respective Parties are shown in Exhibit C hereto.

“**South Carolina Code**” means the Code of Laws of South Carolina 1976, as amended.

“**State**” has the meaning given such term in the Background and Findings of this Agreement.

“**State Constitution**” has the meaning given such term in the Background and Findings of this Agreement.

“**Wastewater Services**” means Seller’s collection, transmission, treatment, discharge, management, and disposal of wastewater through the Plant.

Section 1.02 Construction. In this Agreement, unless context otherwise requires:

- (1) Articles and Sections referred to by number mean the corresponding Articles and Sections of this Agreement.
- (2) The terms “hereby,” “hereof,” “hereto,” “herein,” “hereunder,” and any similar terms refer to this Agreement, and the term “hereafter” shall mean after, and the term “heretofore” shall mean before, the Effective Date of this Agreement.
- (3) Words of the masculine gender shall mean and include correlative words of the female and neuter genders, and words importing the singular number shall mean and include the plural number and vice versa, unless context clearly dictates otherwise.
- (4) Exhibits to this Agreement constitute an integral part of this Agreement.

- (5) Where Business Days are not specified in this Agreement, days should be interpreted as actual calendar days, and time periods shall be computed so as to exclude the reference day for the period and include the day on which the act or event is to happen.
- (6) Three asterisks mark the end of each Article.

* * *

ARTICLE II

GENERAL REPRESENTATIONS AND COVENANTS

Section 2.1 Representations of Seller. Seller hereby represents that it is a municipal corporation and political subdivision of the State and as such it is a validly created governmental entity and a public body politic and corporate of the State and that it has the power, authority, and legal right to own and operate Seller's System and is capable of providing Wastewater Services as contemplated by this Agreement; that it has all necessary powers and authority to undertake and perform its obligations under this Agreement; that the execution and delivery of, and its performance under, this Agreement will not violate any judgment, decree, order, law, rule, permit, contract, or regulation; that no consent, permission, or approval that has not already been given is required for the valid execution and delivery of this Agreement by Seller; that this Agreement has been duly authorized, executed, and delivered by Seller, and constitutes a legal, valid, and binding obligation of Seller, enforceable in accordance with its terms (but subject to the provisions of bankruptcy, insolvency, reorganization, moratorium and similar laws affecting the enforcement of creditors' rights and to usual equity principles, which may limit the specific enforcement of certain remedies); that, as of the Effective Date, there is no litigation or proceeding pending or, to its knowledge, threatened against or affecting Seller that (i) seeks to enjoin the performance of its obligations under this Agreement; or (ii) if adversely determined, would materially adversely affect its ability to perform such obligations; and that it has taken all necessary action to authorize the execution and delivery of this Agreement and to perform its obligations under this Agreement.

Section 2.2 Representations of Each Purchaser. Each Purchaser hereby represents that it is a duly organized and existing political subdivision of the State and has all necessary power and authority to own and operate the Purchaser's System and to perform its obligations under this Agreement; that the execution and delivery of, and its performance under, this Agreement will not violate any judgment, decree, order, law, rule, permit, contract, or regulation; that no consent, permission, or approval that has not already been given is required for the valid execution and delivery of this Agreement by Purchaser; that this Agreement has been duly authorized, executed, and delivered by Purchaser, and constitutes a legal, valid, and binding obligation of Purchaser, enforceable in accordance with the terms hereof, particularly Section 3.3(E) (but subject to the provisions of bankruptcy, insolvency, reorganization, moratorium and similar laws affecting the enforcement of creditors' rights and to usual equity principles, which may limit the specific enforcement of certain remedies); that, as of the Effective Date, there is no litigation or proceeding pending or, to its knowledge, threatened against or affecting Purchaser that (i) seeks to enjoin the performance of its obligations under this Agreement; or (ii) if adversely determined, would materially adversely affect its ability to perform such obligations; and that Purchaser has taken all necessary action to authorize the execution and delivery of this Agreement.

Section 2.3 Discharge Rights. Seller represents that it has all rights, powers, authority, experience, and skills necessary to operate the Plant and to treat and dispose of wastewater and to perform its obligations under this Agreement as evidenced by, but specifically subject to, the provisions of the applicable wastewater construction, operating, and surface water

discharge (“**NPDES**”) permits issued by the DHEC Bureau of Water (a “**NPDES Permit**”). Seller maintains sole responsibility for maintaining its NPDES Permit and for renewals of the permit as required by State and federal law. In additional, Seller retains sole responsibility for operating within the requirements of its NPDES Permit. Any enforcement actions by federal or State agencies in the nature of fines, penalties, and facility upgrades which are required by a federal or state agency for failure of the Seller to comply with its NPDES Permit will be the sole responsibility of Seller and any such fines and penalties shall not be included as part of the Operation and Maintenance Charges, or any other charges, to the Purchasers.

Section 2.4 Purchasers’ Rate Covenant. Each Purchaser covenants that at all times during the term of this Agreement it will impose fees for services provided by such Purchaser’s System sufficient at all times to enable such Purchaser to meet its obligations hereunder.

Section 2.5 Seller’s Rate Covenant. Seller covenants that at all times during the term of this Agreement it will impose fees for services provided to the customers of Seller’s System, other than the Purchasers, that, when combined with the fees and revenues generated under this Agreement, shall be sufficient at all times to enable the Seller to meet its obligations hereunder. Without limiting the foregoing, Seller covenants that it and all other customers of Seller’s System shall be charged rates or amounts computed on a similar basis as those charged to Purchasers, that such amounts shall be sufficient to cover Seller’s proportionate share of the charges set forth at Section 3.3(A), and that receipts from such charges shall be deposited and used for the purposes of the charges set forth at Section 3.3(A).

* * *

ARTICLE III

SALE AND PURCHASE OF WASTEWATER SERVICES AND ALLOCATED CAPACITY

Section 3.1 Term of Agreement. This Agreement shall be effective upon the Effective Date and shall extend for an initial period of 30 years from that date. Absent receipt of Notice from a Party of its intent not to renew, this Agreement shall be automatically extended, to the extent permitted by law, for two separate ten-year periods thereafter. In the event any Party intends not to renew at the end of a term, such Party shall notify the other Parties of its intent, in writing, not less than two years prior to the end of such term. At the termination of this Agreement and any successor agreements, Purchasers shall retain their rights to the Allocated Capacity granted hereunder and shall be entitled to continue to use the same, and shall be required to pay for such use in the amounts and at the times provided by this Agreement, pending negotiation of a successor agreement.

Section 3.2 Sale of Wastewater Services.

(A) Seller shall make available to each Purchaser an amount of treatment capacity in the Plant equal to such Purchaser's Allocated Capacity set forth on Exhibit A and shall provide Wastewater Services delivered hereunder in compliance with all applicable State and federal laws and regulations.

(B) Seller shall receive and transmit wastewater from the Connecting Meters to the Plant in compliance with all applicable State and federal laws and regulations.

(C) At any time, if Seller determines that the daily delivery of wastewater by a Purchaser has exceeded such Purchaser's Allocated Capacity for at least 30 days during any 12-month period (whether or not such days are consecutive), Seller shall notify such Purchaser. Thereupon Seller and such Purchaser shall meet and exchange information concerning the demand for wastewater treatment services on such Purchaser's System and the availability of unused capacity in the Plant. If this information indicates to Seller that such Purchaser's demand is likely to exceed its Allocated Capacity on an on-going basis, then Seller may require that such Purchaser, and such Purchaser shall, obtain additional Allocated Capacity as permitted under the terms of this Agreement, either through purchase or transfer of capacity rights from another Party or through Plant expansion.

Section 3.3 Payment for Wastewater Services; Calculation of Revenue Requirement.

(A) Beginning on the Effective Date and in each succeeding month during the term of this Agreement, Seller shall invoice each Purchaser not later than the 5th day of each month and Purchaser shall pay by the 15th day of each month, an amount equal to:

- (1) the Operation and Maintenance Charge,
- (2) the Capital Charge,
- (3) the Debt Service Charge, and
- (4) the Depreciation Charge.

While Section 3.3(B)(1) is in effect, invoices for all or a portion of the Fiscal Year may be compiled and sent in advance at the beginning of each Fiscal Year and shall be payable for the applicable months on or before the 15th day of such month as described above.

(B) Operation and Maintenance Charges shall be established each Fiscal Year as follows:

(1) From the Effective Date through June 30 of the second full Fiscal Year following the Date of Substantial Completion, Operation and Maintenance Charges shall be established through the Annual Budget and shall be billed monthly as non-volumetric charges on the basis of each Party's Allocated Percentage. Seller shall perform a true-up at the end of its Fiscal Year based on the audited financial statements for Seller's System. If, based on such audit, a Purchaser has paid more than its Allocated Percentage of Operation and Maintenance Charges, Seller shall return the overage within 30 days of the date of such audit. If, based on such audit, a Purchaser has paid less than its Allocated Percentage of Operation and Maintenance Charges, such Purchaser shall pay such additional amount to Seller within 30 days of Notice of the same. Seller shall provide to Purchasers six months into each Fiscal Year a schedule based on such audit comparing actual revenues and expenses to budgeted amounts with the same detail provided in the Annual Budget.

(2) Beginning July 1 of the Fiscal Year immediately following the second full Fiscal Year following the Date of Substantial Completion, Operation and Maintenance Charges shall be based on such Purchaser's Metered Flow divided by all Parties' Metered Flows and shall be billed monthly. Seller shall perform a true-up at the end of its Fiscal Year based on the audited financial statements for Seller's System. If, based on such audit, a Purchaser has paid more than its share of Operation and Maintenance Charges, Seller shall return the overage within 30 days of the date of such audit. If, based on such audit, a Purchaser has paid less than its share of Operation and Maintenance Charges, such Purchaser shall pay such additional amount to Seller within 30 days of Notice of the same. Seller shall provide to Purchasers six months into each Fiscal Year a schedule

based on such audit comparing actual revenues and expenses to budgeted amounts with the same detail provided in the Annual Budget.

(C) Capital Charges, Debt Service Charges, and Depreciation Charges shall be established each Fiscal Year as follows through the Annual Budget and shall be billed monthly as non-volumetric charges on the basis of each Party's Allocated Percentage. Debt Service Charges will automatically be adjusted at any time that Seller's actual Debt Service Expenses change. Seller shall perform a true-up at the end of its Fiscal Year based on the audited financial statements for Seller's System. Amounts representing the Debt Service Coverage Component paid by a Purchaser, shall be returned to such Purchaser within 30 days of the completion of Seller's audited financial statements for a given Fiscal Year.

(D) In calculating the Revenue Requirement and Annual Budget, Seller shall include in its calculations projected income to be derived during the Fiscal Year in question from the treatment of septage waste and other sales of treatment services to customers that do not have an assignment of Allocated Capacity. Such projected income shall be allocated based on Allocated Capacities to offset Operation and Maintenance Expenses during such Fiscal Year.

(E) Each Purchaser hereby agrees to pay all amounts due hereunder from the revenues of its Purchaser's System. The obligation of each Purchaser to pay all of the charges set forth at Section 3.3(A) hereof shall be absolute and unconditional and shall not be suspended or discontinued for any cause whatsoever, including without limiting the generality of the foregoing, the failure of Seller to complete the acquisition, construction, improvement, or up-grading of any portion of the Plant; any acts or circumstances that may constitute failure of consideration, destruction of or damage to any portion of the Plant; and any failure on the part of Seller to perform and observe any agreement, whether expressed or implied, under this Agreement. Each Purchaser hereby covenants to impose rates and charges of the respective Purchaser's System to make 100% of the payments of its portion of the Revenue Requirement each Fiscal Year as required hereunder.

(F) The obligations hereunder shall not in any event constitute an indebtedness of a Party within the meaning of any provision, limitation, or restriction of the State Constitution or statutes of the State and the faith, credit and taxing power of each Purchaser is expressly not pledged therefor. Each Purchaser is not obligated to pay the amounts provided for hereunder, save and except from the revenues of its Purchaser's System.

Section 3.4 Annual Budget; Contingency Fund.

(A) The Parties will form the Advisory Board to make decisions concerning the operation of the Plant and recommendations regarding the Annual Budget, provided, however, the Plant will continue with its current operations until such time as the Advisory Board decides otherwise. Voting on the Advisory Board shall be on a one vote per Party basis, with a majority of all votes entitled to be cast required to approve any item, unless unanimity is specified for the particular approval or action.

(B) The Advisory Board will meet monthly or at some other interval that the Advisory Board may agree upon, provided that the Advisory Board must meet at least quarterly.

Professionals, advisors, and employees of each Party may attend meetings of the Advisory Board along with the Advisory Board member of such Party. Seller shall prepare a monthly financial statement and a monthly operating report and the same will be provided to the Advisory Board not more frequently than monthly, and not less frequently than quarterly; in each case such reports shall be made available within 15 days of the close of the applicable period. Such monthly report shall include a comparison of actual revenues and expenses to budgeted amounts with the same detail provided in the Annual Budget.

(C) Every year, the Advisory Board will discuss possible structural changes to the Advisory Board, the ownership of the Plant, and the Parties' Service Areas and Designated Service Areas. Notwithstanding the foregoing or anything else in this Agreement, the Parties agree to diligently pursue, on terms reasonably agreeable to all Parties, the formation of a Joint Sewer Authority pursuant to Title 6, Chapter 25 of the South Carolina Code in order to purchase, construct, acquire, own, operate, maintain, repair, and improve the Plant.

(D) Seller shall as soon as practicable deliver to the Advisory Board a proposed Annual Budget; provided, that the proposed Annual Budget shall be provided to the Advisory Board no later than the earlier of either (i) April 1 of a Fiscal Year, or (ii) the time when the utility fund portion of the Pendleton's proposed annual budget is publicly presented to Pendleton's governing body for approval. The Advisory Board shall provide a formal written recommendation regarding the proposed Annual Budget within 30 days of receipt from Seller. The proposed Annual Budget shall specify all expense items, charges, and other financial data necessary to compute the Revenue Requirement for such Fiscal Year and the charges payable by each Purchaser, and shall include the comparable data for each entry for the prior Fiscal Year and an explanation of any material variances.

(E) At the request of a Purchaser, Seller will cause the senior management official to meet with such Purchaser, prior to Pendleton's public hearing on the ordinance adopting its annual budget, in order to discuss the Annual Budget in detail. In the event that a Purchaser objects to any part of the proposed Annual Budget, Seller will permit that Purchaser to present its objections to Pendleton's governing body, in open or executive session, prior to final approval of Pendleton's annual budget. Exercise of this right of petition shall not be a precondition of seeking other relief for improper charges.

(F) As part of compiling its Annual Budget and the information provided to the Advisory Board under Section 3.4(B), Seller shall compute and provide a calculation of the Revenue Requirement and the charges to be paid by each Purchaser according to the terms of this Agreement and using a generally accepted cost-of-service rate-making methodology which categorizes costs on a functional basis and allocates them on a cost-causation basis. Charges under Section 3.3(A) shall be computed for each Fiscal Year to be adequate to recover from all Parties sufficient revenues to operate and maintain the Plant on an on-going basis. All revenues received by Seller's System attributable to the Plant shall be reflected in the calculations.

(G) Mid-period adjustments to the Annual Budget and resulting changes to the Section 3.3(A) charges may be implemented by Seller in cases of clearly demonstrated need based on unforeseen costs or circumstances, following submission of the adjustment to the Advisory Board and receiving a recommendation from the Advisory Board regarding such

Annual Budget amendment and revisions to charges. Such adjustments shall be calculated consistent with the Accounting Principles, ratemaking methodologies and cost allocation provisions referenced above. Any such adjustment shall require Notice to the Purchasers with a detailed description on the reasons for the change and accounting and other data supporting the need for the adjustment and the calculation of new Section 3.3(A) charges, with such Notice to be given no later than 30 days prior to the first reading of an ordinance of the Town Council of Pendleton to adjust Section 3.3(A) charges. The recommendation of the Advisory Board shall be provided to Seller's governing body on or before first reading of such ordinance amending the Annual Budget.

(H) If necessary, but only in cases of clerical, metering, or computation error, Seller may issue a corrected billing statement to Purchasers together with a detailed description of the corrections. In such event, Purchasers shall pay to Seller the corrected billing statement within 30 days of the issuance thereof.

(I) Seller shall establish and maintain a Contingency Fund, to be funded at all times in the amount of the Contingency Fund Amount. The Annual Budget shall determine the amount necessary to replenish or maintain the amount on deposit in the Contingency Fund, which amount shall be included in the Operation and Maintenance Charge. Amounts on deposit in the Contingency Fund may be used only for purposes of paying Operation and Maintenance Expenses during periods in which revenues generated by the Operation and Maintenance Charges are insufficient for such purpose. At any time that the amount on deposit in the Contingency Fund exceeds the Contingency Fund Amount, the Seller, in its discretion, shall either refund to the Purchasers the excess amounts or apply them as a credit against the Operation and Maintenance Expenses for the next ensuing billing period.

(J) The Advisory Board shall develop a five-year capital improvement plan for the Plant addressing capital projects, particularly those to be funded under Section 3.6 or 3.7 of this Agreement, and update it annually no later than the time it provides its recommendation regarding the Annual Budget. Upon development and at each update, the five-year capital improvement plan shall encompass the immediately succeeding five full Fiscal Years.

Section 3.5 Plant Renewal and Replacement Fund; Investment Earnings; Initial Funding. There is hereby established the Plant Renewal and Replacement Fund, which may only be used upon the approval of the Advisory Board. Revenues generated by Depreciation Charges, and analogous charges to other customers of Seller's System, shall be credited to the Plant Renewal and Replacement Fund by Seller. Amounts deposited into the Plant Renewal and Replacement Fund may be used from time to time to pay for renewal and replacement of capital improvements of the Plant. Appropriate records of expenditures from this fund shall be maintained by Seller. Allocations into the Plant Renewal and Replacement Fund shall be set forth in the Annual Budget. Allocations into the Plant Renewal and Replacement Fund attributable to Seller's Allocated Capacity shall be billed to Seller's customers and treated as provided in Section 3.3. No Depreciation Charge shall be due when the balance in the Plant Renewal and Replacement Fund equals or exceeds 5% of the replacement value of the Plant as determined by an Independent Consultant or as may be agreed by the Advisory Board. Earnings on the Plant Renewal and Replacement Fund shall be retained in such fund and become exclusively part of such fund.

Section 3.6 Capital Costs Not Related to Increases of a Purchaser's Allocated Capacity in Plant.

(A) Seller shall make all capital improvements necessary to maintain Seller's ability to provide Purchasers Wastewater Service consistent with each Party's Allocated Capacity, including improvements necessary to satisfy applicable regulatory agency requirements, and shall provide information regarding the need for any such capital improvement to the Advisory Board. All capital improvements under this Section 3.6 shall be reviewed by the Advisory Board, which shall provide a recommendation regarding the same, which shall be distributed to the Parties in the same manner as Notice. The costs therefor will be paid as follows:

- (1) First, such costs shall be paid from annual Current Capital Component revenues;
- (2) Second, remaining costs shall be paid from the Plant Renewal and Replacement Fund; and
- (3) Third, remaining costs shall be paid as Future Capital Improvement Costs, with each Purchaser's share of the remaining cost of such improvements to be computed based on its Allocated Percentages. Purchasers shall pay such Future Capital Improvement Costs over the duration of the construction project in amounts reflecting the cash flow requirements of the project (and which may be paid in whole or in part from bonds issued by a Purchaser).

(B) Upon recommendation of the Advisory Board, and in order for the Parties to spread out the costs of capital costs under this Section 3.6 over multiple Fiscal Years, the Parties may agree either (i) for the Seller to issue Bonds to defray the costs of identified capital improvements and make the required payments thereafter to cover the associated Future Capital Improvement Costs on terms agreeable to the Seller and Purchasers, the debt service on which will be paid by such Purchasers as Debt Service Charges, or (ii) for each Party to provide its share of the required sum for the capital improvements by a date certain through any legally available funds, including the issuance of bonds of such Party. Such agreement and terms regarding the provision of funds shall be approved by the governing body of each Party by either resolution or ordinance. Upon the issuance of any Bonds, Exhibit B hereto shall be updated within 30 days of the issuance of such Bonds and provided to the Parties in the same manner as Notice. All amounts payable under this Section 3.6 shall be based on Allocated Percentages. In the absence of such agreement, charges under this Section 3.6 shall be imposed pursuant to paragraphs (1)-(3) of Section 3.6(A). Improvements to expand the capacity of the Plant shall not be included in any calculation under this Section.

(B) Seller shall promptly provide each Purchaser Notice and copies of all correspondence and documents related to any regulatory deficiency in the Plant the correction of which might result in Future Capital Improvement Costs, within five days following its receipt thereof, provided that this requirement shall not apply to any documents protected by the attorney-client privilege. As soon as practicable following such Notice, Seller shall procure an estimate of cost from an Independent Consultant and, upon completion thereof, provide the same to the Purchasers with an estimate of the related Future Capital Component.

Section 3.7 Expansion of the Plant to Provide Additional Capacity.

(A) Additional Allocated Capacity needed by any Party shall be made available from time to time by Seller, if feasible as reasonably determined by unanimous approval of the Advisory Board, with the costs of providing such additional capacity being assumed on a *pro rata* basis by the Party or Parties requesting or needing such additional capacity. If any Party shall determine that it requires additional capacity in the Plant, then it shall provide Notice to the other Parties in writing setting forth its estimated requirement for additional capacity and the time at which it estimates such additional capacity will be required. Seller shall promptly provide Notice of any such request to all other Parties. Within 60 days of the receipt of the initial Notice requesting capacity, representatives of the Seller, the requesting Party, and other interested Parties shall meet and exchange information in order for Seller to determine (i) the total capacity required by all Parties, (ii) the time for providing additional capacity, (iii) the manner of providing such capacity, (iv) the feasibility of the expansion, and (v) such other matters relating to the provision of such capacity as any Party may deem necessary.

(B) Seller agrees to undertake the design and construction of the improvements necessary to provide the additional capacity requested or needed by a Purchaser in a timely manner and diligently pursue the completion thereof such that such capacity will be available on or before the date set forth in such Notice. Provided, however, that, prior to Seller's undertaking of such obligations, the following conditions are met:

- (1) The requested availability date shall be not less than 30 months following the date of the notice of approval of expansion by the applicable regulatory authorities;
- (2) Seller shall not be required to add capacity to the Plant in increments of less than one MGD;
- (3) Purchaser shall advance to Seller such funds as are required to cover the design and engineering expenses of the improvements necessary, and related consulting and legal fees, to provide the additional capacity requested by such Purchaser, following the review of the engineering scope of work and contract for such work by the Advisory Board and recommendation by the Advisory Board regarding the same prior to the award of such contract;
- (4) Purchaser shall make provision for the payment of the costs of construction, construction management, permitting, and related consulting and legal fees of such expansion through (i) the payment of such Purchaser's share of the Future Capital Improvement Costs of such expansion for deposit into and administration under an escrow account during the construction period; or (ii) an amendment to this Agreement among the Parties providing for Seller to issue Bonds on terms agreeable to the Seller and such Purchaser, the allocable portion of the proceeds of which will be deposited into an escrow account and the allocable portion of the debt service on which will be paid by such Purchaser as Debt Service Charges; and

- (5) Seller shall be able to obtain all necessary discharge or other permits required to support the expansion and operate the Plant after such expansion.

(C) In case of expansion, the Parties agree that Exhibit A to this Agreement will be modified by mutual agreement to the extent necessary to set forth the new Allocated Capacities and the Allocated Percentages required as a result of any expansion.

Section 3.8 Additional Future Capacity. Should capacity in the Plant increase beyond that then contemplated in Exhibit A, as may be amended from time to time, by any means other than pursuant to Section 3.7, including, without limitation and by way of example only, improvements funded through a grant, technological enhancements added as part of normal operations, or otherwise, such additional capacity shall be allocated on the basis of then applicable Allocated Capacities unless otherwise agreed among all Parties in writing. Any change in Plant capacity and the resulting changes in Allocated Capacities and Allocated Percentages shall be promptly reflected in an amendment to Exhibit A hereto.

Section 3.9 Response to Capacity Limitations. The Parties recognize that circumstances may arise in which the Purchasers may request additional capacity to serve the needs of wholesale or direct industrial customers under either Section 3.7 or Section 3.8 of this Agreement, and that these requests may come at a time when Seller has reasonably determined that the ability of the Plant to meet projected future needs for sewer treatment capacity is limited by environmental, regulatory, or other engineering constraints. In cases where capacity in the Plant cannot be expanded to meet both the reasonably projected needs within the Parties' respective Service Areas and the request for additional capacity to serve the needs of wholesale or direct industrial customers located outside of the Parties' respective Service Areas, then the Seller shall provide the Purchasers with a capacity needs and expansion study prepared by an engineer licensed in the State of South Carolina selected by the Advisory Board. The purpose of this study shall be to validate and test the estimated needs within the Parties' respective Service Areas and the environmental or engineering limitations that prevent the expansion of capacity in the Plant to meet all of those needs. Such study shall reflect a planning horizon of no greater than five years and shall reflect the independent professional judgment of the engineer who prepared it as to the reasonableness and suitability of all data and assumptions contained in it. In cases where the report validates the inability to serve both sets of needs, the Seller may limit the provision of additional capacity to serve the needs of wholesale or direct industrial customers located outside of the Parties' respective Designated Service Areas in order to ensure that the needs within the Parties' respective Designated Service Areas are met on a priority basis. However, in no case shall Seller offer to provide additional service to wholesale or direct industrial customers located outside of Pendleton's Designated Service Area, or provide capacity to others for doing so, until the Purchasers' prior requests for additional capacity have been met. Should the study indicate capacity may be added, the Parties shall proceed under Section 3.7 hereof.

Section 3.10 Measurement of Wastewater Flows. Each Purchaser's flow shall be individually measured at the applicable Connecting Meters, all as reasonably specified by Seller from time to time. The Connecting Meters shall be selected and installed, if necessary and as applicable, by Seller after consultation with the appropriate Purchaser to permit such Purchaser to provide input into the selection, installation and calibration of such Connecting Meters.

Purchasers shall have the right to observe and inspect the installation of Connecting Meters. The cost of the Connecting Meters and all installation, repair, and maintenance costs thereto as well as the cost of the activities necessary to accurately calculate the Metered Flows shall be paid by the appropriate Purchaser. Seller agrees to permit the Purchasers to conduct such inspection of the Connecting Meters as reasonably requested by Purchasers. Seller further agrees to provide to the Purchasers copies of all data regarding total flows treated at the Plant and the Connecting Meters as reasonably requested by Purchasers. Seller further agrees to provide routine testing and calibration of Connecting Meters no less frequently than once every six months. A Purchaser may request testing outside of the six-month testing cycle. If this out-of-cycle testing shows the Connecting Meters to be accurate within 5% of actual flow, the Purchaser shall pay the costs associated with such testing. If the Connecting Meters are found to be inaccurate by 5% or more, Seller shall pay the costs for such testing and subsequent recalibration.

Section 3.11 Operation and Maintenance of Plant.

(A) Seller agrees to operate and maintain the Plant in a good and proper manner in accordance with all applicable requirements of state and federal regulatory agencies, consistent with Good Utility Practices, and in such a manner as to enable it to comply with its obligations under the Agreement.

(B) Seller shall obtain and maintain, or cause to be obtained and maintained, with responsible insurers such insurance on the Plant (to the extent applicable insurance is available) that is customarily maintained with respect to properties of like character against accident to, loss of, or damage to such properties in an amount, less reasonable deductibles, sufficient to restore the Plant to operation in case of casualty loss.

Section 3.12 Books and Records. Seller shall maintain separate accounting records for both Seller's System and the Plant which records shall be maintained in accordance with Accounting Principles and audited annually by a licensed certified public accountant. All books and records of Seller pertaining to both Seller's System and the Plant and to the Revenue Requirements, and the components thereof, charged hereunder shall be available to each Purchaser for inspection at all reasonable times upon reasonable notice, with Purchaser to pay Seller's reasonable costs for providing Purchaser with such books and records. Seller shall collect data necessary to allocate costs in conformity with cost allocation principles established in this Agreement.

Section 3.13 Sale of Wastewater Services and Allocated Capacity.

(A) Seller and Purchasers agree that this Agreement shall in no way limit or prohibit the sale by any Party within its respective Service Area of wastewater collection or disposal services to the Parties' respective current or future customers using the Wastewater Services provided under this Agreement.

(B) A Party may sell or lease all or any portion of its Allocated Capacity to any other Party on such terms and conditions as shall be agreed to by such Parties.

(C) A Party may sell or lease all or any portion of its Allocated Capacity to a person who is not a Party, as a sale of capacity rights separate and apart from the sale of bundled Wastewater Services to that person, but only upon written consent of all Parties, and compliance with the following conditions:

(1) the Allocated Capacity shall first be offered to the other Parties on the same offered terms for a period of 30 days following Notice of such offer unless extended by the Party selling such Allocated Capacity;

(2) if all of the Parties elect not to purchase any portion, then that portion may then be offered to a new purchaser who is not a Party;

(3) as a condition to such sale or lease, such new purchaser shall become a Purchaser under this Agreement; and

(4) no such sale, lease, or other disposition of Allocated Capacity shall relieve any Party of primary responsibility for the performance of its obligations under this Agreement absent express written consent of all Parties.

(D) Notwithstanding any other provision of this Agreement to the contrary, each Purchaser hereby acknowledges that (i) Seller may finance costs of Seller's System with the proceeds of Bonds and that the interest paid to the holders of certain of the Bonds is tax exempt pursuant to Sections 103 and 141 through 150 of the Internal Revenue Code of 1986, as amended (the "**Code**") and Treasury Regulations promulgated thereunder (the "**Regulations**") and (ii) the Code and Regulations prescribe certain limitations (the "**Private Business Use Limitations**") on the amount of Wastewater Services supplied by Seller's System that Seller is permitted to sell, directly or indirectly, to a person or entity other than a state or local governmental unit as defined by the Code and Regulations ("**Private Persons**") (such direct or indirect sales shall hereinafter be referred to as "**Private Business Use**"). For purposes of this Section, the United States of America and any agency or instrumentality of the United States of America are Private Persons, and providing Wastewater Services by Seller's System to the United States of America and any agency or instrumentality of the United States of America may constitute Private Business Use.

Purchaser hereby further acknowledges that any direct or indirect sale by Purchaser of such Purchaser's Allocated Capacity that constitutes Private Business Use in excess of the Private Business Use Limitations (i) may cause Bonds to be deemed to be private activity bonds under the Code and Regulations, and (ii) may cause the interest on Bonds to be included in gross income of the holders of the Bonds retroactively to the issue date of the Bonds.

The Parties hereby represent, warrant, and covenant as follows:

(1) Each Party shall ensure that for any Fiscal Year (i) not in excess of 10% of the amount its Metered Flows is subject to Private Business Use, if, in addition, the payment of more than 10% of its payments hereunder arise out of such use.

(2) To the extent permitted by law, in the event a Party enters into any contract, arrangement, or agreement, whether formal or informal, that may cause, or

causes, any of the Bonds to fail to satisfy the Private Business Use Limitations, that Party will pay, or cause to be paid, on behalf of the Seller, all amounts required to be paid in order to preserve the tax-exempt status of the Bonds under the Code and the Regulations, including without limitation, (i) all amounts determined to be due and payable to the United States of America with respect to the Bonds in connection with any examination of the Bonds by the Internal Revenue Service, (ii) all amounts determined to be due and payable to the United States of America with respect to the Bonds in connection with the Internal Revenue Service Voluntary Compliance Program, (iii) all amounts determined to be due and payable to the United States of America arising out of any other method or manner of determination by the Internal Revenue Service that the interest on the Bonds is included in the gross income of the holders of the Bonds due to the failure of the Bonds to comply with the Private Business Use Limitations, and (iv) all reasonable attorneys' fees, charges, and costs incurred by the Seller to protect and maintain the tax-exempt status of the Bonds.

(3) The terms of any direct or indirect sale by Purchaser of such Purchaser's Allocated Capacity shall be deemed to include the terms of this Section which shall be binding on all purchasers including all subsequent purchasers. Any transfer of Allocated Capacity or of any other rights arising under this Agreement which transfer is not subject to the terms of this Section shall be void *ab initio*.

Section 3.14 Pretreatment.

(A) The Purchasers grant to the Seller full authority to administer and manage Pendleton's industrial pretreatment program in the Service Areas of Clemson and Anderson, and to their significant industrial users, to be served by the Plant.

(B) The Purchasers grant to the Seller full responsibility and authority of issuing new industrial user permits to all of the Purchaser's existing and future significant industrial customers to be served by the Plant.

(C) The Purchasers grant to the Seller full responsibility and authority for monitoring and sampling all significant industrial users to be served by the Plant in the Purchasers' Service Areas for compliance with the Seller's industrial pretreatment program.

(D) The Purchasers grant to the Seller all rights and remedies in their Service Areas, including the levying of fines, administering civil penalties, and administering criminal penalties as prescribed in the Seller's sewer use ordinance to enforce compliance with the Seller's industrial pretreatment program by customers of the Purchasers served by the Plant. The Advisory Board shall review and approve the imposition of all civil and criminal penalties to be imposed by Seller on a customer of a Purchaser.

(E) The Purchasers grant to the Seller full authority to levy and collect fees and charges from the Purchasers' significant industrial users in their Service Areas to be served by the Plant as are required to cover the costs of Seller's industrial pretreatment program on an equitable basis with all customers of Seller's System.

(F) The Seller agrees to accept the administration, management, monitoring, and enforcement duties and responsibilities of its industrial sewer use ordinance as it relates to the Purchasers' Systems and Service Areas for industrial user customers only and will endeavor to keep the Purchasers fully informed of its permitting activities and proposed enforcement actions relating thereto, subject to Section 3.14(D).

(G) The Purchasers agree to keep the Seller fully informed on all significant industrial user customers of Purchaser in their respective Service Areas served by the Plant, to cooperate regarding the administration and management of the Seller's sewer use ordinance as it applies to significant industrial user customers of the Purchasers, and to assist the Seller regarding compliance and enforcement within the Purchasers' applicable respective Service Areas.

(H) The Parties agree that nothing herein grants Seller the right to waive the terms of any Purchaser ordinance or resolution, or the imposition and collection of any fee or charge imposed by a Purchaser.

Section 3.15 Service Areas.

(A) Anderson, by ordinance, has designated the entire unincorporated area of Anderson as the Designated Service Area of Anderson's System, and provides service within certain areas of the unincorporated area of the County and within certain municipalities as described at paragraph (C) of the Background and Findings hereof.

(B) Anderson consents to Pendleton providing sewer service, at Pendleton's sole expense, within that portion of Anderson's Designated Service Area shown in Exhibit C hereto regardless of whether Pendleton annexes such areas or not (the "***Consented Service Area***"). Consent to Pendleton providing service in such Consented Service Area in no way transfers ownership of any part or portion of Anderson's System and Anderson retains the right to utilize its trunk lines within the Consented Service Area for the conveyance of wastewater. In the portion of the Consented Service Area where Anderson has sewer lines, e.g. the School District area, Pendleton shall exercise reasonable efforts to utilize such existing sewer lines for transportation of wastewater to the Plant and pay Anderson a mutually agreed upon transportation fee as contemplated in that Memorandum of Understanding among Anderson, Pendleton, and Anderson County School District Four dated January 26, 2017. Any wastewater transported by Anderson to the Plant from such area will not count against Anderson's Allocated Capacity.

(C) If Pendleton becomes aware that development is planned in areas outside of the Consented Service Area that does not presently have sewer service and are contiguous to Pendleton's municipal boundaries or the Consented Service Area, and desires to provide such service, Pendleton will immediately provide Notice to Anderson of such development and its interest in providing service. Anderson shall review such Notice and consider whether to grant additional consent for Pendleton to provide service within Anderson's Designated Service Area, with any consent requiring an ordinance of Anderson's County Council.

(D) If Clemson seeks to provide sewer service in Anderson or Pendleton, Clemson will provide Notice to Anderson or Pendleton of such interest in providing service. Anderson or

Pendleton shall review such Notice and consider whether to grant consent for Clemson to provide service within Anderson's Designated Service Area or within Pendleton, with any consent requiring an ordinance of Anderson's County Council or Pendleton's Town Council, as applicable.

(E) If Anderson seeks to provide sewer service in Clemson or Pendleton, Anderson will provide Notice to Clemson or Pendleton of such interest in providing service. Clemson or Pendleton shall review such Notice and consider whether to grant consent for Anderson to provide service within Clemson or Pendleton, with any consent requiring an ordinance of Clemson's City Council or Pendleton's Town Council, as applicable.

* * *

ARTICLE IV

EVENTS OF DEFAULT; REMEDIES

Section 4.1 Events of Default; Remedies.

(A) To the extent permitted by law:

(1) In the event that a Purchaser fails to make any monetary payment required by this Agreement when due, Seller may institute such action as may be necessary to enforce payment of such amounts, including interest on past due amounts, from the date such amount becomes due until paid in full at a default interest rate of 10% per annum. In addition, if such Purchaser fails to make payment when due, upon 60 days Notice from the Seller, the defaulting Purchaser shall forfeit its capacity rights under this Agreement immediately following such 60-day period and does hereby appoint Seller as its agent for the purpose of transferring such Purchaser's Allocated Capacity to the nondefaulting Parties in proportion to their relative Allocated Percentages (for example, if Allocated Percentages were split in thirds, the nondefaulting Parties would each get half of the defaulting Party's Allocated Capacity). Should the defaulting Party pay all amounts due and otherwise comply with the terms of this Agreement, a nondefaulting Party may transfer Allocated Capacity to such Party upon such terms as may be mutually agreeable, or not at all.

(2) In the event that Purchaser fails to perform any non-monetary covenant, obligation, term, or promise in this Agreement after 30 days from the date of Notice to Purchaser of such failure, Seller may bring action against Purchaser for the specific performance by Purchaser of such covenant, obligation, term, or promise.

(3) In the event that a failure by Purchaser to perform any covenant, obligation, term, or promise in this Agreement is the proximate cause of any physical damage to Seller's Plant, then Purchaser shall be responsible for the cost of repairing such damages, and Seller may bring an action therefor.

(B) To the extent permitted by law:

(1) In the event that Seller fails to make any monetary payment required by this Agreement within 30 days from the date when due, Purchasers may institute such action as may be necessary to enforce payment of such amounts, including interest on past due amounts, from the date such amount becomes due until paid in full at a default interest rate of 10% per annum.

(2) In the event that Seller fails to perform any non-monetary covenant, obligation, term, or promise in this Agreement after 30 days from the date of Notice to Seller of such failure, Purchaser may bring action against Seller

for the specific performance by Seller of such covenant, obligation, term, or promise.

(3) In the event that a failure by Seller to perform any covenant, obligation, term, or promise in this Agreement is the proximate cause of any physical damage to Purchaser's System, Seller shall be responsible for the cost of repairing such damages, and Purchaser may bring an action therefor.

(4) If Seller shall become indebted to Purchaser by reason of any provision in this Agreement, Purchaser shall have no right to offset such indebtedness against its obligations to make payments under the provisions of Article III of this Agreement. Seller shall not be liable in any event for consequential, incidental, punitive, economic, or third-party damages. The fact that the obligations of Purchaser to make payments under this Agreement are absolute and unconditional shall not be construed to diminish the exclusive remedies provided by this Section 4.1 for any failure by Seller to perform under this Agreement.

* * *

ARTICLE V

MISCELLANEOUS

Section 5.1 Effects of Force Majeure. If by reason of Force Majeure any Party shall be rendered unable wholly or in part to carry out its obligations under this Agreement, other than the obligations of Purchaser to make the payments required under Section 3.3 of this Agreement, then if such Party shall give notice and full particulars of such Force Majeure in writing to the other Parties within a reasonable time after occurrence of the event or cause relied on, the obligation of such Party giving such notice, so far as it is affected by such Force Majeure, shall be suspended during the continuance of the inability then claimed, but for no longer period, and any such Party shall endeavor to remove or overcome such inability with all reasonable diligence.

Section 5.2 Ownership and Sale of the Plant; Purchaser Right of First Refusal. The Plant shall at all times be the sole and absolute property of Seller; provided, however, Seller acknowledges that each Purchaser has the right to its Allocated Capacity within the Plant in accordance with the provisions of this Agreement. In the event that Seller determines to sell the Plant, and receives written consent from each Purchaser to solicit or receives proposals for the purchase of the Plant, Seller hereby grants to each Purchaser a right of first refusal and agrees to obtain a written proposal from the entity offering to purchase the Plant and will offer the Plant to each Purchaser on the same terms. Seller shall provide Notice and a copy of the proposal to each Purchaser, and each Purchaser may elect in writing within 90 days of Notice of the proposal, to purchase the Plant on the terms indicated. If more than one Purchaser seeks to purchase the Plant, then the Purchasers so electing shall purchase the Plant in shares determined by their relative Allocated Percentages. If a Purchaser does not respond to Notice of Seller's written offer within 90 days from the date of Seller's offer, that Purchaser shall be deemed to have waived its right to purchase the Plant and to have consented to the sale thereof. Seller agrees not to undertake a sale of any of the Plant to any entity unless Seller provides to each Purchaser an opinion of counsel experienced in matters of tax-exempt bonds to the effect that such sale will not adversely affect the tax-exempt status of bonds issued or to be issued by either Purchaser.

Section 5.3 Cooperation in Issuance of Obligations by Each Party. Each Party covenants and agrees that it will cooperate with each other Party in the issuance of any bonds or other obligations proposed to be issued by a Party and secured by revenues of such Purchaser's System or Seller's System. In connection therewith, each Party shall promptly comply with all reasonable requests of each other Party and will, upon request:

- (1) Make available general financial and operational information about itself and its Seller's System or Purchaser's System;
- (2) Consent to publication and distribution of its financial information;
- (3) Certify that information provided by it is accurate, does not contain an untrue statement of a material fact, and does not omit to state a material fact necessary in

order to make the statements in that information, in light of the circumstances under which they were made, not misleading;

- (4) Make available certified copies of official proceedings and records, if applicable;
- (5) Provide reasonable certifications to be used in a transcript of closing documents;
- (6) Provide reasonably requested opinions of counsel as to the validity of its actions taken with respect to and the binding effect of this Agreement, its title to its Seller's System or Purchaser's System, pending or threatened litigation that could materially affect its performance hereunder, and any other reasonably requested opinions; and
- (7) Provide such other information, documents, and certifications as each Party may reasonably request.

Provided, however, that each Party's obligation to cooperate as set forth herein shall be conditional upon agreement by the requesting Party to reimburse any and all reasonable costs associated with such request, provided the requesting Party shall have first received an estimate of such costs from the Party receiving such request.

Section 5.4 Waiver of Jury Trial; Jurisdiction and Venue.

THE PARTIES HERETO HAVE EACH, TO THE FULLEST EXTENT PERMITTED BY APPLICABLE LAW, IRREVOCABLY WAIVED ANY RIGHT THEY MAY HAVE TO A JURY TRIAL WITH REGARD TO ANY DISPUTE HEREUNDER. ALL PARTIES HEREBY CONSENT TO VENUE IN THE STATE COURTS IN ANDERSON COUNTY, SOUTH CAROLINA.

Section 5.5 Notices. "*Notice*" is duly given hereunder: (a) if by transmission by hand delivery, when delivered; (b) if mailed via the official governmental mail system, three Business Days after the post mark, *provided* said notice is sent first class, postage pre-paid, via certified or registered mail, with a return receipt requested; (c) if mailed by an internationally recognized overnight express mail service such as Federal Express, UPS, DHL Worldwide or a similar organization, one Business Day after deposit therewith prepaid; or (d) by e-mail upon delivery with receipt confirmed. Notices shall be transmitted to the principal addresses of the Parties as follows:

If to the Town of Pendleton:

Town of Pendleton
Attn: Town Administrator
310 Greenville Street
Pendleton, SC 29670
Email: stevem@townofpendleton.org
with a copy (which is not Notice) to:

Town of Pendleton
Attn: Town Attorney

If to the City of Clemson:

City of Clemson
Attn: City Administrator
1250 Tiger Boulevard, Suite 1
Clemson, SC 29631
Email: ablondeau@cityofclemson.org

City of Clemson
Attn: Utilities Director
300 Cochran Road
Clemson, SC 29631
Email: bmcgill@cityofclemson.org

with a copy (which is not Notice) to:

City of Clemson
Attn: City Attorney
1250 Tiger Boulevard, Suite 1
Clemson, SC 29631

If to Anderson County:

Anderson County
Attn: County Administrator
P.O. Box 8002
Anderson, SC 29622
Email: rburns@andersoncountysc.org

Anderson County
Attn: Wastewater Manager
P.O. Box 8002
Anderson, SC 29622
Email: dbsingleton@andersoncountysc.org

with a copy (which is not Notice) to:

Anderson County
Attn: Anderson County Attorney
P.O. Box 8002
Anderson, SC 29622
Email: lharmon@andersoncountysc.org

Rejection or other refusal to accept or inability to deliver because of a changed address of which no Notice was given shall be deemed to be receipt of the Notice, request, or other communication. Any Party hereto may, by written notice given to the other Parties to this Agreement, designate any further or different addresses to which subsequent Notice, certificates or other communications shall be sent.

Section 5.6 Authority/Beneficiaries. Each Party hereto hereby represents and warrants that all appropriate action has been taken by their respective governing bodies to authorize the execution of and the performance of the obligations set forth in this Agreement and that the person executing the Agreement on their behalf has been duly authorized to do so. This Agreement shall inure to the benefit of and shall be binding upon Seller and Purchasers and their respective successors or assigns.

Section 5.7 Severability. In the event any provision of this Agreement shall be held invalid or unenforceable by any court of competent jurisdiction, such holding shall not invalidate or render unenforceable any other provision of this Agreement.

Section 5.8 Counterparts. This Agreement may be executed in several counterparts, each of which shall be an original and all of which shall constitute but one and the same instrument.

Section 5.9 Governing Law. This Agreement is prepared and entered into with the intention that the law of the State shall govern its performance and construction, and such performance and construction shall be governed by such law.

Section 5.10 Amendments. This Agreement may not be amended, changed, modified or terminated without in each instance the prior written consent of the Parties hereto. Seller shall promptly circulate all executed amendments to this Agreement to the Parties with the Notice thereof.

Section 5.11 No Adverse Presumption. Seller and Purchasers hereby acknowledge that this Agreement arose as the result of arm's length negotiations between the Parties and that this Agreement was prepared with the advice, consent, recommendation and review of each and all Parties and their counsel, and is the product of input by all Parties. As a result, any ambiguity or uncertainty is not to be construed against the Party whose counsel prepared this Agreement on the grounds that such Party's representatives drafted this Agreement or any part thereof.

Section 5.12 Third Parties. This Agreement does not and is not intended to confer in favor of any persons or entities other than Seller and Purchasers any rights or remedies whatsoever, the Parties hereto intending by the provisions hereof to confer no such benefits or status.

Section 5.13 Captions. The Section headings of this Agreement are inserted for convenience only and shall not constitute a part of this Agreement in construing or interpreting any provisions hereof.

Section 5.14 Further Assurances. The Parties agree to give such further assurances, and to execute, acknowledge and deliver such other instruments as shall be reasonably necessary or appropriate in the judgment of the other Parties to carry out the intent of this Agreement.

Section 5.15 Fully Integrated Agreement, Prior Agreements Superseded. The Parties agree that this Agreement constitutes the entire agreement between or among the Parties related to any aspect of the subject matter hereof, particularly the Plant and Designated Service Areas within Anderson. Reference is made to Section 3.15 regarding Anderson's Designated Service Areas and the requirement of consent to provide service therein. This Agreement shall supersede all existing agreements, understandings, and courses of dealings related to the purchase and sale of Wastewater Services among the Parties hereto. All prior agreements and understandings between or among the Parties related to any aspect of the Plant, and Designated Service Areas within Anderson, are hereby terminated and superseded in full by this Agreement. Specifically, and without limitation, the Prior Agreements are no longer of any force or effect.

(Signature Pages Follow)

IN WITNESS WHEREOF, the Parties hereto have caused this Intergovernmental Wastewater Capacity and Services Agreement to be signed in their names by their duly authorized officers as of the Effective Date.

TOWN OF PENDLETON, SOUTH CAROLINA

By: _____ [Seal]

Print Name: _____

Title: _____

Witness:

IN WITNESS WHEREOF, the Parties hereto have caused this Intergovernmental Wastewater Capacity and Services Agreement to be signed in their names by their duly authorized officers as of the Effective Date.

CITY OF CLEMSON, SOUTH CAROLINA

By: _____ [Seal]

Print Name: _____

Title: _____

Witness:

IN WITNESS WHEREOF, the Parties hereto have caused this Intergovernmental Wastewater Capacity and Services Agreement to be signed in their names by their duly authorized officers as of the Effective Date.

ANDERSON COUNTY, SOUTH CAROLINA

By: _____ [Seal]

Print Name: _____

Title: _____

Witness:

EXHIBIT A

ALLOCATED CAPACITY AND ALLOCATED PERCENTAGE

Prior to the Date of Substantial Completion of the Pendleton Plant Project

<u>Capacity Held By:</u>	<u>Allocated Capacity (MGD)</u>	<u>Allocated Percentage</u>
Pendleton	0.80	40.00%
Clemson	1.00	50.00
Anderson	<u>0.20</u>	<u>10.00</u>
Total Capacity	2.00	100.00%

Upon the Date of Substantial Completion of Pendleton Plant Project

<u>Capacity Held By:</u>	<u>Allocated Capacity (MGD)</u>	<u>Allocated Percentage</u>
Pendleton	1.50	30.00%
Clemson	2.00	40.00
Anderson	<u>1.50</u>	<u>30.00</u>
Total Capacity	5.00	100.00%

EXHIBIT B

PRIOR BONDS COMPONENT AND DEBT SERVICE

Issue	Original Principal Amount	Annual Debt Service	Debt Service Allocation (Anderson)	Debt Service Allocation (Clemson)	Final Maturity
2009 SRF Loan (F1-123-09-472 -05)	\$1,620,850	\$97,099.92	10.00%	50.00%	1/1/2031

EXHIBIT C
SERVICE AREAS MAP

PROPOSED PENDLETON SERVICE AREA

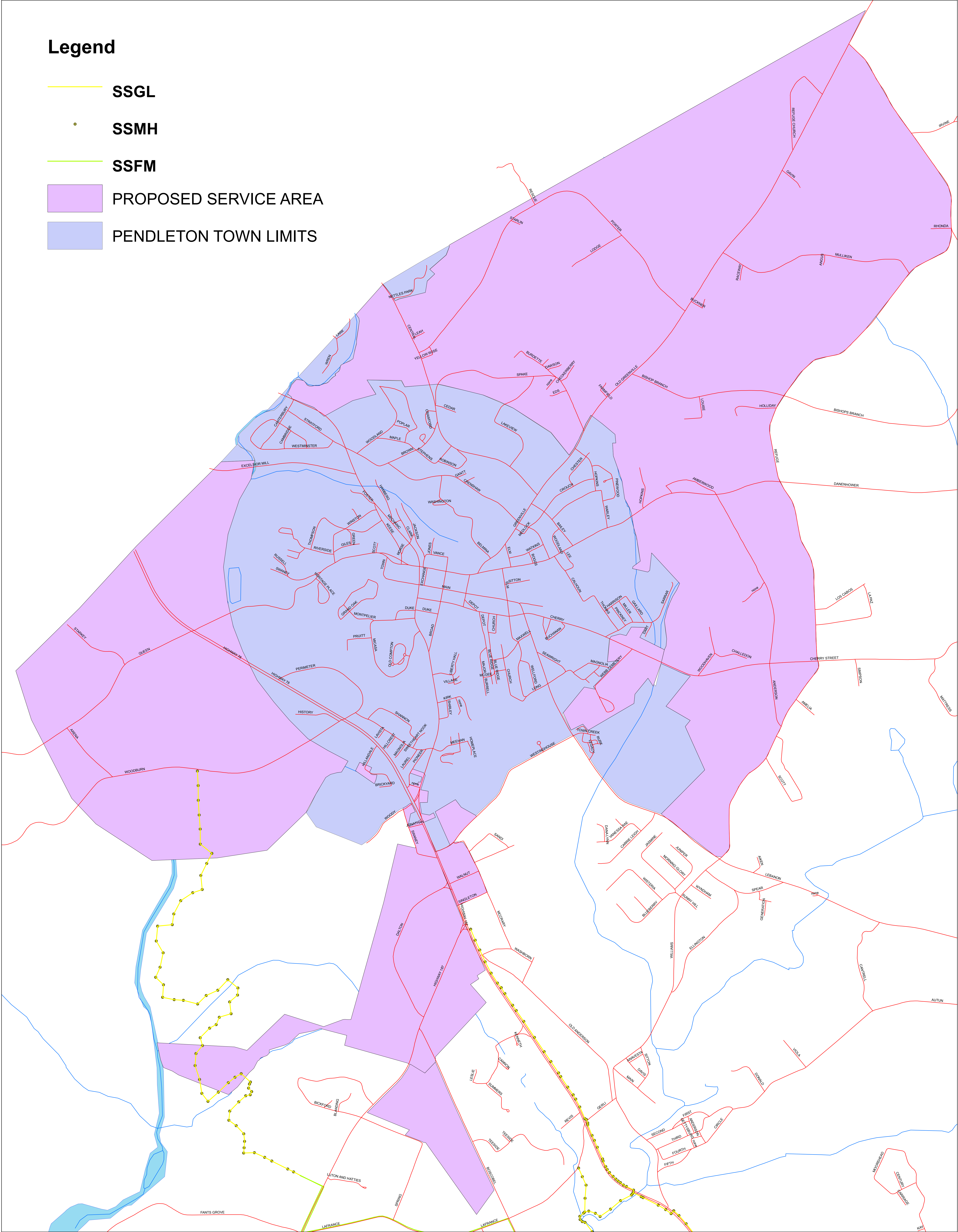


EXHIBIT D

REVENUE REQUIREMENT CALCULATION

PROJECT MANAGEMENT AGREEMENT FOR
WASTEWATER TREATMENT PLANT EXPANSION

among the

Town of Pendleton, South Carolina,
City of Clemson, South Carolina,
Anderson County, South Carolina,

and

U.S. Bank Trust Company, National Association, as Escrow Agent

_____, 2024

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EXHIBIT A – Incumbency Certificate

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This **PROJECT MANAGEMENT AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION** (this “*Agreement*”) is made this ____ day of _____, 2024 (the “*Effective Date*”), by and among the **CITY OF CLEMSON, SOUTH CAROLINA** (“*Clemson*”), **ANDERSON COUNTY, SOUTH CAROLINA** (“*Anderson*”), the **TOWN OF PENDLETON, SOUTH CAROLINA** (“*Pendleton*” and together with Clemson and Anderson, the “*Project Participants*”) and **U.S. BANK TRUST COMPANY, NATIONAL ASSOCIATION** (the “*Escrow Agent*”). Each entity may hereinafter be referred to as a “*Party*” or collectively as the “*Parties*.”

BACKGROUND AND FINDINGS

(A) Capitalized terms used in this Agreement shall have the meanings given to such terms in Section 1.1 of this Agreement. In the event that a capitalized term is defined elsewhere in this Agreement and is also defined in Section 1.1 of this Agreement, and there is any inconsistency between such definitions, the definition in Section 1.1 of this Agreement shall control.

(B) Clemson is a municipal corporation and a political subdivision of the State of South Carolina (the “*State*”) and possesses all general powers granted by the Constitution of the State of South Carolina 1895, as amended (the “*State Constitution*”) and statutes of the State to municipal corporations. Clemson has heretofore lawfully established and now operates a municipal water and wastewater system, which generally serves the entire area of Clemson and certain populated areas adjacent to its corporate limits.

(C) Anderson is a county and a political subdivision of the State, and possesses all general powers granted by the State Constitution and statutes of the State to counties thereof. Anderson has heretofore lawfully established and now operates a wastewater system, which generally serves portions of the unincorporated area of Anderson, and certain areas within the municipalities of Anderson and Pendleton by agreement as set forth in the hereinafter defined Intergovernmental Agreement.

(D) Pendleton is a municipal corporation and a political subdivision of the State and possesses all general powers granted by the State Constitution and statutes of the State to municipal corporations. Pendleton has heretofore lawfully established and now operates a municipal water and wastewater system, which generally serves the entire area of Pendleton and certain populated areas adjacent to its corporate limits. Pendleton has lawfully established and now operates a wastewater treatment and disposal system that provides service to the wastewater systems operated by Clemson and Anderson.

(E) Section 6-15-20 of the South Carolina Code (as defined herein) provides that:

Every governmental entity shall be empowered to enter into contracts with other governmental entities for the collection of sewage, for the disposal of sewage, and for the treatment of sewage, and to that end shall be jointly and severally empowered to construct, operate, maintain, enlarge and improve sewer facilities designed for use by the parties to the contract. Such contract may provide for the

joint ownership of the sewer facilities or for the ownership of such facilities by any of the contracting parties, provided that, in such event, the remaining parties shall be empowered to utilize such sewer facilities to the extent provided for in the contract.

(F) Section 5-31-890 of the South Carolina Code provides that:

All municipalities in this State owning, controlling, leasing or planning to construct a system of sewage disposal with or without outfalls, rights of way, easements and appurtenances thereto, may, through proper officials, commissioners of public works, sewer commissions or any of them or like bodies, enter into contracts and agreements with persons or political subdivisions outside the corporate limits of such municipalities, whether contiguous thereto or not, for the construction, maintenance, operation, improvement, leasing, controlling or furnishing the use, benefits and facilities thereof upon such terms and at such rates and charges as may be fixed by the contract or agreement between the parties when, in the judgment of the proper officials, commissioners of public works, sewer commissions, or any of them or like bodies, as the case may be, it is for the best interest of the city, town or municipality so to do. But no such contract or agreement shall be for a period exceeding thirty years from the effective date thereof.

(G) Pursuant to an Intergovernmental Wastewater Capacity and Services Agreement (the “*Intergovernmental Agreement*”) among the Project Participants dated of even date herewith, the Project Participants have entered into a new agreement regarding the operation and use of the Plant (as defined in the Intergovernmental Agreement), superseding and terminating all prior agreements among the Project Participants with regard to Wastewater Services (as defined in the Intergovernmental Agreement).

(H) The current permitted treatment capacity of the Plant is 2.0 million gallons per day (“*MGD*”), which has been allocated 50% to Clemson, 40% to Pendleton, and 10% to Anderson. The Project Participants seek to expand the treatment capacity of the Plant to 5.0 MGD (the “*Project*,” as further defined herein) in order to meet existing and anticipated future wastewater treatment needs of the Project Participants, to promote economic growth, to provide cost effective sewer service to the Project Participants’ respective customers, and prepare for continued population growth in and around the Project Participants.

(I) Through this Agreement, the Project Participants seek to memorialize the procurement, management, and cost-sharing responsibilities of each Project Participant related to the Project; provide for a Project cost allocation of 43.33% to Anderson, 23.33% to Pendleton, and 33.34% to Clemson; and further provide that any Project Grants (as defined herein) that have been or will be obtained shall reduce total allocable Project Costs prior to allocation, except that the first \$600,000 of the initial Project Grants received shall be disbursed to or retained by Pendleton.

(J) Each Project Participant has found that this Agreement (i) is in the best interest of the public, the Project Participants, and the consumers to be served; and (ii) has been duly

authorized by its respective governing body to sign this Agreement. The undersigned officers have been duly authorized to sign on behalf of their respective Project Participants.

NOW, THEREFORE, in consideration of the premises hereinabove set forth and the agreements of the Parties hereunder, the Parties agree as follows:

ARTICLE I

DEFINITIONS

Section 1.1 Definitions. In addition to any words and terms elsewhere defined in this Agreement, the following words and terms shall have the following meanings unless some other meaning is plainly intended:

“Accounting Principles” means generally accepted accounting principles and practices applicable to governmental entities in the United States, including those applicable to enterprise funds that relate to governmentally owned and operated utility systems, as may be amended or revised from time to time.

“Advisory Board” has the meaning given in the Intergovernmental Agreement.

“Agreement” has the meaning given such term in the Background and Findings to this Agreement.

“Allocated Capacity” has the meaning given such term in the Intergovernmental Agreement.

“Anderson” has the meaning given such term in the Background and Findings to this Agreement.

“Anderson Representative” means the County Administrator of Anderson and the Wastewater Manager of Anderson, either of whom may act independently.

“Anderson Account” means the Anderson Account of the Project Fund created under Section 4.2 hereof.

“Anderson’s System” means Anderson’s system for the collection and transmission of wastewater.

“Business Day” means any day other than a Saturday, Sunday, or federal holiday in the United States of America or a day on which the New York Stock Exchange is closed or a day on which the payment system of the Federal Reserve Bank is not operational.

“Clemson” has the meaning given such term in the Background and Findings to this Agreement.

“Clemson Account” means the Clemson Account of the Project Fund created under Section 4.2 hereof.

“Clemson Representative” means the City Administrator and the Utilities Director of Clemson, either of whom may act independently.

“Clemson’s System” means Clemson’s system for the collection and transmission of wastewater.

“Construction Advisors” means those representatives from the three Project Participants that will supervise the construction and approve certain matters with regard to the Project; the initial Construction Advisors shall be the Utilities Director of Clemson, the Town Administrator of Pendleton, and the Wastewater Manager of Anderson.

“Construction Contract” means the guaranteed maximum price contract with Harper General Contractors, or any successor or assign.

“Deposit Certificate” means the certificate of each Project Participant to be executed and delivered in connection with a Project Participant’s deposit of its Project Costs Share in the Project Fund, the form of which is attached as Exhibit B.

“Disbursement Request” means a request executed by a representative of a Project Participant to requisition funds from the Project Fund for Project Costs, the form of which is attached hereto as Exhibit C.

“Effective Date” has the meaning given such term in the Background and Findings to this Agreement.

“Escrow Agent” has the meaning given such term in the Background and Findings to this Agreement.

“Force Majeure” means, to the extent beyond the control of the Party claiming an event of Force Majeure, any of the following: acts of God or nature; strikes, lockouts, or other industrial disturbances; acts of a public enemy; orders of any kind of the government of the United States or the State or the courts thereof, or any civil or military authority; insurrections, riots, epidemics, pandemics, landslides, lightning, earthquakes, fires, hurricanes, storms, floods, washouts, droughts, arrests, restraint of government and people, civil disturbances, and explosions; malfunctions of machinery and pipe lines; partial or entire failure of electric supply; or the inability of Pendleton to receive wastewater or operate the Plant hereunder, or a Participant to control wastewater flows hereunder, on account of any other causes not reasonably within the control of the Party claiming such inability.

“Intergovernmental Agreement” has the meaning given such term in the Background and Findings of this Agreement.

“MGD” means millions of gallons per day, with the term “day” being understood to refer to the 24-hour period commencing at 12:00 a.m. (midnight) Eastern Time of a given calendar day.

“Operation and Maintenance Expenses” has the meaning given such term in the Intergovernmental Agreement.

“Participant” means, together or individually as the context requires, Anderson or Clemson, or both, and their respective successors and assigns.

“Participant’s System” means, individually or collectively, as the context requires, Anderson’s System or Clemson’s System, or both.

“Party” or **“Parties”** has the meaning given such term in the Background and Findings to this Agreement.

“Pendleton” has the meaning given such term in the Background and Findings to this Agreement.

“Pendleton Account” means the Pendleton Account of the Project Fund created under Section 4.2 hereof.

“Pendleton Representative” means the Town Administrator.

“Pendleton’s System” means Pendleton’s entire system for the collection, transmission, treatment, discharge, management, and disposal of wastewater, including the Plant.

“Plant” has the meaning given such term in the Intergovernmental Agreement.

“Project” has the meaning given such term in Section 3.1 hereof.

“Project Budget” has the meaning and is the amount provided at Section 3.1.

“Project Costs” means, and is limited to, Project expenditures that are treated as capital expenditures under Accounting Principles. In general, costs shall be treated as capital costs if they are incurred for the planning, acquisition, construction, or improvement of property having a useful life of more than one year and include costs related to the planning, acquisition, construction, or improvement of land, buildings, infrastructure improvements, and intangible assets. Capital costs also include costs and expenditures that increase the value of existing property with a useful life of more than one year or that extend the useful life of existing property for a period of more than one year. Capital costs consist of both direct costs and indirect costs.

“Project Costs Share” means, as to a particular Project Participant, such Project Participant’s share of the Project Costs.

“Project Fund” means the fund of such name created under Article IV of this Agreement.

“Project Grants” means any grant to one of the Parties made with respect to the Project, including, but not limited to, the SCIIP Grant.

“Project Participant” has the meaning given such term in the Background and Findings to this Agreement. References herein to the direction of or consent of a Project Participant shall be deemed to mean a direction or consent given by the Representative of such Project Participant.

“Representative” means, individually or collectively as context requires, the Anderson Representative, the Clemson Representative, and the Pendleton Representative.

“SCIIP Grant” means the \$10,000,000 grant awarded to Pendleton in 2023 from the South Carolina Infrastructure Investment Program administered by the South Carolina Rural Infrastructure Authority using State and Local Recovery Funds received through the American Rescue Plan Act

“South Carolina Code” means the Code of Laws of South Carolina 1976, as amended.

“State” has the meaning given such term in the Background and Findings of this Agreement.

“State Constitution” has the meaning given such term in the Background and Findings of this Agreement.

“Wastewater Services” has the meaning given such term in the Intergovernmental Agreement.

Section 1.02 Construction. In this Agreement, unless context otherwise requires:

- (1) Articles and Sections referred to by number mean the corresponding Articles and Sections of this Agreement.
- (2) The terms “hereby,” “hereof,” “hereto,” “herein,” “hereunder,” and any similar terms refer to this Agreement, and the term “hereafter” shall mean after, and the term “heretofore” shall mean before, the Effective Date of this Agreement.
- (3) Words of the masculine gender shall mean and include correlative words of the female and neuter genders, and words importing the singular number shall mean and include the plural number and vice versa, unless context clearly dictates otherwise.
- (4) Exhibits to this Agreement constitute an integral part of this Agreement.
- (5) Where Business Days are not specified in this Agreement, days should be interpreted as actual calendar days, and time periods shall be computed so as to exclude the reference day for the period and include the day on which the act or event is to happen.
- (6) Three asterisks mark the end of each Article.

* * *

ARTICLE II

REPRESENTATIONS

Section 2.1 Representations of Pendleton. Pendleton hereby represents that it is a municipal corporation and political subdivision of the State and as such it is a validly created governmental entity and a public body politic and corporate of the State and that it has the power, authority, and legal right to own and operate Pendleton's System and is capable of providing Wastewater Services as contemplated by the Intergovernmental Agreement; that it has all necessary powers and authority to undertake and perform its obligations under this Agreement; that the execution and delivery of, and its performance under, this Agreement will not violate any judgment, decree, order, law, rule, permit, contract, or regulation; that no consent, permission, or approval that has not already been given is required for the valid execution and delivery of this Agreement by Pendleton; that this Agreement has been duly authorized, executed, and delivered by Pendleton, and constitutes a legal, valid, and binding obligation of Pendleton, enforceable in accordance with its terms (but subject to the provisions of bankruptcy, insolvency, reorganization, moratorium and similar laws affecting the enforcement of creditors' rights and to usual equity principles, which may limit the specific enforcement of certain remedies); that, as of the Effective Date, there is no litigation or proceeding pending or, to its knowledge, threatened against or affecting Pendleton that (i) seeks to enjoin the performance of its obligations under this Agreement; or (ii) if adversely determined, would materially adversely affect its ability to perform such obligations; and that it has taken all necessary action to authorize the execution and delivery of this Agreement and to perform its obligations under this Agreement.

Section 2.2 Representations of Each Participant. Each Participant hereby represents that it is a duly organized and existing political subdivision of the State and has all necessary power and authority to own and operate the Participant's System and to perform its obligations under this Agreement; that the execution and delivery of, and its performance under, this Agreement will not violate any judgment, decree, order, law, rule, permit, contract, or regulation; that no consent, permission, or approval that has not already been given is required for the valid execution and delivery of this Agreement by Participant; that this Agreement has been duly authorized, executed, and delivered by Participant, and constitutes a legal, valid, and binding obligation of Participant, enforceable in accordance with the terms hereof (but subject to the provisions of bankruptcy, insolvency, reorganization, moratorium and similar laws affecting the enforcement of creditors' rights and to usual equity principles, which may limit the specific enforcement of certain remedies); that, as of the Effective Date, there is no litigation or proceeding pending or, to its knowledge, threatened against or affecting Participant that (i) seeks to enjoin the performance of its obligations under this Agreement; or (ii) if adversely determined, would materially adversely affect its ability to perform such obligations; and that Participant has taken all necessary action to authorize the execution and delivery of this Agreement.

Section 2.3 Project Permits and Related Matters. Pendleton represents that it has obtained or satisfied, or is in the process of obtaining and satisfying, all permits, permissions, approvals, easements, and other requirements necessary to complete the Project.

* * *

ARTICLE III

THE PROJECT

Section 3.1 Scope of Project. The “*Project*” encompasses the scope of work necessary to increase the capacity of the Plant from 2.0 MGD to 5.0 MGD and improve water quality of treated effluent to Eighteen Mile Creek. The Project should be developed in accordance with the following:

- The Project Budget is \$64,328,198.00.
 - \$3,334,000.00 represents design costs incurred and paid by the Project Participants. No further design costs are owing from any Project Participant.
 - \$60,994,198.00 is the cost of the Construction Contract. Of such amount:
 - \$17,620,639.59 represents the portion of the Construction Contract funded in part from the SCIIP Grant; of such amount \$9,400,000 will come from the SCIIP Grant and \$8,220,639.59 will be provided by the Project Participants through their respective Project Costs Shares.
 - \$43,373,558.41 represents the portion of the Construction Contract that is not funded in part from the SCIIP Grant and which shall be provided in whole by the Project Participants through their respective Project Costs Shares.
 - Any increase in the Project Budget or any component thereof recited in this Section 3.1 requires an amendment to this Agreement.
- The substantial completion date of the Project is June 2026.
- Pendleton shall execute the Construction Contract within ten days of:
 - Confirmation from the granting authority of the availability to proceed with expending proceeds of Projects Grants in an amount of not less than \$9,400,000.00, and
 - Receipt of Deposit Certificates in the aggregate amount of \$51,594,198.00.

Section 3.2 Change Orders; Increased Costs.

(A) Pendleton shall not make any material changes in the scope of the Project, the improvements on the site of the Project, or any component part of the Project, without an

amendment to this Agreement. Any reduction in the scope of the Project that would cause the capacity of the Plant at substantial completion of the Project to be below 5.0 MGD is a material change. Nonmaterial changes shall be subject to the review and approval of the Construction Advisors as contemplated in Section 3.3 hereof.

(B) Should Pendleton, after consulting with the Construction Advisors, anticipate that construction costs of the Project will exceed the Project Budget, Pendleton shall provide Notice of the same, and include the proposed change order from the contractor, the amount of the increase in the costs of the Project, and the reason for the change with supporting documentation. Each Project Participant agrees to submit the proposed amendment providing for the amended Project Budget to its governing body for consideration within 30 days of receiving Notice thereof. Nothing herein shall be interpreted to require approval of such request by a Project Participant's governing body.

(C) Following any amendment to this Agreement to provide for an amended Project Budget, each Project Participant shall transfer to the Escrow Agent for deposit to the credit of the Project Fund their allocable share of the increased Project Budget in accordance with the terms of and within the timeline established in such amendment.

(D) The Escrow Agent shall not be liable for any increased amounts or any deficiency in the Project Fund, except as may be caused by its negligence or willful misconduct in the performance of any obligation imposed on it under this Agreement.

Section 3.3 Owner of Plant; Role of Construction Advisors.

(A) The Plant shall at all times be the sole and absolute property of Pendleton, unless otherwise agreed to in writing; provided, however, Pendleton acknowledges that each Participant has the right to its Allocated Capacity within the Plant in accordance with the Intergovernmental Agreement.

(B) In connection with the accomplishment of the Project, the Participants hereby appoint Pendleton as their agent for the purpose of signing and performing any and all agreements and contracts necessary or applicable in connection with all phases of the Project; provided, however, that prior to signing any contract or making any agreement or amendment thereto whether written or oral, including the final form of the Construction Contract, the Construction Advisors shall in each case review and approve such contract or agreement. Approval by the Construction Advisors shall require unanimity thereof, and may be evidenced by mail, email, or other writing in such form as to clearly evidence approval by each of the Construction Advisors.

(C) Pendleton shall keep the Construction Advisors fully informed with regard to, and provided free access to all aspects of, the Project, including, without limitation, planning and budgeting of the construction of the Project, selecting contractors, negotiating contracts, regular monitoring of construction work to assure compliance with plans and specifications for the Project, reviewing and paying of construction invoices, and coordinating required inspections, permits, and licenses for the Project. Pendleton, as the agent of the Participants for the foregoing purposes, shall cause the Project to be completed in accordance with this Agreement, the Construction Contract, the Intergovernmental Agreement, and any applicable requirements of governmental authorities and law.

Section 3.4 Enforcement of Contracts. Pendleton has the right to enforce in its own name and/or in the name of the Participants such purchase orders or contracts, in consultation with and upon approval by the Advisory Board.

Section 3.5 Acceptance. Pendleton, for \$1.00 and other good and valuable consideration in hand received, does hereby accept the foregoing appointment as agent of each of the Participants for the purposes set forth in, and subject to the limitations of, this Agreement.

Section 3.6 Books and Records. Pendleton shall maintain accounting records for the Project which records shall be maintained in accordance with Accounting Principles. All documents, contracts, and other records pertaining to the development of the Project shall be available to each Participant for inspection at all reasonable times upon reasonable notice. Pendleton shall collect data necessary to allocate costs in conformity with cost allocation principles established in this Agreement.

* * *

ARTICLE IV

THE PROJECT FUND

Section 4.1 Project Costs Share. The Project Participants agree that the Project Costs of \$51,594,198.00 (which is equal to the total Project Cost of \$64,328,198.00, less design fees previously expended of \$3,334,000.00 and less Project Grants of \$9,400,000.00) to be allocated among the Project Participants shall be based on the following Project Costs Shares:

Project Participant	Dollar Value of Project Costs Share	Percentage of Project Costs Share
Anderson	\$ 22,355,765.99	43.33%
Clemson	17,201,505.61	33.34
Pendleton	<u>12,036,926.39</u>	<u>23.33</u>
Total:	\$ 51,594,198.00	100.00%

The Project Participants acknowledge and agree that each Project Participant has met all of its obligations with regard to remitting design fees and the same have been fully paid, that no additional design fees are contemplated, and that no moneys required for design fees are being deposited to the Project Fund.

Section 4.2 Creation of Project Fund.

(A) There is hereby created and established with the Escrow Agent a special fund designated the Project Fund to be held in the custody of the Escrow Agent separate and apart from other funds and accounts of the Project Participants and the Escrow Agent. Within the Project Fund, there is hereby created and established with the Escrow Agent the following accounts and subaccounts: (i) the Anderson Account, (ii) the Clemson Account, and (iii) the Pendleton Account. The Escrow Agent shall create additional accounts and subaccounts within the Project Fund on any Project Participant's written direction, provided that the Escrow Agent may only create a subaccount within a Project Participant's account of the Project Fund with the written direction of such Participant.

(B) Money in the Project Fund shall be applied to the costs of the Project. The Project Fund, including all accounts and subaccounts thereof, shall remain open until this Agreement is terminated in accordance with Section 6.14 herein. The balance, if any, remaining in the Project Fund, including any account or subaccount thereof, after termination of this Agreement in accordance with Section 6.14 herein, shall be disbursed back to the applicable Project Participant and may be used for any purpose permitted by applicable law and the bond documents authorizing the revenue bonds from which the funds derive.

(C) The Escrow Agent will hold each account and subaccount of the Project Fund as a separate escrow fund wholly segregated from all other funds and accounts held in any capacity and will make disbursements from each account and subaccount of the Project Fund only in accordance with the provisions of this Agreement

(D) Under no circumstances will the Escrow Agent have a lien on the Project Fund for its charges, fees and expenses and under no circumstances will the Escrow Agent make any claim against the Project Fund for such charges, fees, and expenses.

Section 4.3 Deposits to Project Fund. Within 30 days of the Effective Date of this Agreement, each Project Participant shall each cause to be irrevocably deposited with the Escrow Agent, in a single deposit, funds representing the full amount of its Project Costs Share. When depositing funds into the Project Fund, each Project Participant shall execute and deliver to the Escrow Agent a Deposit Certificate, substantially in the form attached hereto as Exhibit B, and the Escrow Agent shall acknowledge its receipt. Upon receipt of funds from the Project Participants which is accompanied by a corresponding Deposit Certificate, the Escrow Agent shall deposit such funds in the applicable account of the Project Fund as directed in such Deposit Certificate.

Section 4.4 Investment. The money in the respective accounts and subaccounts of the Project Fund will be held as cash uninvested or invested as permitted under Section 6-5-10 of the South Carolina Code, at the written direction of the applicable Project Participant depositing such funds to such subaccount. Investment earnings shall accrue only to the subaccount generating such earnings. If the Escrow Agent has not received written investment direction from the applicable Representative with respect to any amounts held by the Escrow Agent, the Escrow Agent shall hold such amounts uninvested in cash, without liability for interest. The Escrow Agent shall be fully protected in relying on the written investment directions it receives from the applicable Representative as to the legality and suitability of such directed investments and their qualification as permitted under Section 6-5-10 of the South Carolina Code. Investments may be made by the Escrow Agent through its own bank investment department and (a) will have maturities or be readily marketable prior to maturity in the amounts and not later than the dates as may be necessary to provide funds for the purpose for which the money in any account is to be used, (b) will be held by or under the control of the Escrow Agent, and (c) will at all times be considered a part of the subaccount for whose benefit the investment was made. Each Project Participant acknowledges that regulations of the Comptroller of the Currency grant the Representatives the right to receive brokerage confirmation of security transactions as they occur. Each Project Participant specifically waives such right to notification to the extent permitted by law and acknowledges that it will receive periodic transaction statements that will detail all investment transactions.

Section 4.5 Requisition and Disbursements.

(A) The Escrow Agent shall disburse the money in the Project Fund to pay Project Costs upon receipt of a properly executed Disbursement Request executed by a Pendleton Representative, an Anderson Representative, and a Clemson Representative. The Project Participants shall have the right to request from Pendleton, and Pendleton shall provide, information related to Disbursement Requests and requisitions from the Project Fund as they determine necessary or convenient to maintain adequate books and records, including but not limited to bills, paid invoices, payroll records, inspections, and certifications.

(B) Upon the receipt of a Disbursement Request, the Escrow Agent shall withdraw from each of the Anderson Account, the Clemson Account, and the Pendleton Account, amounts

based on each Project Participant's Project Costs Share. Under no circumstances shall amounts attributable to one Project Participant's Project Costs Share be withdrawn from another Project Participant's subaccount of the Project Fund. Each Disbursement Request shall reflect the Project Costs Share of each Project Participant with respect to such Disbursement Request on which the Escrow Agent shall be entitled to rely.

(C) For any Disbursement Request that is reimbursed in whole or in part with the proceeds of a Project Grant, including specifically the SCIIP Grant, such reimbursement shall be deposited to the Project Fund and allocated among the Anderson Account, the Clemson Account, and the Pendleton Account on the basis of each Project Participant's Project Costs Share.

Section 4.6 Report. The Escrow Agent shall provide to each Project Participant online access to monthly statements and transaction activity for the accounts and subaccounts related to that Project Participant's accounts and subaccounts of the Project Fund as specified in Section 4.2 above. The Project Participants shall each designate one or more authorized representatives who shall promptly establish online account access and who shall make reasonable efforts to maintain active online account access by accessing at least one account or subaccount every ninety days. In addition, Pendleton hereby directs the Escrow Agent to provide to the Participants online access to all monthly statements and transaction activity for all of the accounts and subaccounts created under 4.2 above. Upon receipt by the Escrow Agent of written direction by Pendleton or by any authorized representative of any Participant, the Escrow Agent shall also cause monthly statements to be delivered to the authorized representative by United States Postal Service. Upon written request by Pendleton, the Escrow Agent will use best efforts to create and provide any specific report reasonably requested.

Section 4.7 Escrow Agent Fees. The Escrow Agent's fees and costs for and in carrying out the provisions of this Agreement are as set forth in Exhibit D hereto, which fees and costs are to be paid by Pendleton annually in advance as part of the Operation and Maintenance Expenses of the Plant and not from funds in the Project Fund. The Escrow Agent is not liable for any loss resulting from any investment made pursuant to the terms and provisions of this Agreement.

Section 4.8 Escrow Agent Generally.

(A) The Escrow Agent has no responsibility to the Project Participants or any person in connection herewith except as specifically provided herein and is not responsible for anything done or omitted to be done by it, except for its own negligence or willful misconduct in the performance of any obligation imposed on it hereunder.

(B) Subject to the exception in paragraph (a) as to its own negligence or willful misconduct, the Escrow Agent has no responsibility for verifying the genuineness, correctness, or competence of any document, instrument or writing, and shall not be charged with knowledge or notice of any fact or circumstance not specifically set forth herein.

(C) The Escrow Agent may conclusively rely and act on any written notice, request, waiver, consent, certificate, receipt, authorization, power of attorney, or other instrument or

document received from the Representatives which the Escrow Agent reasonably and in good faith believes to be genuine and to be what it purports to be.

(D) The Escrow Agent has no duty to determine or inquire into the happening or occurrence of any event or contingency or the performance or failure of performance of the Project Participants with respect to arrangements or contracts with others. The Escrow Agent may request from the Project Participants or any person such reasonable evidence as the Escrow Agent in its discretion deems necessary to determine any fact relating to the occurrence of any event or contingency and in this connection may inquire and consult with the Project Participants, among others, at any time. The Project Participants shall provide such evidence to the Escrow Agent and the Escrow Agent is entitled to rely thereon. The Escrow Agent's permissive rights hereunder shall not be construed as duties

(E) The Escrow Agent has no liability for following any instructions given by the Project Participants or in this Agreement or set forth in any court or administrative order.

(F) The Escrow Agent is authorized to comply with orders issued or process entered by any court with respect to the Project Fund, without determination by the Escrow Agent of such court's jurisdiction in the matter. If the Project Fund or any portion is at any time attached or levied on under any court order, or if the payment, assignment, transfer or delivery of any such property is stayed or enjoined by any court order, or if any order, judgment or decree is made or entered by any court affecting such property, then and in any such event, the Escrow Agent is authorized to rely on and comply with any such order, judgment or decree without the need for appeal or other action; and if the Escrow Agent complies with any such order, judgment or decree, it is not liable to any party hereto or to any other person or entity by reason of such compliance even if such order, judgment or decree is subsequently reversed, modified, set aside or vacated.

(G) With respect to the Project Fund, the duties and responsibilities of the Escrow Agent set forth herein shall control over any terms or provisions of any other agreement or undertaking between or among the Parties.

(H) The Escrow Agent may resign and thereby become discharged from the trusts hereby created by providing notice in writing given to the Parties not less than 30 days before such resignation is to take effect. The Escrow Agent agrees to serve as Escrow Agent until a successor is appointed. Such resignation is effective immediately, however, on the appointment of a successor Escrow Agent if such successor Escrow Agent is appointed before the expiration of said notice period. If such appointment of a successor Escrow Agent is not made within 30 days after the date that such resignation was to take effect as provided in the notice thereof given to the Parties, then the Escrow Agent may apply to a court of competent jurisdiction to appoint a successor Escrow Agent. In such event, the Escrow Agent shall give notice thereof to the Parties and not object to the Parties' intervention therein.

(I) The Escrow Agent may be replaced by Pendleton with the consent of the Participants and thereby become discharged from the obligations hereby created by notice in writing given from Pendleton to the Escrow Agent not less than 30 days before such replacement is to take effect. The Escrow Agent agrees to serve as Escrow Agent until a successor is appointed. Such replacement is effective immediately, however, on the appointment of a

successor Escrow Agent if such successor Escrow Agent is appointed before the expiration of said notice period.

(J) If a disagreement or dispute arises under this Agreement, or if adverse claims or demands are made in connection with this Agreement or any property involved herein or affected hereby, the Escrow Agent may petition any court of competent jurisdiction within Anderson County, South Carolina to resolve the disagreement or dispute or adverse claims or demands and shall, at the time of filing such petition, give notice thereof to the Parties within 5 Business Days after the date of such filing. In connection therewith, the Escrow Agent may (but is not required to) tender into the custody of the court all money or property in its hands under the terms of this Agreement, and then be discharged from all further duties under this Agreement. The filing of any such legal proceeding does not deprive Escrow Agent of its compensation earned before such filing.

(K) The Escrow Agent may execute any of the trusts or powers hereof and perform any of its duties by or through attorneys, agents, receivers or employees but shall be answerable for the conduct of the same in accordance with the standard specified above, and shall be entitled to consult with counsel and act on an opinion of counsel concerning all matters of trust hereof and the duties hereunder, and may in all cases pay such reasonable compensation to all such attorneys, agents, receivers, and employees as may reasonable be employed in connection with the trusts hereof.

(L) The Escrow Agent has no obligation to use its own funds to satisfy any obligations under this Agreement.

(M) Notwithstanding any other provision in this Agreement to the contrary, no provision of this Agreement shall be construed to relieve the Escrow Agent from liability for its own negligent action, its own negligent failure to act, or its own willful misconduct, except that: (i) the Escrow Agent shall not be liable for any error in judgment made in good faith, unless it is proved that the Escrow Agent was negligent in ascertaining the pertinent facts, and (ii) the Escrow Agent is not liable with respect to any action it takes or omits to be taken by it in good faith in accordance with the direction of the Parties under any provision of this Agreement relating to the time, method and place of conducting any proceeding for any remedy available to the Escrow Agent, or exercising any trust or power conferred upon the Escrow Agent under this Agreement.

Section 4.9 Directions to the Escrow Agent; Designation of Representatives. The Escrow Agent may accept and act upon directions or instructions given pursuant to this Agreement and signed by a Representative. Each Project Participant shall provide to the Escrow Agent an incumbency certificate substantially in the form attached hereto as Exhibit A (the “*Incumbency Certificate*”) designating the Representatives for such Project Participant and containing specimen signatures of such Representatives and email and telephone contact information, which incumbency certificate may be amended from time to time by submitting a new Incumbency Certificate to the Escrow Agent. The Escrow Agent shall accept and act upon instructions or directions pursuant to this Agreement sent by unsecured e-mail, facsimile transmission, or other similar unsecured electronic methods from the persons specified in the incumbency certificate. The Escrow Agent shall not be liable for any losses, costs, or expenses

arising directly or indirectly from the Escrow Agent's reliance upon and compliance with such instructions notwithstanding such instructions conflict or are inconsistent with a subsequent written instruction. Each Project Participant agrees to assume all risks arising out of the use of such electronic methods to submit instructions and directions to the Escrow Agent, including without limitation, the risk of the Escrow Agent acting on unauthorized instructions, and the risk of interception and misuse by third parties; provided that such unauthorized instructions, interception or misuse was not due to the Escrow Agent's gross negligence or the compromise of the Escrow Agent's security systems.

* * *

ARTICLE V

EVENTS OF DEFAULT; REMEDIES

Section 5.1 Events of Default; Remedies.

Events of default and remedies hereunder shall be governed by Article IV of the Intergovernmental Agreement; provided, however, that should any Project Participant fail to make the deposit required by Section 4.3 hereof, each non-defaulting Project Participant shall have the right to withdraw all funds from the Project Fund deposited in its respective subaccount.

* * *

ARTICLE VI

MISCELLANEOUS

Section 6.1 Effects of Force Majeure. If by reason of Force Majeure any Party shall be rendered unable wholly or in part to carry out its obligations under this Agreement, other than the obligations of Participant to make the payments required under Section 4.3 of this Agreement, then if such Party shall give notice and full particulars of such Force Majeure in writing to the other Parties within a reasonable time after occurrence of the event or cause relied on, the obligation of such Party giving such notice, so far as it is affected by such Force Majeure, shall be suspended during the continuance of the inability then claimed, but for no longer period, and any such Party shall endeavor to remove or overcome such inability with all reasonable diligence.

Section 6.2 Waiver of Jury Trial; Jurisdiction and Venue.

THE PARTIES HERETO HAVE EACH, TO THE FULLEST EXTENT PERMITTED BY APPLICABLE LAW, IRREVOCABLY WAIVED ANY RIGHT THEY MAY HAVE TO A JURY TRIAL WITH REGARD TO ANY DISPUTE HEREUNDER. ALL PARTIES HEREBY CONSENT TO VENUE IN THE STATE COURTS IN ANDERSON COUNTY, SOUTH CAROLINA.

Section 6.3 Notices. “*Notice*” is duly given hereunder: (a) if by transmission by hand delivery, when delivered; (b) if mailed via the official governmental mail system, three Business Days after the post mark, *provided* said notice is sent first class, postage pre-paid, via certified or registered mail, with a return receipt requested; (c) if mailed by an internationally recognized overnight express mail service such as Federal Express, UPS, DHL Worldwide or a similar organization, one Business Day after deposit therewith prepaid; or (d) by e-mail upon delivery with receipt confirmed. Notices shall be transmitted to the principal addresses of the Parties as follows:

If to the Town of Pendleton:

Town of Pendleton
Attn: Town Administrator
310 Greenville Street
Pendleton, SC 29670
Email: stevem@townofpendleton.org

If to the City of Clemson:

City of Clemson
Attn: City Administrator
1250 Tiger Boulevard, Suite 1
Clemson, SC 29631
Email: ablondeau@cityofclemson.org

City of Clemson
Attn: Utilities Director
300 Cochran Road
Clemson, SC 29631
Email: bmcgill@cityofclemson.org

with a copy (which is not Notice) to:

City of Clemson
Attn: City Attorney
1250 Tiger Boulevard, Suite 1
Clemson, SC 29631

If to Anderson County:

Anderson County
Attn: County Administrator
P.O. Box 8002
Anderson, SC 29622
Email: rburns@andersoncountysc.org

Anderson County
Attn: Wastewater Manager
P.O. Box 8002
Anderson, SC 29622
Email: dbsingleton@andersoncountysc.org

with a copy (which is not Notice) to:

Anderson County
Attn: Anderson County Attorney
P.O. Box 8002
Anderson, SC 29622
Email: lharmon@andersoncountysc.org

If to the Escrow Agent:

U.S. Bank Trust Company National Association
1441 Main Street, Suite 775
Columbia, SC 29201
Attn: Corporate Trust

Rejection or other refusal to accept or inability to deliver because of a changed address of which no Notice was given shall be deemed to be receipt of the Notice, request, or other communication. Any Party hereto may, by written notice given to the other Parties to this

Agreement, designate any further or different addresses to which subsequent Notice, certificates or other communications shall be sent.

Section 6.4 Authority/Beneficiaries. Each Party hereto hereby represents and warrants that all appropriate action has been taken by their respective governing bodies to authorize the execution of and the performance of the obligations set forth in this Agreement and that the person executing the Agreement on their behalf has been duly authorized to do so. This Agreement shall inure to the benefit of and shall be binding upon Pendleton and Participants and their respective successors or assigns.

Section 6.5 Severability. In the event any provision of this Agreement shall be held invalid or unenforceable by any court of competent jurisdiction, such holding shall not invalidate or render unenforceable any other provision of this Agreement.

Section 6.6 Counterparts. This Agreement may be executed in several counterparts, each of which shall be an original and all of which shall constitute but one and the same instrument.

Section 6.7 Governing Law. This Agreement is prepared and entered into with the intention that the law of the State shall govern its performance and construction, and such performance and construction shall be governed by such law.

Section 6.8 Amendments. This Agreement may not be amended, changed, modified or terminated without in each instance the prior written consent of the Parties hereto. Any amendment to this Agreement shall be approved by the governing body of each Party.

Section 6.9 No Adverse Presumption. The Parties hereby acknowledge that this Agreement arose as the result of arm's length negotiations between the Parties and that this Agreement was prepared with the advice, consent, recommendation, and review of each and all Parties and their counsel, and is the product of input by all Parties. As a result, any ambiguity or uncertainty is not to be construed against the Party whose counsel prepared this Agreement on the grounds that such Party's representatives drafted this Agreement or any part thereof.

Section 6.10 Third Parties. This Agreement does not and is not intended to confer in favor of any persons or entities other than Pendleton and Participant any rights or remedies whatsoever, the Parties hereto intending by the provisions hereof to confer no such benefits or status.

Section 6.11 Captions. The Section headings of this Agreement are inserted for convenience only and shall not constitute a part of this Agreement in construing or interpreting any provisions hereof.

Section 6.12 Further Assurances. The Parties agree to give such further assurances, and to execute, acknowledge and deliver such other instruments as shall be reasonably necessary or appropriate in the judgment of the other Parties to carry out the intent of this Agreement.

Section 6.13 Fully Integrated Agreement. The Parties agree that this Agreement represents all agreements between or among the Parties related to the Project, other than the Intergovernmental Agreement.

Section 6.14 Duration; Termination. This Agreement shall be effective on the Effective Date and shall remain in full force and effect until (i) the Project is complete and all remaining costs and expenses related to the Project have been paid, each as certified in writing to the Escrow Agent by a Pendleton Representative, and (ii) no funds remain in the Project Fund. This Agreement may be terminated by the mutual consent of the Parties, provided that if an Event of Default has occurred and is continuing, the provisions of Section 5.1 herein shall apply

* * *

(Signature Pages Follow)

IN WITNESS WHEREOF, the parties hereto have caused this PROJECT MANAGEMENT AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION to be signed in their names by their duly authorized officers as of the Effective Date.

TOWN OF PENDLETON, SOUTH CAROLINA

By: _____ [Seal]

Print Name: _____

Title: _____

Witness:

IN WITNESS WHEREOF, the parties hereto have caused this PROJECT MANAGEMENT AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION to be signed in their names by their duly authorized officers as of the Effective Date.

CITY OF CLEMSON, SOUTH CAROLINA

By: _____ [Seal]

Print Name: _____

Title: _____

Witness:

IN WITNESS WHEREOF, the parties hereto have caused this PROJECT MANAGEMENT AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION to be signed in their names by their duly authorized officers as of the Effective Date.

ANDERSON COUNTY, SOUTH CAROLINA

By: _____ [Seal]

Print Name: _____

Title: _____

Witness:

IN WITNESS WHEREOF, the parties hereto have caused this PROJECT MANAGEMENT AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION to be signed in their names by their duly authorized officers as of the Effective Date.

**U.S. BANK TRUST COMPANY, NATIONAL
ASSOCIATION**

By: _____ [Seal]

Print Name: _____

Title: _____

Witness:

EXHIBIT A
INCUMBENCY CERTIFICATE

Anderson Representatives

Russell D. Burns, County Administrator

Name and Title

(864) 260-4031

Phone Number

Specimen Signature

rburns@andersoncountysc.org

Email

Derrick B. Singleton, Wastewater Manager

Name and Title

(864) 260-4023

Phone Number

Specimen Signature

dbsingleton@andersoncountysc.org

Email

Clemson Representatives

Andy Blondeau, City Administrator

Name and Title

(864) 653-2030

Phone Number

Specimen Signature

ablondeau@cityofclemson.org

Email

Benjie McGill, Utilities Director

Name and Title

(864) 624-1177

Phone Number

Specimen Signature

bmcgill@cityofclemson.org

Email

Pendleton Representative

Steve Miller, Town Administrator

Name and Title

(864) 646-5425

Phone Number

Specimen Signature

stevem@townofpendleton.org

Email

EXHIBIT B
FORM OF DEPOSIT CERTIFICATE

DEPOSIT CERTIFICATE

The undersigned County Administrator of Anderson County, South Carolina has this day deposited into the Anderson Account of the Project Fund the sum of \$22,355,765.99, which represents the full amount of Anderson's Project Costs Share as such term is defined in that Project Management Agreement for Wastewater Treatment Expansion among the Town of Pendleton, South Carolina; City of Clemson, South Carolina; Anderson County, South Carolina; and U.S. Bank Trust Company, National Association dated _____, 2024.

ANDERSON COUNTY, SOUTH CAROLINA

By: _____
Russell D. Burns
County Administrator

The undersigned representative of the Escrow Agent hereby acknowledges receipt of the above-referenced deposit of Anderson's Project Costs Share into the Anderson Account of the Project Fund.

U.S. BANK TRUST COMPANY, NATIONAL
ASSOCIATION

By: _____
Natalie M. Charles
Vice President

_____, 2024

DEPOSIT CERTIFICATE

The undersigned City Administrator of the City of Clemson, South Carolina has this day deposited into the Clemson Account of the Project Fund the sum of \$17,201,505.61, which represents the full amount of Clemson's Project Costs Share as such term is defined in that Project Management Agreement for Wastewater Treatment Expansion among the Town of Pendleton, South Carolina; City of Clemson, South Carolina; Anderson County, South Carolina; and U.S. Bank Trust Company, National Association dated _____, 2024.

CITY OF CLEMSON, SOUTH CAROLINA

By: _____
Andy Blondeau
City Administrator

The undersigned representative of the Escrow Agent hereby acknowledges receipt of the above-referenced deposit of Clemson's Project Costs Share into the Clemson Account of the Project Fund.

U.S. BANK TRUST COMPANY, NATIONAL
ASSOCIATION

By: _____
Natalie M. Charles
Vice President

_____, 2024

DEPOSIT CERTIFICATE

The undersigned Town Administrator of the Town of Pendleton, South Carolina has this day deposited into the Pendleton Account of the Project Fund the sum of \$12,036,926.39, which represents the full amount of Pendleton's Project Costs Share as such term is defined in that Project Management Agreement for Wastewater Treatment Expansion among the Town of Pendleton, South Carolina; City of Clemson, South Carolina; Anderson County, South Carolina; and U.S. Bank Trust Company, National Association dated _____, 2024.

TOWN OF PENDLETON, SOUTH CAROLINA

By: _____
Steve Miller
Town Administrator

The undersigned representative of the Escrow Agent hereby acknowledges receipt of the above-referenced deposit of Pendleton's Project Costs Share into the Pendleton Account of the Project Fund.

U.S. BANK TRUST COMPANY, NATIONAL
ASSOCIATION

By: _____
Natalie M. Charles
Vice President

_____, 2024

EXHIBIT C

FORM OF DISBURSEMENT REQUEST

**REQUISITION
(DISBURSEMENT REQUEST FROM PROJECT FUND)**

U.S. Bank Trust Company, National Association
Columbia, South Carolina

Re: Direction to Make Disbursement from the Project Fund

To the Addressee:

You are hereby directed to disburse from the Project Fund created under that Project Management Agreement for Wastewater Treatment Expansion among the Town of Pendleton, South Carolina; City of Clemson, South Carolina; Anderson County, South Carolina; and U.S. Bank Trust Company, National Association dated _____, 2024 (the "Project Agreement"; capitalized terms used herein and not otherwise defined have the meanings given such terms in the Project Agreement), the amount set forth below in accordance with the instructions set forth below:

1. The amount to be paid: \$ _____. Such amount shall be withdraw from each of the Anderson Account, the Clemson Account, and the Pendleton Account based on each Party's percentage of Projects Costs Share, in the following amounts:

- (a) Anderson Project Costs Share: \$ _____
(43.33%)
- (b) Clemson Project Costs Share: \$ _____ (33.34%)
- (c) Pendleton Project Costs Share: \$ _____ (23.33%)

2. The nature of the purpose of the obligation for which this payment is requested is:

3. The name and address of the person, firm, or corporation to whom such obligation is owed or to whom a reimbursable advance has been made:

4. With respect to Project Costs, the undersigned hereby certifies as follows:
- (a) the Project Costs for which payment is being requested (i) have been paid or incurred in the amount and for the purpose specified, (ii) have not been the subject of any previous request for payment, and (iii) if this request is for an amount to reimburse a Project Participant for an expenditure paid by a Project Participant prior to the date on which the Project Fund was established, specifies the prior cost, and
 - (b) all requirements of the Project Agreement relevant to the disbursement of money from the Project Fund have been met.
3. The Project Participants have retained in their records copies of any invoices, receipts, canceled checks, payroll records and other data which are reasonably required to evidence the paying or incurring of any Project Costs for which payment is being requested. Such records will be made available upon request.

Dated this _____ day of _____, 20____.

ANDERSON COUNTY, SOUTH CAROLINA

By: _____
Anderson Representative

CITY OF CLEMSON, SOUTH CAROLINA

By: _____
Clemson Representative

TOWN OF PENDLETON, SOUTH CAROLINA

By: _____
Pendleton Representative

EXHIBIT D
ESCROW AGENT FEE SCHEDULE

**CITY OF CLEMSON
AGENDA ITEM REQUEST FORM**

Requested by: Benjie McGill

Date Submitted: July 9, 2024

Council Meeting Date: July 15, 2024

Type of Request: (check only one)

☐ Report/Discussion

☒ Policy/Action

☐ Executive Session

Agenda Item Summary: (brief for public information and posted agenda)

Approve the construction contract with Harper Corporation for construction of the Pendleton/Clemson Wastewater Treatment Plant expansion contingent upon the anticipated approval by SC RIA, (Rural Infrastructure Authority.)

Agenda Item Detail: (expand as necessary for clarification)

Based on GMC's 100% design drawings provided on 3.8.2024, communication with GMC and the owning interests (Town of Pendleton / City of Clemson / Anderson County), Harper proposes a 100% design project cost for the expansion of the Pendleton-Clemson Regional WWTP of \$60,994,197.92. This price includes \$1,545,800.00 of project allowances and \$3,320,450.47 of project contingency. The City of Clemson portion of the contract will be \$20,335,466 which is 33.34 % of the 3.000 MGD upgrade.

\$17,620,639.59	SCIIP
\$43,373,558.33	Non-SCIIP
\$60,994,197.92	Project Total

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

Prepared By



Endorsed By



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National Society of Professional Engineers
1420 King Street, Alexandria, VA 22314-2794
(703) 684-2882
www.nspe.org

American Council of Engineering Companies
1015 15th Street N.W., Washington, DC 20005
(202) 347-7474
www.acec.org

American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400
(800) 548-2723
www.asce.org

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AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

This Agreement is by and between **Town of Pendleton, City of Clemson, and Anderson County** ("Owner") and **Harper General Contractors, Inc.** ("Contractor").

Terms used in this Agreement have the meanings stated in the General Conditions and the Supplementary Conditions.

Owner and Contractor hereby agree as follows:

ARTICLE 1—WORK

- 1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows: **Construction and modifications to the existing Pendleton-Clemson Regional Wastewater Treatment Plant (WWTP).**

ARTICLE 2—THE PROJECT

- 2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: **Pendleton-Clemson Regional WWTP located at 865 Woodburn Road, Pendleton, SC 29670.**

ARTICLE 3—ENGINEER

- 3.01 The Owner has retained **Goodwyn Mills Cawood (GMC)** ("Engineer") to act as Owner's representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.
- 3.02 The part of the Project that pertains to the Work has been designed by **Goodwyn Mills Cawood (GMC).**

ARTICLE 4—CONTRACT TIMES

- 4.01 *Time is of the Essence*
- A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.
- 4.02 *Contract Times: Days*
- A. The Work will be substantially complete within **715** days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within **825** days after the date when the Contract Times commence to run.
- 4.03 *Liquidated Damages*
- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. The parties also recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration

proceeding, the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. *Substantial Completion*: Contractor shall pay Owner **\$\$500.00** for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.
 2. *Completion of Remaining Work*: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner **\$\$500.00** for each day that expires after such time until the Work is completed and ready for final payment.
 3. Liquidated damages for failing to timely attain Milestones, Substantial Completion, and final completion are not additive, and will not be imposed concurrently.
- B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

ARTICLE 5—CONTRACT PRICE

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents, the amounts that follow, subject to adjustment under the Contract:
- A. For all Work other than Unit Price Work, a lump sum of **\$43,373,558.33**.
All specific allowances are included in the above price in accordance with Paragraph 13.02 of the General Conditions.
 - B. For all Work, at the prices stated in Contractor's Final 100% Proposal, attached hereto as an exhibit.

ARTICLE 6—PAYMENT PROCEDURES

- 6.01 *Submittal and Processing of Payments*
- A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.
- 6.02 *Progress Payments; Retainage*
- A. Owner shall make progress payments on the basis of Contractor's Applications for Payment on or about the **25th** day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.
 - a. **Ninety** percent [90%] of the value of the Work completed (with the balance being retainage).
 - 1) If **fifty** percent [50%] or more of the Work has been completed, as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and
 - b. **Ninety** percent [90%] of cost of materials and equipment not incorporated in the Work (with the balance being retainage).
- B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to **one-hundred** percent [100%] of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less **two-hundred** percent [200%] of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 *Final Payment*

- A. Upon final completion and acceptance of the Work, Owner shall pay the remainder of the Contract Price in accordance with Paragraph 15.06 of the General Conditions.

6.04 *Consent of Surety*

- A. Owner will not make final payment or return or release retainage at Substantial Completion or any other time, unless Contractor submits written consent of the surety to such payment, return, or release.

ARTICLE 7—CONTRACT DOCUMENTS

7.01 *Contents*

- A. The Contract Documents consist of all of the following:
 1. This Agreement (pages 1 to 8, inclusive).
 2. Bonds:
 - a. Performance bond (together with power of attorney) (pages 1 to 4, inclusive).
 - b. Payment bond (together with power of attorney) (pages 1 to 4, inclusive).
 3. General Conditions (pages 1 to 70, inclusive).
 4. Supplementary Conditions (pages 1 to 10, inclusive).
 5. Specifications and Drawings (attached and incorporated herein as part of the Contract Documents between Owner and Contractor).
 6. Exhibits to this Agreement (enumerated as follows):

a. Exhibit – Pendleton-Clemson Regional WWTP Expansion 100% Budget Proposal

b. Exhibit GMC Geotech Report

7. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice to Proceed.
 - b. Work Change Directives.
 - c. Change Orders.
 - d. Field Orders.
 - e. Warranty Bond, if any.
- B. The Contract Documents listed in Paragraph 7.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 7.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

ARTICLE 8—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.01 Contractor's Representations

- A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:
 1. Contractor has examined and carefully studied the Contract Documents, including Addenda.
 2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 3. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
 4. Contractor has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
 5. Contractor has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
 6. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the

effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.

7. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
8. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
9. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

8.02 *Contractor's Certifications*

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 8.02:
 1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

8.03 *Standard General Conditions*

- A. Owner stipulates that if the General Conditions that are made a part of this Contract are EJCDC® C-700, Standard General Conditions for the Construction Contract (2018), published by the Engineers Joint Contract Documents Committee, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the

standard wording of such published document to the Contractor, through a process such as highlighting or “track changes” (redline/strikeout), or in the Supplementary Conditions.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on **[indicate date on which Contract becomes effective]** (which is the Effective Date of the Contract).

Owner:

Town of Pendleton

(typed or printed name of organization)

By:

(individual's signature)

Date:

(date signed)

Name:

(typed or printed)

Title:

(typed or printed)

Attest:

(individual's signature)

Title:

(typed or printed)

Address for giving notices:

Designated Representative:

Name:

(typed or printed)

Title:

(typed or printed)

Address:

Phone:

Email:

(If [Type of Entity] is a corporation, attach evidence of authority to sign. If [Type of Entity] is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

Owner:

City of Clemson

(typed or printed name of organization)

By:

(individual's signature)

Date:

(date signed)

Name:

(typed or printed)

Title:

(typed or printed)

Attest:

(individual's signature)

Title:

(typed or printed)

Address for giving notices:

Designated Representative:

Name:

(typed or printed)

Title:

(typed or printed)

Address:

Phone:

Email:

(If [Type of Entity] is a corporation, attach evidence of authority to sign. If [Type of Entity] is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

Owner:

Anderson County

(typed or printed name of organization)

By:

(individual's signature)

Date:

(date signed)

Name:

(typed or printed)

Title:

(typed or printed)

Attest:

(individual's signature)

Title:

(typed or printed)

Address for giving notices:

Designated Representative:

Name:

(typed or printed)

Title:

(typed or printed)

Address:

Phone:

Email:

(If **[Type of Entity]** is a corporation, attach evidence of authority to sign. If **[Type of Entity]** is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

Contractor:

Harper General Contractors, Inc.

(typed or printed name of organization)

By:

(individual's signature)

Date:

(date signed)

Name:

(typed or printed)

Title:

(typed or printed)

(If **[Type of Entity]** is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

(individual's signature)

Title:

(typed or printed)

Address for giving notices:

Harper General Contractors, Inc.

35 W. Court Street, Suite 400

Greenville SC 29601

Designated Representative:

Name:

(typed or printed)

Title:

(typed or printed)

Address:

Phone:

Email:

License No.:

(where applicable)

State:

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared By



Endorsed By



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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. *Application for Payment*—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. *Bidder*—An individual or entity that submits a Bid to Owner.
 6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
 7. *Bidding Requirements*—The Advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. *Claim*
 - a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the

requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.

- b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.
 - c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.
 - d. A demand for money or services by a third party is not a Claim.
- 11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
 - 12. *Contract*—The entire and integrated written contract between Owner and Contractor concerning the Work.
 - 13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
 - 14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.
 - 15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
 - 16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
 - 17. *Cost of the Work*—See Paragraph 13.01 for definition.
 - 18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
 - 19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
 - 20. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.
 - 21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the

recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. *Engineer*—The individual or entity named as such in the Agreement.
23. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.
 - a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.
 - b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.
 - c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.
25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.
28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
29. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
30. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.
32. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.
34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals.
36. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor’s Applications for Payment.
37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.
38. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.
39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
40. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers’ instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.
42. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion of such Work.

43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.
44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
45. *Supplier*—A manufacturer, fabricator, supplier, distributor, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
46. *Technical Data*
- a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.
 - b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.
 - c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.
47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.
48. *Unit Price Work*—Work to be paid for on the basis of unit prices.
49. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.
50. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 Terminology

- A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:* The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. *Day:* The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:* The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - 1. does not conform to the Contract Documents;
 - 2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - 3. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).
- E. *Furnish, Install, Perform, Provide*
 - 1. The word “furnish,” when used in connection with services, materials, or equipment, means to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 - 2. The word “install,” when used in connection with services, materials, or equipment, means to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 - 3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, means to furnish and install said services, materials, or equipment complete and ready for intended use.
 - 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

- F. *Contract Price or Contract Times*: References to a change in “Contract Price or Contract Times” or “Contract Times or Contract Price” or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term “or both” is not expressed.
- G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Performance and Payment Bonds; Evidence of Insurance*

- A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.
- C. *Evidence of Owner’s Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:
 - 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 - 2. a preliminary Schedule of Submittals; and
 - 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work

into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work, and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will be made to Contractor until acceptable schedules are submitted to Engineer.
 - 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
 - 2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
 - 3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.
 - 4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.
- B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.
- F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.
- G. Nothing in the Contract Documents creates:
 - 1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or
 - 2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

3.02 *Reference Standards*

- A. *Standards Specifications, Codes, Laws and Regulations*
 - 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, means the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 - 2. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner or Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility

inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.
2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.

- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

- A. Contractor and its Subcontractors and Suppliers shall not:
 - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
 - 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein precludes Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work may be done at the Site prior to such date.

4.03 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the

established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.
 - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
 - 1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 - 2. Abnormal weather conditions;
 - 3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and
 - 4. Acts of war or terrorism.

- D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:
1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.
 2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.
 3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.
- E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:
1. The circumstances that form the basis for the requested adjustment;
 2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;
 3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;
 4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and
 5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.
- Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.
- F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.
- G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor in writing of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas*

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
 2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.
- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will conform to applicable Laws and Regulations.
 - C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment

and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

- D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:

1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;
2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and
3. Technical Data contained in such reports and drawings.

- B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

- C. *Reliance by Contractor on Technical Data:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b.

- D. *Limitations of Other Data and Documents:* Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:
 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto;
 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;
 3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or
 4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate;
 2. is of such a nature as to require a change in the Drawings or Specifications;
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- E. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in

Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

- a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,
 - c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise;
 - b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice required by Paragraph 5.04.A.
 3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
 4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.
- F. *Underground Facilities; Hazardous Environmental Conditions:* Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:
1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 2. complying with applicable state and local utility damage prevention Laws and Regulations;

3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;
 4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.
- C. *Engineer's Review:* Engineer will:
1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;
 2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;
 3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and
 4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- F. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

- a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and
 - c. Contractor gave the notice required in Paragraph 5.05.B.
2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.
 4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;
2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures

- of construction to be employed by Contractor, and safety precautions and programs incident thereto;
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.
- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.
- H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special

conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.
- B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.
- C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

Regulations, and must be issued and signed by a surety named in “Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies” as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual’s authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

- D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.
- E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.
- F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner’s termination rights under Article 16.
- G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.
- H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.02 *Insurance—General Provisions*

- A. Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Alternative forms of insurance coverage, including but not limited to self-insurance and “Occupational Accident and Excess Employer’s Indemnity Policies,” are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.
- D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by

Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.

- E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.
- F. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.
- H. Contractor shall require:
 - 1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and
 - 2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.
- I. If either party does not purchase or maintain the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.
- K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price will be adjusted accordingly.

- L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.
- M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.
- N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.

6.03 *Contractor's Insurance*

- A. *Required Insurance:* Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.
- B. *General Provisions:* The policies of insurance required by this Paragraph 6.03 as supplemented must:
 - 1. include at least the specific coverages required;
 - 2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;
 - 3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract;
 - 4. apply with respect to the performance of the Work, whether such performance is by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable; and
 - 5. include all necessary endorsements to support the stated requirements.
- C. *Additional Insureds:* The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:
 - 1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;
 - 2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;
 - 3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);

4. not seek contribution from insurance maintained by the additional insured; and
5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 *Builder's Risk and Other Property Insurance*

- A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.
- B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.
- C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.
- D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.
- E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

- A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against

Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.

1. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils, risks, or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.
 2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.
1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.
- C. The waivers in this Paragraph 6.05 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.
- D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

6.06 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.
- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account, and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

- A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.02 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall maintain good discipline and order at the Site.

- B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.
- C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.04 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.05 *"Or Equals"*

- A. *Contractor's Request; Governing Criteria:* Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that the proposed item:
 - 1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

- 2) will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) has a proven record of performance and availability of responsive service; and
 - 4) is not objectionable to Owner.
- b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:
- 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.
- D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.
- E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 Substitutes

- A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.
1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.
 2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:
 - a. will certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design;
 - 2) be similar in substance to the item specified; and
 - 3) be suited to the same use as the item specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times;
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from the item specified; and
 - 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

- E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.
- B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.
- E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.
- F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

- H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.
- J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.
- K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.
- L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.
- M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If an invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights will be disclosed in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.09 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

7.10 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.11 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.
- C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.
- B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.
- C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.
- F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
- G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.
- H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

- I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).
- J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as material safety data sheets) or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

- 1. Before submitting a Shop Drawing or Sample, Contractor shall:
 - a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determine and verify:
 - 1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;
 - 2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - 3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;
 - c. confirm that the Submittal is complete with respect to all related data included in the Submittal.
- 2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.

3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.
- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.
1. *Shop Drawings*
 - a. Contractor shall submit the number of copies required in the Specifications.
 - b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.
 2. *Samples*
 - a. Contractor shall submit the number of Samples required in the Specifications.
 - b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.
 3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Engineer's Review of Shop Drawings and Samples*
1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.
 3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
 4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will

document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.
6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.
8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.

D. Resubmittal Procedures for Shop Drawings and Samples

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.
2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

E. Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:
 - a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.
 - b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.
 - c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.

- d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.
- 2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03, 2.04, and 2.05.
- F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

7.17 Contractor's General Warranty and Guarantee

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.
- B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:
 - 1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and
 - 2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.
- C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 - 1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 - 2. normal wear and tear under normal usage.
- D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:
 - 1. Observations by Engineer;
 - 2. Recommendation by Engineer or payment by Owner of any progress or final payment;
 - 3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 - 4. Use or occupancy of the Work or any part thereof by Owner;
 - 5. Any review and approval of a Shop Drawing or Sample submittal;
 - 6. The issuance of a notice of acceptability by Engineer;
 - 7. The end of the correction period established in Paragraph 15.08;
 - 8. Any inspection, test, or approval by others; or

9. Any correction of defective Work by Owner.
- E. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract will govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 Indemnification

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 Delegation of Professional Design Services

- A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.
- B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.
- C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

- D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.
- E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:
 - 1. Checking for conformance with the requirements of this Paragraph 7.19;
 - 2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and
 - 3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.
- F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.
- G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.
- D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

- E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.
- F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
 - 1. The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
 - 2. An itemization of the specific matters to be covered by such authority and responsibility; and
 - 3. The extent of such authority and responsibilities.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

- A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.
 - 1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.
 - 2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.
- C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents will be that of the former Engineer.

9.03 *Furnish Data*

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Resident Project Representative*

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07.
- B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 *Engineer's Authority*

- A. Engineer has the authority to reject Work in accordance with Article 14.
- B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.
- C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.
- D. Engineer's authority as to changes in the Work is set forth in Article 11.

E. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.05 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.06 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.07 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.06.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs of which Engineer has been informed.

ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

- A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
- B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.
- C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
 - 1. Changes in Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 - 2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 - 3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and
 - 4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

- A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.

- B. If Owner has issued a Work Change Directive and:
 - 1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.
 - 2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 *Field Orders*

- A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.
- B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.
- B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.
- C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:

1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);
 2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or
 3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).
- C. *Contractor's Fee:* When applicable, the Contractor's fee for overhead and profit will be determined as follows:
1. A mutually acceptable fixed fee; or
 2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;
 - b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent;
 - c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
 - d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
 - e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and
 - f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

11.08 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.
- B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

- A. *Purpose and Content:* Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.
- B. *Change Proposal Procedures*
 - 1. *Submittal:* Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.
 - 2. *Supporting Data:* The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.
 - a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.
 - b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

- 3. *Engineer's Initial Review:* Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.
- 4. *Engineer's Full Review and Action on the Change Proposal:* Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change

Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.
- D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12—CLAIMS

12.01 *Claims*

- A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:
 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;
 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and
 4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.
- B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge

and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

- C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation*
 - 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.
 - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.
 - 3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13—COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

- A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
 - 1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included:* Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:
1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.
 2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.
 3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
 4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.
 5. Other costs consisting of the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are

consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

- 1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

c. *Construction Equipment Rental*

- 1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.
 - 2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.
 - 3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.
- d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
- e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
- f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.

- g. The cost of utilities, fuel, and sanitary facilities at the Site.
 - h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
 - i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.
- C. *Costs Excluded:* The term Cost of the Work does not include any of the following items:
 - 1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
 - 2. The cost of purchasing, renting, or furnishing small tools and hand tools.
 - 3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
 - 4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
 - 5. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
 - 6. Expenses incurred in preparing and advancing Claims.
 - 7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.
- D. *Contractor's Fee*
 - 1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:
 - a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.
 - b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:
 - 1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.
 - 2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.
 - 2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

- E. *Documentation and Audit*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

13.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances*: Contractor agrees that:
1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.
- C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision

thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:
 - a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
 - b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.
2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.
3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply with such procedures and programs as applicable.

14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 3. by manufacturers of equipment furnished under the Contract Documents;
 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests will be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects:* Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs,

losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

- A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.
- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 - 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work,

or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 Owner May Correct Defective Work

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15—PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 Progress Payments

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments*
 - 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.
 - 2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. Review of Applications

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work;
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or
 - e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

- b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. The Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. The Contract Price has been reduced by Change Orders;
 - i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;
 - j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or
 - l. Other items entitle Owner to a set-off against the amount recommended.
2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.
 3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time

submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.
- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without

significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.
2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.
2. The final Application for Payment must be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

- d. a list of all duly pending Change Proposals and Claims; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
- 3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.
- B. *Engineer's Review of Final Application and Recommendation of Payment:* If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.
- C. *Notice of Acceptability:* In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.
- D. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.
- E. *Final Payment Becomes Due:* Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

- A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim,

appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such adjacent areas;
 - 2. correct such defective Work;
 - 3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.
- B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.
- C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.
- D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

- F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects,

attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

- A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The

provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this article:
 - 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and
 - 2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this article, Owner or Contractor may:
 - 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;
 - 2. agree with the other party to submit the dispute to another dispute resolution process; or
 - 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

- A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:
 - 1. in person, by a commercial courier service or otherwise, to the recipient's place of business;
 - 2. by registered or certified mail, postage prepaid, to the recipient's place of business; or
 - 3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 *Computation of Times*

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

- A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination of the Contract or of the services of Contractor.

18.07 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Assignment of Contract*

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract.

18.09 *Successors and Assigns*

- A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

18.10 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

GUIDE TO THE PREPARATION OF SUPPLEMENTARY CONDITIONS

Prepared by



Issued and Published Jointly by



Endorsed by



This **Guide to the Preparation of Supplementary Conditions** has been prepared for use with the Standard General Conditions of the Construction Contract (EJCDC® C-700, 2013 Edition). Their provisions are interrelated and a change in one may necessitate a change in the other. The suggested language contained in the **Guide to the Preparation of Instructions to Bidders** (EJCDC® C-200, 2013 Edition) is also carefully integrated with the suggested language of this document. The full EJCDC Construction series of documents is discussed in the **Commentary on the 2013 EJCDC Construction Documents** (EJCDC® C-001, 2013 Edition).

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

SC-1.01 *Defined Terms*

- A. If the Contract will include a Geotechnical Baseline Report (see Article 5 below), include the following definitions:

SC-1.01. Add to the list of definitions in Paragraph 1.01.A by inserting the following as numbered items in their proper alphabetical positions:

Geotechnical Baseline Report (GBR) — The interpretive report prepared by or for Owner regarding subsurface conditions at the Site, and containing specific baseline geotechnical conditions that may be anticipated or relied upon for bidding and contract administration purposes, subject to the controlling provisions of the Contract, including the GBR's own terms. The GBR is a Contract Document.

Geotechnical Data Report (GDR) — The factual report that collects and presents data regarding actual subsurface conditions at or adjacent to the Site, including Technical Data and other geotechnical data, prepared by or for Owner in support of the Geotechnical Baseline Report. The GDR's content may include logs of borings, trenches, and other site investigations, recorded measurements of subsurface water levels, the results of field and laboratory testing, and descriptions of the investigative and testing programs. The GDR does not include an interpretation of the data. If opinions, or interpretive or speculative non-factual comments or statements appear in a document that is labeled a GDR, such opinions, comments, or statements are not operative parts of the GDR and do not have contractual standing. Subject to that exception, the GDR is a Contract Document.

ARTICLE 2 – PRELIMINARY MATTERS

SC-2.02 *Copies of Documents*

SC-2.02 Delete Paragraph 2.02.A in its entirety and insert the following new paragraph in its place:

- A. Owner shall furnish to Contractor [**2**] copies of conformed Contract Documents incorporating and integrating all Addenda and any amendments negotiated prior to the Effective Date of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies of the conformed Contract Documents will be furnished upon request at the cost of reproduction.

ARTICLE 5 – SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

SC-5.03 Subsurface and Physical Conditions

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.03.B:

- C.** The following reports of explorations and tests of subsurface conditions at or adjacent to the Site are known to Owner:
 - 1.** Reference Exhibit – GMC Geotech Report dated 09.27.2022 attached herein and made part of this Agreement.

SC-E. 5.06 Hazardous Environmental Conditions

A. Use the following SC-5.06 if there are no known HEC reports or drawings:

SC 5.06 Delete Paragraphs 5.06.A and 5.06.B in their entirety and insert the following:

- A.** No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.
- B.** Not Used.

ARTICLE 6 – BONDS AND INSURANCE

SC-6.03 Contractor's Insurance

SC 6.03 Add the following new paragraph immediately after Paragraph 6.03C:

K. The limits of liability for the insurance required by Paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

- 1.** Workers' Compensation, and related coverages under Paragraphs 6.03.A.1 and A.2 of the General Conditions:

State:	<u>Statutory</u>
Federal, if applicable (e.g., Longshoreman's):	<u>Statutory</u>
Jones Act coverage, if applicable:	
Bodily injury by accident, each accident	\$ <u>2,000,000.00</u>
Bodily injury by disease, aggregate	\$ <u>2,000,000.00</u>
Employer's Liability:	
Bodily injury, each accident	\$ <u>2,000,000.00</u>
Bodily injury by disease, each employee	\$ <u>2,000,000.00</u>
Bodily injury/disease aggregate	\$ <u>2,000,000.00</u>
For work performed in monopolistic states, stop-gap liability coverage shall be endorsed to either the worker's compensation or	\$ <u>1,000,000.00</u>

commercial general liability policy with a
minimum limit of: _____

Foreign voluntary worker compensation

Statutory

2. Contractor's Commercial General Liability under Paragraphs 6.03.B and 6.03.C of the General Conditions:

General Aggregate \$ 2,000,000.00

Products - Completed Operations Aggregate \$ 1,000,000.00

Personal and Advertising Injury \$ 1,000,000.00

Each Occurrence (Bodily Injury and Property Damage) \$ 1,000,000.00

3. Automobile Liability under Paragraph 6.03.D. of the General Conditions:

Bodily Injury:

Each person \$ 1,000,000.00

Each accident \$ 1,000,000.00

Property Damage:

Each accident \$ 1,000,000.00

[or]

Combined Single Limit of \$ 1,000,000.00

4. Excess or Umbrella Liability:

Per Occurrence \$ 5,000,000.00

General Aggregate \$ 5,000,000.00

5. Contractor's Pollution Liability:

Each Occurrence \$ 5,000,000.00

General Aggregate \$ 5,000,000.00

6. Contractor's Professional Liability:

Each Claim	\$ 3,000,000.00
Annual Aggregate	\$ 3,000,000.00

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

SC-7.03 Labor; Working Hours

SC-7.03.B. Add the following new subparagraphs immediately after Paragraph 7.03.C:

1. Regular working hours will be Monday thru Thursday 7:00 AM to 5:30 PM.
2. Contractor's legal holidays are New Year's Day, Independence Day, Labor Day, Thanksgiving Day, Day after Thanksgiving, Christmas Eve, Christmas Day.

SC-7.03.C. Add the following new paragraph immediately after subparagraph 7.03.C.2: For purposes of administering the foregoing requirement, additional overtime costs are defined as, overtime rates will begin after ten (10) crew hours a day or forty (40) crew hours per week. Overnight rates will be two times (2x) the all-inclusive rates. Overnight rates will begin after sixteen (16) crew hours a day or on any holidays. Crew hours are calculated as time that at least one (1) Harper employee is on site.

SC-

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

SC-10.03 Resident Project Representative

SC-10.03 Add the following new paragraphs immediately after Paragraph 10.03.A:

- B.** The Resident Project Representative (RPR) will be Engineer's representative at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions.
1. General: RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR's dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner only with the knowledge of and under the direction of Engineer.
 2. Schedules: Review the progress schedule, schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.
 3. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.
 4. Liaison:
 - a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing

information regarding the provisions and intent of the Contract Documents.

- b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.
 - c. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.
- 5. Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.
- 6. Shop Drawings and Samples:
 - a. Record date of receipt of Samples and Contractor-approved Shop Drawings.
 - b. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.
 - c. Advise Engineer and Contractor of the commencement of any portion of the Work requiring a Shop Drawing or Sample submittal for which RPR believes that the submittal has not been approved by Engineer.
- 7. Modifications: Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR's recommendations, if any, to Engineer. Transmit to Contractor in writing decisions as issued by Engineer.
- 8. Review of Work and Rejection of Defective Work:
 - a. Conduct on-Site observations of Contractor's work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.
 - b. Report to Engineer whenever RPR believes that any part of Contractor's work in progress is defective, will not produce a completed Project that conforms generally to the Contract Documents, or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer of that part of work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.
- 9. Inspections, Tests, and System Start-ups:
 - a. Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.
 - b. Observe, record, and report to Engineer appropriate details relative to the test procedures and systems start-ups.

10. Records:

- a. Prepare a daily report or keep a diary or log book, recording Contractor's hours on the Site, Subcontractors present at the Site, weather conditions, data relative to questions of Change Orders, Field Orders, Work Change Directives, or changed conditions, Site visitors, deliveries of equipment or materials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.
- b. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.
- c. Maintain records for use in preparing Project documentation.

11. Reports:

- a. Furnish to Engineer periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.
- b. Draft and recommend to Engineer proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.
- c. Immediately notify Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.

12. Payment Requests: Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

13. Certificates, Operation and Maintenance Manuals: During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Contract Documents to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.

14. Completion:

- a. Participate in Engineer's visits to the Site to determine Substantial Completion, assist in the determination of Substantial Completion and the preparation of a punch list of items to be completed or corrected.
- b. Participate in Engineer's final visit to the Site to determine completion of the Work, in the company of Owner and Contractor, and prepare a final punch list of items to be completed and deficiencies to be remedied.

- c. Observe whether all items on the final list have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the notice of acceptability of the work.
- C. The RPR shall not:
1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including “or-equal” items).
 2. Exceed limitations of Engineer’s authority as set forth in the Contract Documents.
 3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
 4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor’s work.
 5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
 6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
 7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.
 8. Authorize Owner to occupy the Project in whole or in part.
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ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

SC-13.01 *Cost of the Work*

SC 13.01.B.5.c Delete Paragraph 13.01.B.5.c in its entirety and insert the following in its place:

- c. Construction Equipment and Machinery:
 - 1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - 2) Costs for equipment and machinery owned by Contractor will be paid at a rate shown for such equipment in the *Rental Rate Blue Book for Construction Equipment published by Equipment Watch by Randall Reilly*. Rates will be computed on a daily, weekly, monthly basis. These computed rates will include all operating costs. Costs will include the time the equipment or machinery is in use and the costs of transportation, loading, unloading,

assembly, dismantling, and removal. The cost of any such equipment or machinery, or parts thereof, shall cease to accrue when the use thereof is no longer necessary for the Work. Equipment or machinery with a value of less than \$1,000 will be considered small tools.

SC- 13.02 – Allowances

SC 13.02 B and C Delete paragraph 13.02.B.1.2 and 13.02.C in its entirety and insert the following in its place:

B. Included in the cost there are contingencies and allowances which are defined below:

1. Construction Contingency – “Body of Work Changes”

- i. Contingency for the Construction Manager at Risk’s exclusive use to cover those costs considered reimbursable as the Cost of the Work but not included in a Change Order to the Contract. Any changes to this contingency will include fee markup of 4.0%.
- ii. Example: Due to substantial rain another access road had to be built with additional fabric and stone.
- iii. Example: Control wiring was not included in the HVAC or SCADA contractors’ scope of work but was included in the plans and specs. This scope gap will be billed to the construction contingency.

2. Design Contingency – “Design Development”

- i. Contingency that is to be used for costs associated with further design of the project. Any changes to this contingency will include fee markup of 4.0%.
- ii. Example: Slab thickness at the sedimentation basin changes from 6” to 8”, after further engineering analysis.

3. Owner Contingency – “Scope of Work Changes”

- i. Contingency for the owner to add scope of work which shall be considered a Change Order for the project and eligible for additional markup and additional Contract time by the Construction Manager at Risk. Any changes to this contingency will include fee markup of 15%.
- ii. Example: The Owner would like to add another sample pump for redundancy, as an enhancement to the Project.

C. Allowances

1. Allowances are cost set aside for a specific item which is to be further designed or subject to change over time. Any overage or surplus allowance amounts should be converted to or reimbursed through the Owner Contingency.
 - i. Example: Asphalt pricing increased due to crude oil prices and this escalation would be applied to the allowance.

D. Adjustment in Contract Time Related to Contingencies and Allowances

1. Adjustment of Contract Time for items related to contingencies and allowances within this Agreement shall be accounted for via Contract Change Order in accordance with Article 11 – Changes to the Contract in the General Conditions.

E. Any remaining contingency at the end of the project shall be split between the Construction Manager at Risk and the Owner at the following percentages (Owner/Contractor):

- i. Remaining Construction Contingency – 60/40
- ii. Remaining Design Contingency – 60/40
- iii. Remaining Owner Contingency – 100/0
- iv. Remaining Allowances – 100/0

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

SC-17.02 Add the following new paragraph immediately after Paragraph 17.01.

SC-17.02 Arbitration

- A. All matters subject to final resolution under this Article will be decided by arbitration in accordance with the rules of *Uniform Arbitration Act SC-15-48-10*, subject to the conditions and limitations of this paragraph. This agreement to arbitrate and any other agreement or consent to arbitrate entered into will be specifically enforceable under the prevailing law of any court having jurisdiction.
- B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitrator or arbitration provider, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the specific time required in this Article, or if no specified time is applicable within a reasonable time after the matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such matter in question would be barred by the applicable statute of limitations. The demand for arbitration should include specific reference to Paragraph SC-17.02.D below.
- C. No arbitration arising out of or relating to the Contract shall include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:
 - 1. the inclusion of such other individual or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration; and
 - 2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings.
- D. The award rendered by the arbitrator(s) shall be consistent with the agreement of the parties, in writing, and include a concise breakdown of the award, and a written explanation of the award specifically citing the Contract provisions deemed applicable and relied on in making the award.
- E. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to

provisions of the Laws and Regulations relating to vacating or modifying an arbitral award.

F. The fees and expenses of the arbitrators and any arbitration service shall be shared equally by Owner and Contractor.

Town of Pendleton | City of Clemson | Anderson County

Pendleton-Clemson WWTP Expansion CMAR

April 29th, 2024

HARPER
GENERAL CONTRACTORS

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we build trust.

HARPER | GENERAL CONTRACTORS
Environmental Systems

Contact: Justin Jones | Preconstruction Manager | JustinJ@HarperGC.com | 843.637.7815



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2	Cost Development Tracking
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A photograph of an industrial facility, likely a water treatment plant, featuring large white pipes, valves, and machinery. The scene is dimly lit with a blue tint. The text "SECTION ONE" and "PROPOSAL SUMMARY" is overlaid in white.

SECTION ONE PROPOSAL SUMMARY

April 29th, 2024

Town of Pendleton | City of Clemson | Anderson County
Attn: Steve Miller, Benjie McGill, Derrick Singleton

Pendleton-Clemson Regional WWTP Expansion CMAR 100% Proposal

Based on GMC's 100% design drawings provided on 3.8.2024, communication with GMC and the owning interests (Town of Pendleton / City of Clemson / Anderson County), the project history, the listed scope clarifications, the attached Harper/GMC question log, and the attached overall project cost summary, Harper proposes a 100% design project cost for the expansion of the Pendleton-Clemson Regional WWTP of **\$60,994,197.92**. This price includes 1,545,800.00 of project allowances and \$3,320,450.47 of project contingency (0% for design development, 6% for construction contingency, and 0% for owner scope adds).

Cost breakouts for the SCIIP and Non-SCIIP portions of the project per the attachment #4 are shown below:

\$17,620,639.59	SCIIP
\$43,373,558.33	Non-SCIIP
\$60,994,197.92	Project Total

I and everyone at Harper Corporation sincerely thank you for giving us the opportunity to submit this proposal. If we can be of any further assistance, please let us know.

Respectfully,

Justin Jones
Preconstruction Manager
Harper Corporation
Environmental Systems Division
justinj@harpergc.com
843.637.7815

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General Project Scope

The project generally consists of constructing a new influent pump station, headworks, SBR basins, digester tank, and improvements to existing facilities at the existing Pendleton-Clemson Regional WWTP to expand the plant's capacity to 5.0 MGD. These improvements include, but are not limited to:

- New influent line with new doghouse manhole to route flow to new influent pump station.
- New influent pump station including 5ea submersible pumps and manual & mechanical screening.
- New headworks complete with 3ea rotary drum fine screens and 2ea vortex grit removal systems.
- New parshall flume / headworks discharge structure near existing EQ basin .
- Three new SBR basins complete with blowers, diffusers, stainless-steel air piping, etc.
- 60' Dia. Post EQ tank (modified existing 60' clarifier).
- 45' Dia. Level Correction tank (modified existing 45' clarifier) with 2ea new level correction pumps.
- 45' Dia. Sludge Buffer tank (modified existing 45' clarifier) with telescoping valve.
- New 80' Dia. cast-in-place digester with new 125 HP blower, aeration diffusers, stainless-steel air piping, floating weir/decanter equipment, stairwell/access platform, and metal canopy.
- Upgrades to existing 80' dia. Digester including new aeration diffusers, stainless-steel air piping, floating weir/decanter equipment, stairwell/access platform, and metal canopy over existing 125 HP blower.
- Addition of two new cloth media disc filter trains including backwash pumps.
- Rehabilitation of existing UV system including replacement of lamps/sleeves (64ea), cylinders (13ea), hydraulic oil (20L), cleaning gel (2 cases), upgrades to the PLC/HMI, and a new actuated level controller.
- Addition of serpentine weir constructed of 304 SST for the 6' wide UV channel. Weir to be approximately 36" deep and 48 LF long.
- Expansion of UV/Filtration area concrete slab and addition to existing pre-engineered metal canopy.
- Modifications to effluent line from UV channel to cascade aeration including conversion of existing baffle into a v-notch weir (no new weir to be provided).
- Two new masonry electrical buildings with standing seam metal roofing.
- 2ea 1 MW standby power generators with paralleling switchgear.
- Piping modifications from existing small EQ basin to SBRs to accommodate a higher SBR feed rate.
- Installation of 4" concrete liner in existing small EQ basin.
- Reuse water system including new submersible Reuse Pump #2 and new pneumatic tank.
- Electrical and SCADA to transition power to new site distribution without interrupting the existing treatment process.
- Demolition: including existing stationary screens, demolition of the existing IPS to 3' below grade, mechanical demolition of the headworks, EPDM liner in small EQ basin, mechanical demolition in the existing clarifiers, demolition of the mixing station, demolition of 6ea sludge drying beds, and miscellaneous hardscape demolition to facilitate installation of the above scopes of work.
- Preparation of existing headworks for future modification in to septage receiving structure; including concrete fill of existing channels with sloped topping slab, 8" PVC drain line routing to influent manhole.
- Misc. site improvements including new fencing at the IPS, new site paving, retaining walls, and grassing.

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Scope Clarification Summary:

General Requirements

- American Iron and Steel and Build America, Buy America Act requirements are not included.
- Davis-Bacon wage rates and certified payroll are not required for this project.
- Building and any other miscellaneous permit costs are excluded per 60% budget review meeting.
- Material Testing: Owner to contract separately with a testing firm for the testing of construction materials for this project.
- Excludes seismic requirements.
- Harper excludes water charges incurred during leak testing.
- Harper excludes existing concrete structure guarantees, including but not limited to crack injection, spall repair, reinforcing, etc. An allowance has been included for basic repairs.
- Based on Alternative Delivery project procedure, equipment rates carried in the estimate are based on current market rates as published by Equipment Watch.
- Harper markup is not included on contingency. Markup to be added to change requests when drawing from contingency.
- The price does not include any value engineering options not incorporated into the plans and specs already.
- All accepted and assumed changes per attached Harper/GMC question log are incorporated in the contract price.
- Pricing is based upon Harper performing the mutually inclusive scopes of work for both the SCIIP portion and the non-SCIIP portion of the project.

Earthwork

- Backfill of excavated structures will be completed by mechanical means all the way up to the side of the structure. Stockpiled cut is assumed to be suitable for backfill.
- Note 16 on C-201 calls for staked sod on slopes 3H:1V, which conflicts with what is drawn. ECB and TRM are included per drawing C-201, and strippings from grading are assumed to be sufficient to meet topsoil requirements.
- Actual limits of disturbance to be greater than limits shown on C-601 due to required scope of work.
- Assumes note 1 on sheet G-005 does not apply.

Site Improvements

- Assumes asphalt is to be 6-inch crushed aggregate base course, 2-inch binder course, and 1-inch bituminous wearing course to match existing.
- No landscaping is included in the contract price.

Existing Conditions

- Assumes that existing conditions under the existing small EQ liner require no dewatering, grading, compaction, or other sitework prior to its replacement with a concrete liner.
- No work associated with existing digester #1 or existing digester blower #1.

Concrete

- SBRs are precast, post-tensioned tanks designed and constructed by Dutchland, Inc.

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- Cast-in-place reinforced concrete base slab consisting of a 16" thickness under the walls reducing to a 10" thickness for the remainder of the slab. Basin floors do not slope.
- Precast post-tensioned concrete walls with an 18" minimum thickness.
- Harper to coordinate the tank installation and will install all treatment equipment, metals, etc. for the post-tensioned tanks.
- SBR concrete does not include any coatings or Xypex admixture.
- Precast concrete does not include any coatings or Xypex mixture.

Architectural

- All concrete steps to be cast-in-place concrete in lieu of precast concrete stairs.
- Stairs to SBR basins to be aluminum grating treads and railings attached to aluminum grating stairs.
- Handrail and grating quantities for the SBRs have been modified to match preliminary drawings provided by Dutchland.
- Digester blower canopies are to be 13'x17'x12' galvanized steel framed canopies mounted to concrete.
- Filter canopy to be painted to match existing filter canopy.
- SBR blower canopy to be galvanized steel.

Pipe & Valve

- 42" HDPE RWW line from the small EQ basin down the hill to the 42" 90 bend be installed via open cut in lieu of a jack & bore and casing pipe.
- Assumes SBR effluent can route directly to filters during modification of existing clarifier to post EQ tank per 12.12.23 meeting with GMC.
- Stainless steel air piping to be nozzle welded branch connections in lieu of individual tee fittings. No reinforcement of stainless-steel nozzle branch is included.
- Existing yard piping to be demolished only as needed. Lines to be abandoned will be capped or cut and plugged with grout.
- Harper furnished HDPE pipe includes a DR11 rating.
- Assumes that all ductile iron pipe fittings are C153 as called out in the specifications.
- Gravity bypass to be abandoned in place after construction. There will be a connection from the HDPE gravity bypass to the level correction tank that will be installed based on the included allowance. The operators will then be able to utilize the existing aeration basins for additional EQ. When the basins need to be drained, sump pumps can be dropped into the basin and the discharge pumped into the gravity bypass line to level correction.
- We have heat traced and insulated the following lines only; GR, DS, and RUW where the lines are 4" exposed and smaller.
- Note 6 on C-301 is not assumed to include any other lines or tanks.
- Steel reinforcement is not included in pipe encasement. Pipe encasement is 3000PSI concrete.

Process Equipment

- New digester #3 blower quoted as hybrid type PD blower to match existing digester #2 blower, in lieu of specified standard PD blower.
- No temporary UV treatment is included as work is projected to take place during 8-hour shutdowns.

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- Assumes existing 60' clarifier is sufficient for current plant flow for the duration of SBR construction and startup. This will be coordinated with the plant such that the interval where all flow is routed through the 60' clarifier is minimized.
- Seeding/transfer of sludge granules for startup of the SBRs is not included. Per GMC the plant should be able to meet limits quickly even before granules develop.

Electrical

- Assumes existing Duke power feeds will still be available during electrical changeover to new Duke feeders and new process equipment.
- Duke to furnish and install all conductors, conduit, labor, etc. on the utility side of the Duke-supplied transformer.
- Assumes transformer at service entrance will be provided by the utility.
- WAS pump replacement VFDs are included per the below
 - 15HP, 3/460V in 48"x36"x16" NEMA 4X 304SS enclosure, fan cooled
 - Danfoss 6 pulse drives
 - Input line reactors included
 - Output reactor included
- All blower VFDs are outside under metal canopies.
- Due to shipping constraints, the generator enclosure provided have an overall width of 132". Deducting 6" for both walls and 51" for the generator, there is 75" of clearance or 37.5" per side. The rear or the unit has a 5' spacing between the unit and the enclosure.

Sludge Removal

- Sludge removal is included as an allowance given the uncertain quantities we may encounter during construction. Quantities are based on discussions with the plant operator:
 - IPS: assume 30-35% of volume is wet sludge
 - Headworks: assume 30-35% of volume is wet sludge
 - EQ Basins: assume plant can remove sludge via normal process
 - Aeration Basins: Assume bottom 3' is sludge
 - Digester #2: Assume plant can remove sludge above air piping via normal process, bottom 2' of sludge to be removed by Harper
 - Clarifiers: Assume sludge can be removed via normal process
- The unit rates for sludge are based on the sludge encountered being 15% solids (120 lb/cf) and 85% water (62.4 lb/cf). Individual unit rates are provided due to differing access and equipment requirements for each structure. If the sludge present differs from this assumption a new unit rate will be negotiated. The 15% solids is the basis for the "Dry Tonnage" unit rates for sludge removal below.
- Sludge removal allowance includes removal, hauling, and tipping.
- Existing sludge drying beds are assumed suitable for use.

Allowance Descriptions

- Escalation allowance is included to cover raw material prices that cannot be guaranteed until the materials are delivered and installed onsite. Issuing purchase orders and/or subcontracts do not lock in pricing for materials such as asphalt, stone, lumber, PVC piping, fencing, copper/aluminum, etc.

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- The electrical MOPO (maintenance of plant operations) allowance is intended to cover costs for additional conductor runs, temporary electrical connections, existing to maintain operations of the plant during the project upgrade. While the record drawings provide some detail for onsite electrical systems, there will be a significant amount of on the site coordination and changes between Harper, GMC, and Anderson/Clemson/Pendleton.
- The plans and specs do not detail site lighting, so we have included an allowance for light fixtures across the site. We will design and coordinate site lighting within this allowance as a team during submittals.
- Temporary chemical feed allowance includes a Sodium Alum feed pump skid in an enclosure, chemical tote, chemical supply chemical piping, and heat trace/insulation.
 - Eyewash station for temporary chemical feed is excluded.
- Lightning protection allowance will include local grounding rings at the electrical building and any tall structures using air terminals attached to the local ring. Pole mounted dissipation devices are not provided. Final lightning protection plan to be designed during submittals.
- Concrete repair for existing structures includes minor spall repair, crack injection, etc.
- Builder's Risk cost is included as an allowance since Harper's insurance provider, Epic, cannot guarantee pricing until a contract for construction is executed. Once the contract for construction is executed, Harper will request a revised quote from Epic and the cost for Builder's Risk is subject to change based on market changes in the period between the 100% cost proposal and contract execution.

Project Allowances

Lump Sum Allowances

- \$400,000.00 Escalation Allowance
- \$80,000.00 Electrical MOPO
- \$125,000.00 Light Fixture Allowance
- \$100,000.00 Temporary Chemical Feed & Supply
- \$250,000.00 Lightning Protection Allowance
- \$25,000.00 Concrete Repair for Existing Structures
- \$175,000.00 Builder's Risk Insurance

Unit Rate Allowances – Sludge Removal

Structure	QTY [Dry Tons]	Unit Rate [\$ / Dry Ton]	Total (Incl in 100% Pricing)
Aeration Basins	250	\$800.00	\$200,000.00
Influent Pump Station	4	\$1,800.00	\$7,200.00
Headworks	11	\$1,800.00	\$19,800.00
Digester	91	\$1,800.00	\$163,800.00
Sludge Removal Totals	356	Varies	\$390,800.00

Project Allowances TOTAL (Lump Sum and Unit Rate Items) = \$1,545,800.00

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Attachments

1. Trojan UV Proposal
2. Dutchland Preliminary Drawings
3. Harper Sketch for Existing Headworks Improvements
4. SCIP Area Breakout

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312 East Coffee St. | Greenville, SC 29601 **p** 864.546.7900 **f** 864.546.7941 HarperGC.com

A photograph of a water treatment facility. In the background, a tall metal water tower stands against a cloudy sky. The middle ground features a two-story brick building with a dark roof. In front of the building, there are several yellow and black electrical enclosures on a concrete pad. To the right, there's a smaller single-story brick building with a door and a window. The foreground is a large, curved concrete structure, likely part of a water storage tank. The entire image has a dark, semi-transparent overlay.

SECTION TWO COST DEVELOPMENT TRACKING

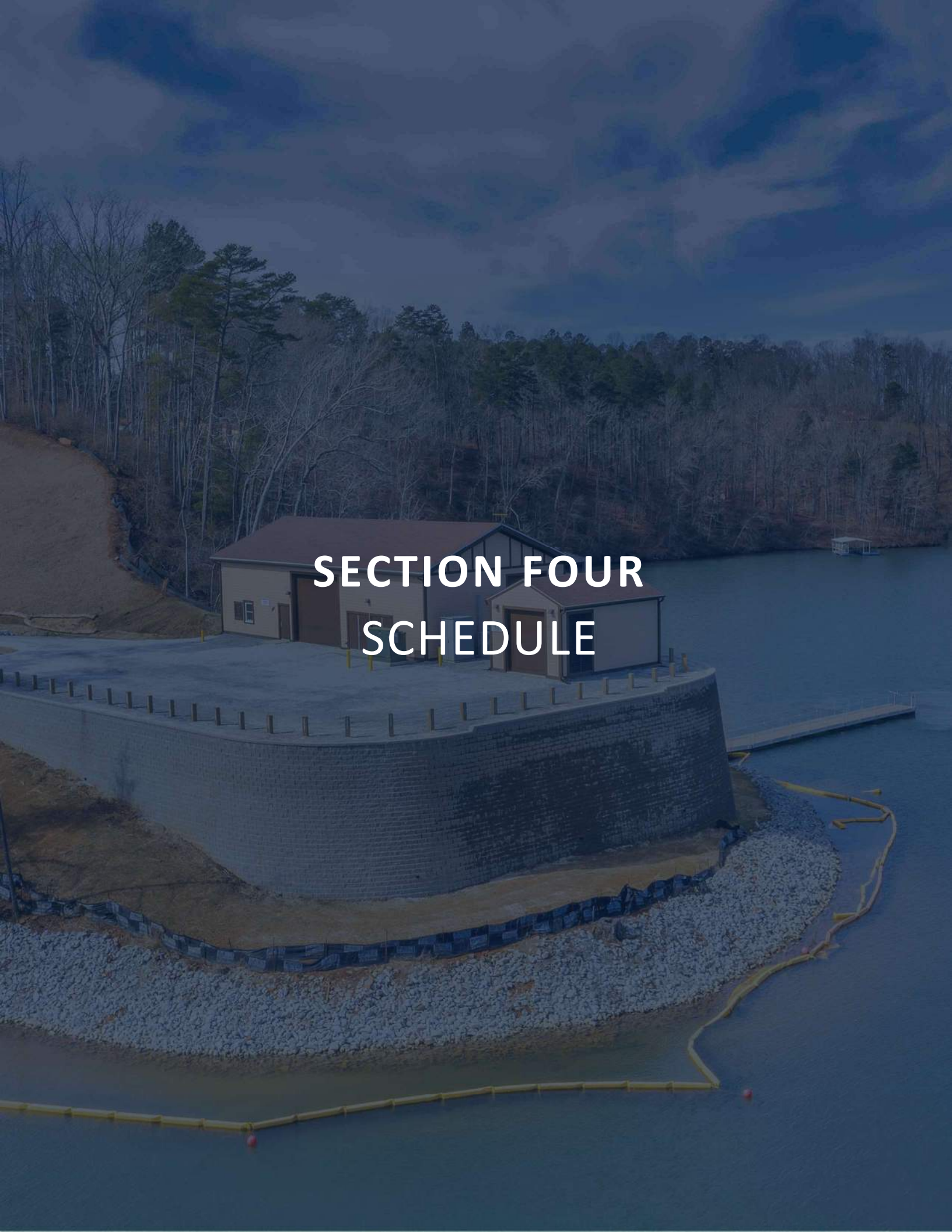
Pendleton-Clemson WWTP Expansion CMAR							HARPER GENERAL CONTRACTORS Environmental Systems
Cost Development Tracking							
Divisional Breakout							
Description	Harper 30% Design - 4.11.23	Harper 60% Design - 9.29.23	Harper 90% Design - 1.30.24	Harper 100% Design - 4.29.24	Delta from 90%	% of Project Total	Notes
					\$ -		
Design/Escalation Contingency	\$ 4,360,700.75	\$ 4,208,225.17	\$ 2,434,723.37	\$ -	\$ (2,434,723.37)	0.00%	Escalation Allowance Moved to Div 01 and Design Contingency Reduced to 0%
Construction Contingency	\$ 3,270,525.57	\$ 3,156,168.87	\$ 3,246,297.83	\$ 3,320,450.47	\$ 74,152.64	5.44%	6% Contingency for Construction
Harper Markup	\$ 2,180,350.38	\$ 2,104,112.58	\$ 2,164,198.55	\$ 2,213,633.65	\$ 49,435.09	3.63%	4% per Harper Proposal
Bonds & Insurance	\$ 347,541.42	\$ 305,787.71	\$ 305,218.36	\$ 300,372.73	\$ (4,845.63)	0.49%	Performance & Payment Bond
Preconstruction Fee	\$ 75,000.00	\$ 75,000.00	\$ 75,000.00	\$ 75,000.00	\$ -	0.12%	Per Harper Proposal
Div 01 - General Conditions Overhead	\$ 2,896,987.34	\$ 2,181,518.89	\$ 2,120,638.68	\$ 2,120,638.68	\$ -	3.48%	Per Harper Proposal
Div 01 - General Conditions Cost of Work	\$ 697,211.36	\$ 604,433.87	\$ 672,707.76	\$ 672,707.76	\$ -	1.10%	Per RFP Breakdown
Div 01 - Escalation Allowance	w/ above contingencies	w/ above contingencies	w/ above contingencies	\$ 400,000.00	\$ 400,000.00	0.66%	Changed from Contingency to Allowance
Div 01 - Permitting & Licensure	\$ 60,000.00	\$ 60,000.00	\$ -	\$ -	\$ -	0.00%	No Business License and Permits Required per 60% Meeting
Div 02 - Demolition & Sludge Removal	\$ 1,312,369.47	\$ 978,577.06	\$ 963,132.07	\$ 1,071,730.72	\$ 108,598.65	1.76%	Added Sludge Removal at IPS, Digester, and Headworks
Div 03 - Concrete	\$ 6,854,338.85	\$ 4,390,439.07	\$ 6,417,764.01	\$ 7,246,275.64	\$ 828,511.63	11.88%	Compiled All Concrete to Div 3 (Site Concrete, Crane, etc.), Added Xypex Adder for IPS Concrete
Div 04 - Masonry	\$ -	\$ 350,000.00	\$ 135,501.90	\$ 186,058.18	\$ 50,556.28	0.31%	Building Height Increased from 12' to 15'
Div 05 - Metals	\$ 880,805.23	\$ 641,554.99	\$ 921,546.75	\$ 959,702.17	\$ 38,155.42	1.57%	Material Escalation, Headworks Structure Now 2' Taller
Div 07 - Thermal and Moisture Protection	\$ 6,691.36	\$ 10,704.13	\$ 66,116.35	\$ 55,342.37	\$ (10,773.98)	0.09%	Roofing - No Changes
Div 08 - Openings	\$ -	\$ -	\$ 76,070.63	\$ 96,817.21	\$ 20,746.58	0.16%	Doors, Hardware, OH Doors Escalation
Div 09 - Painting and Coating	\$ 438,288.54	\$ 321,201.06	\$ 346,166.58	\$ 165,250.84	\$ (180,915.74)	0.27%	Removed Coating at IPS (Xypex)
Div 10 - Specialties	\$ 18,742.66	\$ 18,725.00	\$ 18,725.00	\$ 13,376.07	\$ (5,348.93)	0.02%	Some Valve/Equipment Tags with P&V
Div 13 - Special Structures	\$ 435,586.42	\$ 169,897.32	\$ 231,340.08	\$ 199,804.68	\$ (31,535.40)	0.33%	Competively Bid and Changed Awnings to Versatube
Div 22 - Plumbing	\$ 53,552.61	\$ 51,001.07	\$ 2.14	\$ 2.14	\$ -	0.00%	Plumbing - No Changes
Div 23 - Heating, Ventilating, and Air Conditioning (HVAC)	\$ 340,171.73	\$ 98,353.50	\$ 161,161.02	\$ 171,865.00	\$ 10,703.98	0.28%	HVAC Design Added
Div 25 - SCADA & Instrumentation	\$ 738,578.83	\$ 1,076,960.19	\$ 480,711.45	\$ 767,319.55	\$ 286,608.10	1.26%	Scope Development and Additional Panels/Integration
Div 26 - Electrical	\$ 7,174,714.67	\$ 7,463,855.30	\$ 8,365,062.44	\$ 11,241,298.02	\$ 2,876,235.58	18.43%	Scope Development and Verified Electrician
Div 26 - Generators	\$ 404,242.51	\$ 767,857.17	\$ 1,247,000.00	\$ 1,271,235.97	\$ 24,235.97	2.08%	Added Radiator Mounted Loadbank
Div 31 - Earth Moving & Excavation	\$ 2,060,393.56	\$ 1,203,037.46	\$ 1,585,312.17	\$ 1,614,504.92	\$ 29,192.75	2.65%	Final Scope Details
Div 31 - Dewatering	\$ 286,095.71	\$ 205,700.92	\$ 259,311.00	\$ 315,175.06	\$ 55,864.06	0.52%	Added for Septage Drain from Storage Basin to IPS
Div 31 - Shoring and Underpinning	\$ 765,956.69	\$ 712,411.72	\$ 744,559.68	\$ 744,559.68	\$ -	1.22%	No Change
Div 32 - Exterior Improvements	\$ 487,631.03	\$ 1,019,869.84	\$ 1,018,385.30	\$ 659,036.14	\$ (359,349.16)	1.08%	Moved Site Concrete to Division 3
Div 33 - Pipe & Valve	\$ 6,326,436.95	\$ 5,681,649.07	\$ 5,841,256.78	\$ 3,946,312.45	\$ (1,894,944.33)	6.47%	Final Piping Design for AquaNereda, Competitively Bid, and C900 VE Acceptance
Div 33 - Stormwater	\$ 243,983.56	\$ 74,163.80	\$ 56,263.80	\$ 102,843.00	\$ 46,579.20	0.17%	Additional Stormdrain for Scope Development
Div 33 - SST Air Piping	\$ 1,129,385.00	\$ 225,899.00	\$ 167,525.00	\$ 140,705.00	\$ (26,820.00)	0.23%	Competively Bid
Div 35 - Slide Gates	\$ 504,446.51	\$ 264,208.68	\$ 140,880.48	\$ 160,219.66	\$ 19,339.18	0.26%	Size Change for Headworks Gates, Serpentine Weir added
Div 40 - Process Interconnections	\$ 10,206.74	\$ 5,310.22	\$ 60,592.08	\$ 60,592.08	\$ -	0.10%	HT & Insulation - No Changes
Div 41 - Material Processing and Handling Equipment	\$ 72,818.57	\$ 60,174.03	\$ 42,751.86	\$ 44,751.86	\$ 2,000.00	0.07%	IPS Hoist - No Major Changes
Div 43 - Blowers	\$ 1,403,138.00	\$ 142,579.64	\$ 208,341.84	\$ 140,394.70	\$ (67,947.14)	0.23%	Digester Blower Pricing Reduction
Div 43 - Liquid Handling Equipment	\$ 1,061,237.39	\$ 655,775.36	\$ 537,680.35	\$ 548,380.35	\$ 10,700.00	0.90%	IPS Pump Escalation
Div 43 - Gas and Liquid Storage	\$ 186,448.82	\$ 73,295.00	\$ -	\$ -	\$ -	0.00%	No Permanent Chem Storage & Feed System
Div 46 - Preliminary Treatment Equipment	\$ 2,279,600.35	\$ 2,709,705.40	\$ 2,412,492.62	\$ 2,415,866.33	\$ 3,373.71	3.96%	Screens (Coarse & Fine), Grit Removal, Disk Filters
Div 46 - Water and Wastewater Chemical Feed Equipment	\$ 2.14	\$ 22,471.07	\$ 100,005.21	\$ 100,005.21	\$ -	0.16%	Temporary Sodium Alum Feed System - No Changes
Div 46 - Clarification and Mixing Equipment	\$ 1,218,468.85	\$ 1.07	\$ -	\$ -	\$ -	0.00%	Clarifier Mechanisms & BNR Mixers Removed after 30% - No Changes
Div 46 - Secondary Treatment Equipment	\$ 827,804.60	\$ 9,455,710.91	\$ 9,559,682.81	\$ 9,497,087.81	\$ (62,595.00)	15.57%	AGS System Package Cost Reduction Through Scope Development
Div 46 - Advanced Treatment Equipment	\$ 606,641.15	\$ 606,069.40	\$ 196,523.69	\$ 193,262.69	\$ (3,261.00)	0.32%	UV Rehab Scope Finalization
Div 46 - Residuals Handling and Treatment	\$ 211,851.02	\$ 4.82	\$ 5.35	\$ 5.35	\$ -	0.00%	Removed Sludge Thickener Mechanism after 30% - No Changes
Div 47 - Labor	\$ 6,570,700.38	\$ 6,194,324.43	\$ 5,403,730.90	\$ 4,943,232.32	\$ (460,498.58)	8.10%	Scope and Schedule Breakdown based on Trade Partner Scope Finalization
Div 47 - Equipment	\$ 5,595,689.40	\$ 3,799,586.42	\$ 3,240,796.68	\$ 2,818,381.49	\$ (422,415.19)	4.62%	Scope and Schedule Breakdown based on Trade Partner Scope Finalization
Totals	\$ 64,395,336.13	\$ 62,146,321.20	\$ 62,025,183.64	\$ 60,994,197.92	\$ 1,030,985.72	100.00%	

An aerial photograph of a wastewater treatment plant. The image shows several large, rectangular ponds filled with green, algae-covered water. In the foreground, there are concrete structures, likely part of the treatment process, and a small building with a green roof. The background is a dense forest under a cloudy sky. The text "SECTION THREE TRADE PARTNER SUMMARY SHEET" is overlaid in white, bold, sans-serif font in the center of the image.

SECTION THREE TRADE PARTNER SUMMARY SHEET

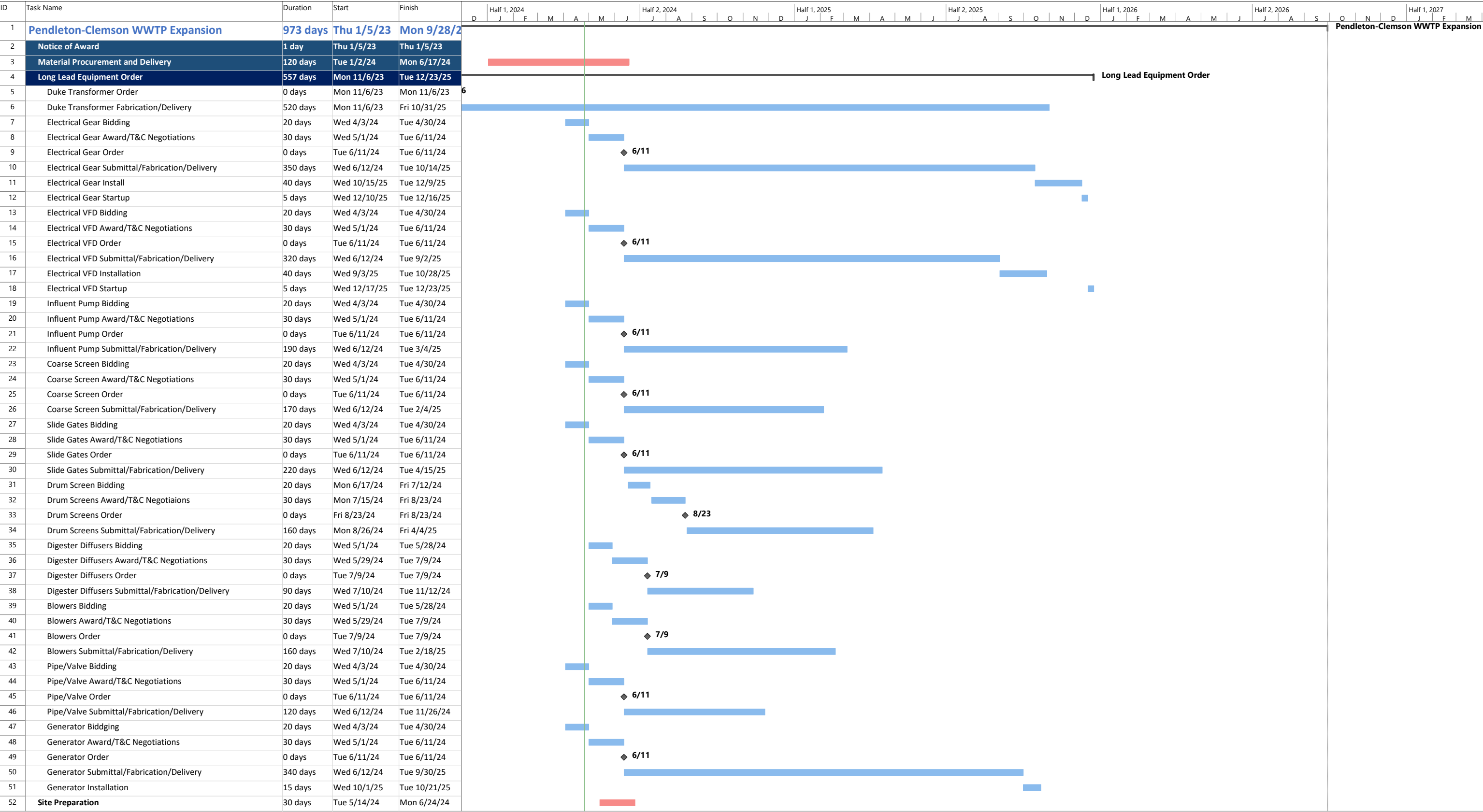
PROJECT: Pendleton-Clemson WWTP Expansion													HARPER GENERAL CONTRACTORS Environmental Systems		
SCOPE: Trade Partner Selections															
OWNER/Engineer: Pendleton Clemson Anderson															
REVISION: 00															
Scope Description		Sub/Supplier Project Overview			Alternative Sub/Supplier			Alternative Sub/Supplier			Alternative Sub/Supplier				
		Sub/Supplier	Price	Comment	Sub/Supplier	Price	Comment	Sub/Supplier	Price	Comment	Sub/Supplier	Price	Comment		
02-Existing Conditions															
Demolition		Cooper Sand & Gravel	\$	497,187.43	Selected at 90%										
Sludge Removal (Allowance)		Cooper Sand & Gravel	\$	390,800.00	Selected at 90%										
Concrete Cutting		Dixie	\$	12,687.00	Selected at 90%										
03-Concrete															
Utility Precast Concrete		Tindall	\$	56,689.00	Lindsay Precast	\$	59,866.94	Foley Concrete Products	\$	21,675.00	Incomplete Scope	CP&P	\$	7,588.00	Incomplete Scope
					Armorock	\$	417,194.00					Knight's Precast	\$	68,938.51	
CIP Concrete		Donley	\$	2,596,000.00	Selected at 90%										
Concrete Material		With CIP Concrete													
Rebar		With CIP Concrete													
Dutchland Tanks		Heyward Dutchland	\$	4,302,750.00	Selected at 90%										
04-Masonry															
Masonry		Feltman Brothers	\$	174,606.00	Selected at 90%										
05-Metals															
Misc Metals		Dixie Metals	\$	765,864.00	Selected at 90%										
Hatches		With Misc Metals and Precast Concrete													
07 - HT & Insulation															
Heat Trace & Insulation		Insulating Services	\$	59,400.00	Selected at 90%										
08 - Openings															
Doors & Hardware (Material)		Latham Door & Hardware	\$	57,000.00	Selected at 90%										
Doors & Hardware (Install)		Harper XS	\$	2,250.00	Selected at 90%										
OH Doors		Waynes Overhead Doors, Inc	\$	33,574.00	Selected at 90%										
09-Finishes															
Coating		Southern Paint & Maintenance	\$	163,760.00	Selected at 90%										
13 -Special Construction															
Engineered Canopies (Filters, SBRs)		Prosteel	\$	181,650.00	Prosteel	\$	181,650.00	Design Build Construction	\$	249,893.00		Harrell Construction, Inc	\$	218,800.00	
Carports (Digester Blowers)		Versatube	\$	11,874.00	Versatube	\$	11,874.00	Carport.com	\$	12,290.00		Backyard Storage	\$	12,359.48	
Electrical Buildings - Roofing		Pickens Roofing	\$	52,910.00	Selected at 90%										
Trusses		SCCI	\$	25,580.00	Selected at 90%										
Misc Architectural		AJH Custom Homes	\$	48,400.00	Selected at 90%										
23 - HVAC															
HVAC		Mathis Plumbing & Heating Co.	\$	163,800.00	Selected at 90%										
25-Integrated Automation															
SCADA		MR Systems	\$	743,820.00	Selected at 90%										
26-Electrical															
Electrical		Smart Electric	\$	10,384,500.00											
Generator		Blanchard CAT	\$	1,126,400.00	Selected at 90%										
31-Earthwork															
Rock Drilling		Palmetto Rock Services	\$	106,886.00	Selected at 90%										
Shoring - IPS		Berkel	\$	665,000.00	Selected at 90%										
Shoring - Utility		United Rentals	\$	51,597.88	Selected at 90%										
Sitework		HDH	\$	1,650,069.00	Selected at 90%										

Scope Description	Harper Recommended Sub/Supplier			Alternative Sub/Supplier			Alternative Sub/Supplier			Alternative Sub/Supplier		
	Sub/Supplier	Price	Comment	Sub/Supplier	Price	Comment	Sub/Supplier	Price	Comment	Sub/Supplier	Price	Comment
Dewatering	Mersino	\$ 215,711.00		Selected at 90%								
32- Exterior Improvements												
Fencing	Newman Fence Co.	\$ 15,500.00		Selected at 90%								
Paving	Carolina Asphalt	\$ 432,000.00		Elite Asphalt Services	\$ 579,845.00		Carolina Asphalt	\$ 432,000.00				
33 - Utilities												
Bypass Pumping	United Rentals	\$ 159,814.60		Selected at 90%								
DIP / LB PVC Pipe and valve	C&B/Core & Main	\$ 2,808,887.36		Ferguson	\$ 3,316,869.00		C&B/Core & Main	\$ 2,808,887.36		C&B/Ferguson	\$ 2,999,816.57	
				Core & Main	\$ 2,815,494.78							
Small Bore Pipe & Valve	IMS	\$ 110,837.69		Ferguson	\$ 14,150.00	Incomplete Scope	C&B/Core & Main	\$ 11,736.69	Incomplete Scope			
SST Piping	Piping Service, Inc	\$ 131,500.00		Felker Brothers	\$ 138,200.00		Infab Piping Services	\$ 155,450.00		Coenen Mechanical	\$ 139,830.00	
				C&B Piping	\$ 382,385.26		PB Equipment	\$ 481,500.00		Piping Service, Inc	\$ 131,500.00	
Pipe Supports	FM Stainless	\$ 189,330.00		Selected at 90%								
41- Cranes												
Monorail Crane	Eastern Crane & Hoist	\$ 42,650.60		Selected at 90%								
43- Liquid Handling												
Influent PS Pumps	Tencarva KSB	\$ 465,000.00		Selected at 90%								
Influent PS Pumps - VFDs	Tencarva KSB	\$ 280,000.00		Selected at 90%								
Reuse System	Tencarva KSB	\$ 120,000.00		Selected at 90%								
Pneumatic Tank	With Reuse System											
Level Correction Pumps	Tencarva KSB	\$ 47,500.00		Selected at 90%								
Level Correction Pumps - VFDs	Tencarva KSB	\$ 55,000.00		Selected at 90%								
46- Treatment Equipment												
Coarse Mechanical Bar Screen	EW2 Saveco	\$ 173,632.00		Selected at 90%								
Rotary Drum Screens	EW2 Saveco	\$ 549,995.00		Selected at 90%								
Washing/Conveyance Systems	With Screens											
Grit Removal System	Smith & Loveless	\$ 549,118.00		Selected at 90%								
SST Slide Gates	EW2 Whipps	\$ 139,180.00		Selected at 90%								
Parshall Flume	With SCADA											
Temporary Chem Feed System	Combs & Associates	\$ 25,000.00		Selected at 90%								
Tertiary Filters	Heyward Aqua	\$ 979,640.00		Selected at 90%								
Backwash Pumps	With Filters											
SBR Equipment Package	Heyward Aqua	\$ 8,756,780.00		Selected at 90%								
Aeration Blower (For SBRs)	With SBR Package											
Aeration Blower (For Digester)	EW2 Aerzen	\$ 131,208.00	Hybrid Type PD	EW2 Aerzen	\$ 131,208.00	Hybrid Type PD	EW2 Aerzen	\$ 124,121.00	Standard PD	Vand Kaesar	\$ 128,821.00	
				Combs Gardner Denver	\$ 154,000.00	Rotary Lobe PD						
Digester Diffusers	Heyward SSI Aeration	\$ 77,000.00		Selected at 90%								
Digester Weirs/Decanters	Heyward Aqua	\$ 42,000.00		Selected at 90%								
UV Rehabilitation	EW2 Trojan PTS	\$ 189,468.25		Selected at 90%								
Serpentine Weir	Dixie Metals	\$ 8,055.00		EW2 Guardian	\$ 19,300.00		Dixie Metals	\$ 8,055.00				



SECTION FOUR SCHEDULE

Pendleton-Clemson WWTP Expansion CMAR - Construction Schedule

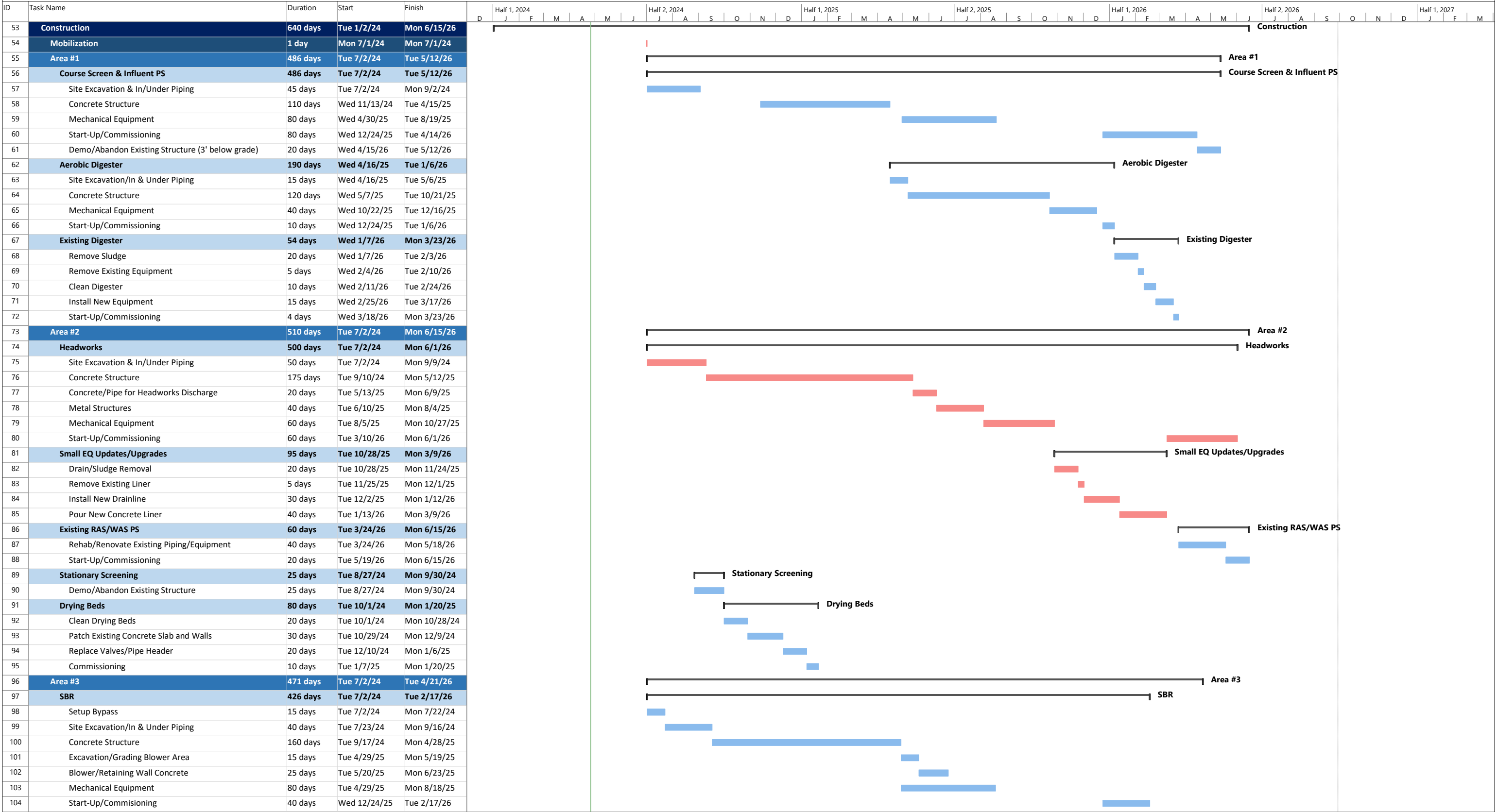


Project: Pendleton-Clemson Re

Date: Fri 4/26/24

Task	Summary	Inactive Milestone	Duration-only	Start-only	External Milestone	Critical Split
Split	Project Summary	Inactive Summary	Manual Summary Rollup	Finish-only	Deadline	Progress
Milestone	Inactive Task	Manual Task	Manual Summary	External Tasks	Critical	Manual Progress

Pendleton-Clemson WWTP Expansion CMAR - Construction Schedule



Project: Pendleton-Clemson Re
Date: Fri 4/26/24

Task

Split

Milestone

Summary

Project Summary

Inactive Task

Inactive Milestone

Inactive Summary

Manual Task

Duration-only

Manual Summary Rollup

Manual Summary

Start-only

Finish-only

External Tasks

External Milestone

Deadline

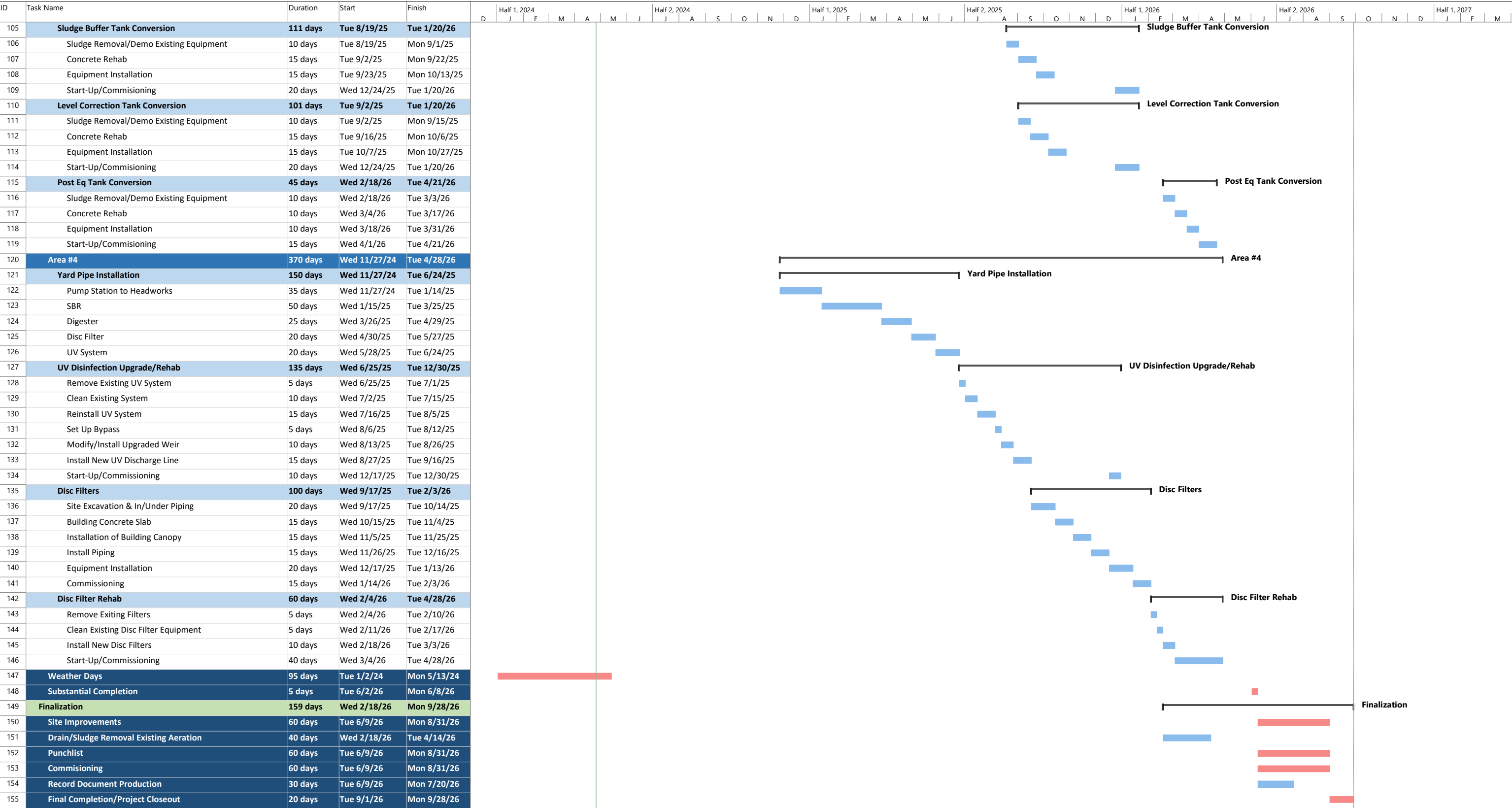
Critical

Critical Split

Progress

Manual Progress

Pendleton-Clemson WWTP Expansion CMAR - Construction Schedule



Project: Pendleton-Clemson Re
Date: Fri 4/26/24

Task

Split

Milestone

Summary

Project Summary

Inactive Task

Inactive Milestone

Inactive Summary

Manual Task

Duration-only

Manual Summary Rollup

Manual Summary

Start-only

Finish-only

External Tasks

External Milestone

Deadline

Critical

Critical Split

Progress

Manual Progress

The background image shows an industrial water treatment facility. In the foreground, there are large, horizontal, metallic pipes with red valves. The pipes are labeled with '02S' and 'S20'. To the left, there is a concrete structure with a metal railing. In the background, there is a body of water, possibly a lake or reservoir, surrounded by a chain-link fence. The sky is overcast with grey clouds. The overall scene is industrial and outdoor.

SECTION FIVE QUESTION LOG

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Item	Trade	Question	Relevant Documents	Harper Assumption or Recommendation	Engineer Response	Issue Date	Reply Date	Addendum No	Comments
ISSUE DATE = 3.22.24									
1	Procurement	Does the Build America, Buy America Act apply to this project?		No.	Confirmed	3.22.24	3.29.24	1	
2	Procurement	Do American Iron and Steel (AIS) requirements apply to this project?		No.	Confirmed	3.22.24	3.29.24	1	
3	Procurement	Do Davis-Bacon wage rates apply to this project?		Yes.	Confirmed	3.22.24	3.29.24	1	
4	Davis Bacon Wage Rates	If Davis-Bacon wage rates are applicable, can you please provide the wage rate sheet and building type classification that applies to this project?		Anderson Building classification wage rates are assumed correct. <i>Rates provided by Harper on 4.12.24.</i>	See response from Tyler Morgan on 4/15	3.22.24	4.15.24		
5	Digester #2	The aeration grid, air diffusers, and air piping on sheet I-701 are shown as existing. Please confirm these are to be replaced.		Aeration grid, air diffusers, and air piping for existing digester #2 need to be replaced and match the new equipment for new digester #3. The existing blower and VFD #2 are assumed to be in adequate condition for reuse.	Confirmed	3.22.24	3.29.24	1	
6	Existing Utility lines in SBR footprint	There are now water, power, and sewer lines shown in the footprint of the SBR excavation. To the extent possible, please delineate which lines must be relocated and/or kept in service during and after construction.		Harper assumes the critical electrical lines and aeration basin effluent piping and WAS piping must be kept in service/bypassed during construction, but may be abandoned/demolished as needed after permanent connections are made.	Confirmed. For the existing 2" WL, see bypass plan provided by GMC.	3.22.24	3.29.24		
7	Concrete Pipe Encasement	Please confirm whether the preference is to encase pipe with concrete or a steel pipe casing under roadways.	Det D, C-911	Harper assumes this detail is for the RWW jack & bore, but the rest of the piping underneath roadways and concrete slabs is assumed to be encased with non-reinforced concrete.	Concrete encasement is acceptable.	3.22.24	3.29.24		
8	Building Dimensions	Sheet A-802 shows a 12' eave with acoustical ceiling tile while sheet E-612 shows stacked cable tray 14'-6" and 12' A.F.F.		Based on responses to the 90% question log and 2.22.24 meeting with the project team, the eave height can be 12' and still allow for cable tray. Harper assumes a 12' with no acoustical ceiling tile and a drywall ceiling.	Due to the minimum bending radius of the proposed cables, the minimum required ceiling height will be 15'-0"AFF. Mount the lower cable tray 11'-0"AFF to the bottom of the tray. Mount the upper cable tray 13'-0"AFF to the bottom of the tray.	3.22.24	3.29.24	1	
9	Exst Headworks	Please confirm scope for existing headworks: Preparation for septage receiving including internal mechanical demo only and modifications to interior to drain to IPS. This includes concrete fill and drain piping, but does not include septage equipment and/or aerators.	Harper septage receiving sketch	Harper assumes the scope is correct as described.	Confirmed.	3.22.24	3.29.24	1, attach septage scope sheet	

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Item	Trade	Question	Relevant Documents	Harper Assumption or Recommendation	Engineer Response	Issue Date	Reply Date	Addendum No	Comments
10	Xypex	Please confirm that Xypex is acceptable for the IPS concrete in lieu of epoxy liner. Please add this to the specification.		Harper assumes this is acceptable. Density of Xypex (per unit volume of concrete). Harper assumes density of Xypex to be 7#/CY unless notified otherwise by GMC.	Confirmed. Use manufacturer recc.	3.22.24	3.29.24	1	
11	Canopies	The drawings still show engineered lean-to style canopies at the digesters. Please confirm that standard freestanding pole-barns/carports are acceptable. Can you please update the drawings to reflect this change for construction.		Harper assumes the filter canopy and SBR blower canopies are engineered structures, while the digester blower canopies are simple, freestanding pole-barns.	Confirmed.	3.22.24	3.29.24	1	
12	Pipe Supports	Is it acceptable to remove the requirement to provide PE stamped pipe supports?		Harper assumes yes. Pipe supports will be standard supports with no PE stamp.	Confirmed, but supports must be within precalculated tolerance range of each support.	3.22.24	3.29.24	1	
13	Pipe Supports	Is it acceptable to make pipe supports galvanized except for supports in/over water retaining structures? Pipe supports for SST air piping and pipe supports in/over tankage, wet wells, or channels to remain 304SST.		Harper assumes yes.	Use 304 stainless steel for all pipe support.	3.22.24	3.29.24	1	
14	Exst Aeration Basins	Please provide a plan sheet for the aeration basin abandonment. There have also been discussions about repurposing the basins to be offline EQ.		Harper Assumptions: • TBD upon discussions with project team	Base pricing to reflect sumps in aeration basins and pipe routing to level correction tank.	3.22.24	3.29.24	1	
15	Lightning Protection	Sheet E-004 shows the original lightning protection plan. Based on our discussion, please provide a revised lightning protection plan.		Harper assumes lightning protection will continue to be carried as an allowance.	Confirmed. Comply with codes but use standard design requirements.	3.22.24	3.29.24	1	
16	EB-2	The blower VFDs (for the SBRs) are now shown under the blower canopy instead of EB-2. Since these were originally inside of EB-2, can the building be reduced in size? Also, there is 14.5' and 12' stacked cable tray shown feeding the original VFD area inside the building. Can this tray be removed?.	E-621	Harper assumes the blower VFDs are located under the blower canopy. Eave height for EB-2 is assumed to be 12', but we will assume length and width of the building are as shown until further direction.	It is possible, but it is unlikely to save more than a couple of feet because of how the equipment is required to be laid out. Everything shown on the north wall of EB-2 has to be in that position other than Panels HEB2A, LEB2A, & Transformer TR-LEB2A. Double doors are also required so there isn't a lot to be saved as far as L&W is concerned.	3.22.24	3.29.24		
17	SCADA Blocks	Which SCADA block diagrams are correct? E-951/952 or I-931/932?	E-951/952, I-931/932	Harper assumes E-951/E-952 are correct.	E sheets are the most recent.	3.22.24	3.29.24	1	
18	LCP-3400	Is LCP-3400 located at the level correction tank or the RAS/WAS PS? I-932 shows it in the RAS/WAS PS while E-952, E-311, and D-311 show it outside of the level correction tank.	I-932, E-952, D-311	Harper assumes LCP-3400 is located at the level correction tank and I-932 is incorrect.	E-951 and E-952 are most recent. LCP3400 should be located at level correction tank.	3.22.24	3.29.24	1	
19	HVAC	Please provide HVAC drawings.		In lieu of drawings, harper assumes the HVAC scope is two 5.0 Ton Bard units with 5 KW resist heat and 15% outside air each for EB-1 and two 7.5 Ton Bard units with 3 KW resist heat and 15% outside air each for EB-2.	HVAC design shall be delegated through the contractor.	3.22.24	3.29.24		

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Item	Trade	Question	Relevant Documents	Harper Assumption or Recommendation	Engineer Response	Issue Date	Reply Date	Addendum No	Comments
28	VFDs	IPS VFDs need to be sourced through pump supplier?		Harper assumes yes.	Yes	3.26.24	3.26.24	1	
ISSUE DATE = 3.29.24									
29	Serpentine Weir	Please provide a drawing for the serpentine weir proposed in the UV effluent channel.		Harper assumes the design for the serpentine weir will be such that it does not interfere with the new or existing reuse water system.	Scope to be bid out, GMC to provide drawing. FRP or SST is acceptable. <i>Drawing provided by GMC.</i>	3.29.24	3.29.26	1, attach sheet	
30	Piping Clash	There seems to be a conflict with an existing utility on C-306. Is this utility to be cut and abandoned when the new line is installed?	C-306	Harper assumes this line will be out of service when the new line is installed.	Confirmed.	3.29.24	3.29.26	1	
31	HVAC Relocation	The placement of the relocated HVAC unit in the RAS/WAS electrical room appears to interfere with existing conductors. Per conversations with GMC on site, location of this unit is inconsequential and can be field routed.		Harper assumes this unit can be relocated as needed to avoid interference with existing or new electrical panels.	Relocate the existing HVAC evap unit directly upward as high as possible.	3.29.24	3.29.26	1	
32	Manual Screen	In lieu of an engineered manual screen, can a fabricated metal screen be provided through the miscellaneous metals supplier if spacing and sizing is the same as specified?		Harper assumes yes.	Confirmed.	3.29.24	3.29.24		
33	Retaining Wall	Please provide structural retaining wall details.			Detail added to structural sheets	3.29.24	4.15.24		
34	SBR Blower Structure	Please provide structural details for the blower structure at the SBRs.			Detail added to structural sheets	3.29.24	4.15.24		
35	Plug Valves	Is J&S an approved equal plug valve manufacturer?			Proceed with pricing.	3.29.24	3.29.24		
36	BFVs	Is J&S an approved equal butterfly valve manufacturer?			Proceed with pricing.	3.29.24	3.29.24		
37	Plug Valves	Is GA an approved manufacturer for plug valves?			Proceed with pricing.	3.29.24	3.29.24		
38	Check Valves	Is GA an approved manufacturer for check valves?			Proceed with pricing.	3.29.24	3.29.24		
39	Electrical Buildings	A801 note #11 calls for steel stud but both the arch and S dwgs show concrete block.	A-801	Current basis of bid is hat channel with gypsum board over block wall.	Confirmed.	3.29.24	3.29.24		
40	Electrical Buildings	A801 note #3 calls for insulation supported by carrier but the RCP shows gyp bd finish and note #9 calls for an acoustical tile ceiling.	A-801	Current basis: Gypsum board installed to underside of metal roof trusses and ACT-suspended from this gyp bd /roof assembly to 10' AFF.	Confirmed.	3.29.24	3.29.24		
41	Generator Enclosure	Generator enclosure spec clearance is now 6 feet instead of 5 feet. This will impact cost by increasing material required for the tank and enclosure. Is this intentional?		Harper assumes a 5' spacing on the enclosure is acceptable.	5'-0" spacing is acceptable.	3.29.24	4.11.24	1	Response Revised
42	Generator Load Banks	The 100% specifications call for a radiator mounted load bank rated at 70% of the alternator load. This is costly and could impact our schedule, are there other load bank options we can pursue and still meet client needs?		Harper assumes as long as a load bank can be docked for testing, a permanent load bank does not need to be provided.	30% radiator mounted load bank is acceptable in lieu of 70%. The load bank for each generator is required for load optimization. Option for external, padmounted, load banks with docking stations would be acceptable pending review.	3.29.24	4.11.24	1	Response Revised

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Item	Trade	Question	Relevant Documents	Harper Assumption or Recommendation	Engineer Response	Issue Date	Reply Date	Addendum No	Comments
49	Pipe Material	The pipe schedule is, in some cases, contradictory to what Harper provided at 60% and 90% design. Please specify pipe materials shall be used for yard piping at 100% design. Based on the assumptions, please specify the type/rating of PVC for each application.		Harper assumes the following: - Below grade piping upstream of the SBRs: • PVC piping - Above grade piping upstream of the SBRs: • P401/Permax Lined DIP - Below grade piping downstream of the SBRs: • PVC piping - Above grade piping downstream of the SBRs: • Cement Lined DIP - Below grade sludge piping • P401/Permax Lined DIP - Above grade sludge piping: • P401/Permax Lined DIP	[Verbal] Confirmed, P401 might be removed from AG DIP upstream of the SBRs GMC looking into this.	4.2.24	4.5.24	1	
50	Electrical	Drawing E-923 contains a dry type transformer TR-LHW, but a kVA rating is not provided. Please confirm the rating required.	E-923		30 KVA	4.2.24	4.11.24		
51	Electrical	Drawing E-925 contains a dry type transformer TR-LEB2A, but a kVA rating is not provided. Please confirm the rating required.	E-925		45KVA. 45KVA applies to TR-LEB1A as well.	4.2.24	4.11.24		
52	Electrical	Drawing E-927 contains a dry type transformer TR-LBNR, but a kVA rating is not provided. Please confirm the rating required.	E-927		30KVA	4.2.24	4.11.24		
53	Electrical	Drawing E-927 contains a panelboard LBNR, but a panel schedule was not provided. Please provide a schedule if required.	E-927		See Additional Tabs in this Excel Workbook...	4.2.24	4.11.24		
54	Electrical	A specification was provided for dry type medium voltage transformers, however I do not see any indicated on the drawings as being required, unless those are the units on E-922 and E-926 that do not include ratings. Please confirm what's required.	E-922, E-926		MV-TR1 and MV-TR3 are step-up transformers rated 2000KVA; 480V Input; 4160V Output with 2-2.5% FCAN and 4-2.5% FCBN taps. MV-TR2 and MV-TR4 are step-down transformers rated 2000KVA; 480V Input; 4160V Output with 2-2.5% FCAN and 4-2.5% FCBN taps. Transformer degree rise shall be 115DEGC. Transformers can be Liquid-Filled or Dry-Type. Transformer enclosures shall be NEMA 3R.	4.2.24	4.11.24		

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Item	Trade	Question	Relevant Documents	Harper Assumption or Recommendation	Engineer Response	Issue Date	Reply Date	Addendum No	Comments
55	Electrical	A specification was not provided for the 480V primary dry type transformers required. Please confirm what's required.			Transformers shall comply with the following requirements: Provide 2-2.5% FCAN and 4-2.5% FCBN taps. The degree rise for all LV and MV Transformers shall be 115DEGC. MV Transformers may be Liquid-Filled or Dry-Type. MV Transformers mounted outdoors shall be housed in NEMA 3R enclosure. All LV Transformers shall be housed in NEMA 4 stainless enclosure other than those installed in a non-hazardous or corrosive, climate controlled, environment such as EB-1 and EB-2.	4.2.24	4.11.24		
56	Electrical	Please confirm an integrator is responsible for the overall monitoring system shown on drawings E-951 and E-952. Electrician is only responsible for the LVA Switchgear Control Systems. Please confirm.	E-951, E-952	Yes.	The Switchgear Manufacturer is responsible for the closed transition Auto-Throw Over Scheme at each switchgear lineup. The Switchgear Manufacturer is responsible for starting each generator. The Switchgear Manufacturer is responsible for paralleling the two generators. Switching breakers with internal fusing (providing series higher fault ratings) WILL NOT BE ALLOWED. All switching and distribution circuit breakers are to be insulated-case type breakers.	4.2.24	4.11.24		
57	Electrical	The schedules for the LVA lineups have references to Auxiliaries and Specific Notes as highlighted below, but we can't seem to figure out what those correlate to in the drawing package. Please provide more information.			See Additional Tabs in this Excel Workbook...	4.2.24	4.11.24		
58	SBR Drain	Drain piping for the SBR basins is not shown. Is one required?		Harper assumes no.	[Verbal] Confirmed.	4.2.24	4.5.24		
59	E-Bldg	What electrical gear manufacturer's sizing was used to layout the electrical buildings?			Siemens LV MC Switchgear	4.2.24	4.11.24		
60	Conductors	Please confirm that copper cable is an acceptable alternative to aluminum feeders and conductors?		Yes.	Copper is acceptable.	4.2.24	4.11.24		
61	Backfill	Please provide a detail for the backfill requirements for direct bury conductors.			See #63	4.2.24	4.12.24		

Pendleton-Clemson WWTP
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Item	Trade	Question	Relevant Documents	Harper Assumption or Recommendation	Engineer Response	Issue Date	Reply Date	Addendum No	Comments
62	Site Lighting	Please confirm that no site lighting is to be provided in the project scope. Assumption: Confirmed, no site lighting.		Harper assumes site lighting is not in the project scope.	Site lighting will be required and GMC will develop drawings as soon as possible. For pricing purposes, see the comment cell to the right for BoD fixture and poles	4.2.24	4.11.24		Cooper #GALN-SA2-C-740-U-SL4-PA-BK-ZW-WOFBK-HSS mounted on 30' tall, 4" black square steel pole on concrete pole base. Quantity of 18 (subject to change).
ISSUE DATE = 4.2.24									
63	Direct Bury Conductors	Based on further discussions with electricians, we have safety concerns for the future plant operations with the direct bury conductors and no obvious marking, ductbank, special backfill, etc. (someone accidentally puts an excavator through an energized conductor after the project is complete).		Our recommendation for the direct bury conductors is to backfill the conductors with sand and place a dyed-red concrete cap over the sand, then cover with 6" to 1' of topsoil. Please advise if you agree with this scope change.	Concrete cap and dyed #57 stone/sand are options.	4.2.24	4.11.24		
ISSUE DATE = 4.5.24									
64	LCP-3000	Please clarify the intent of LCP-3000. The blowers and associated VFDs for the digesters are both located outside at the digesters themselves with local control as part of the VFD.			LCP-3000 serves to connect all IP and discrete communication from the BNR Control Cabinet to the Plant SCADA system.	4.5.24	4.11.24		
65	Blower Canopy	Please confirm Harper is to supply and install a canopy over the existing blower.		Harper assumes yes. Canopy to match the one supplied for the new blower.	Yes. Canopy to be installed over existing blower at Digester No.2.	4.5.24	4.15.24		
66	LCP-1000	Please confirm the intent of LCP-1000. FCP-1000 controls the mechanical screen at the IPS and LCP-1010 is the combined control panel for all 5 influent submersible pumps.			LCP-1000 collects all IP and discrete signals from local field device as well as the local I/O from the Influent Pumps. FCP-1000 does control the Screen at the IPS. LCP-1010 collects all IP signals located in EB1 (i.e. VFDs, switchgear, power conditioning units, etc) and communicates with the plant SCADA systems.	4.5.24	4.12.24		
67	Exst HW	Please confirm Harper sketch for headworks modification scope. <i>See question # 9</i> .	See Harper Sketch "Exst HW Modifications"		[Verbal] Confirmed.	4.5.24	4.5.24	1	
68	Serpentine Weir	Please confirm Harper sketch for the serpentine weir. <i>See question # 29</i> .	See Harper Sketch "Serpentine Weir"		See GMC Drawing.	4.5.24	4.10.24	1	
69	Jack & Bore	Please confirm open cut (with trench boxes) is acceptable in lieu of jack and bore for installation of the RWW line leaving the small EQ basin.			[Verbal] Confirmed, Harper to sketch this and provide to GMC.	4.5.24	4.5.24		
70	Pipe Bollards	Please specify number of metal pipe bollards required, or a spacing requirement.		Harper is including 10ea bollards in the generator area and 2ea bollards for each overhead door.	Please revise to 32ea bollards. GMC to review potential locations.	4.5.24	4.8.24		

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100% Design

Item	Trade	Question	Relevant Documents	Harper Assumption or Recommendation	Engineer Response	Issue Date	Reply Date	Addendum No	Comments
71	SST Piping Manufacturers	Please confirm that if SST pipe fabricators supply piping meets specifications, they do not need to be sourced from an approved manufacturer. Harper assumes that this requirement stemmed from AIS/BABAA requirements, which are not part of this project.		Harper assumes we can use open material sourcing, provided the piping sourced meets the specifications. For Example, Coenen Mechanical is a US based fabricator, but they buy raw materials from overseas.	[Verbal] Confirmed.	4.5.24	4.5.24		
72	HVAC	Please provide the following information for HVAC design (delegated to contractor per Q19) for both electrical buildings. Per our selected HVAC Trade Partner, this information is required for delegated design: •Dimensioned plan and elevation dwgs •Site plan showing orientation (n,e,s,w) •Structural & architectural drawings (or description), with details on insulation •Electrical Plan showing panel locations (& preferably elevation plans) •Lighting plan, Type of lights, KW •Equipment kw & normal occupancy •Preferred or Available heat source other than electric for HVAC, if any? •Filtration, Humidity/ Exhaust/ Ventilation requirements (economizer/power exhaust/ Scrubber, etc)? •Hazardous gas potential, if any or special coatings requiments? •Redundancy, backup systems? •Desired temp/humidity settings & 24hr or occupied/unoccupied •Condensate to Grade ok or need dry well (due to walkways or concrete,, etc.)		Harper assumes we are to put together a design build proposal with Mathis, the selected HVAC subcontractor. •Dimensioned plan and elevation dwgs <i>Harper to provide to Mathis, assuming bldgs are same LxW with 15' eave.</i> •Lighting plan, Type of lights, KW <i>Assuming 10ea CPX 1X4 2000LM 80CRI 30K A12 347 per bldg. These are 21.5W/ea.</i> •Equipment kw & normal occupancy <i>Harper to provide to Mathis based on E-sheets</i> •Preferred or Available heat source other than electric for HVAC, if any? <i>GMC to advise, Harper assuming electric</i> •Filtration, Humidity/ Exhaust/ Ventilation requirements (economizer/power exhaust/ Scrubber, etc)? <i>Industry Standard</i> •Hazardous gas potential, if any or special	[Verbal] Proceed with this direction. Heat Loads For Electrical Building #1: •185HP VFD's: 160000W * .015* 3 = 7200W (maximum Influent Flow using three peak pumps) •SCADA Cabinet; MSBA; and lighting: 1400W •Power Conditioning Unit: 680000VAR * .01 = 6800W •TR-LEB1A: 45000W * .03 = 1350W •Ambient Loading For Pendleton SC: Determined By Mechanical Engineer •Total Without Ambient Loading: 16750W Heat Loads For Electrical Building #2:	4.5.24	4.15.24		Response revised 4.15.24

Pendleton-Clemson WWTP
100% Design

Item	Trade	Question	Relevant Documents	Harper Assumption or Recommendation	Engineer Response	Issue Date	Reply Date	Addendum No	Comments
		•Are stamped Drawings required?		•Hazardous gas potential, if any or special coatings requiments? <i>No/Industry Standard</i> •Redundancy, backup systems? <i>Yes, Redundant</i> •Desired temp/humidity settings & 24hr or occupied/unoccupied <i>Industry standard for unoccupied space</i> •Condensate to Grade ok or need dry well (due to walkways or concrete,, etc.) <i>Assuming drain to grade OK</i> •Are stamped Drawings required? <i>Yes for EB-1 and EB-2, no for RAS/WAS PS</i>	•SCADA Cabinet; MSBB; and lighting: 1400W •BNR PLC Cabinet: 1600W •Power Conditioning Unit: 440000VAR * .02 = 8800W •TR-LEB1A: 45000W * .03 = 1350W •Ambient Loading For Pendleton SC: Determined By Mechanical Engineer •Total Without Ambient Loading: 18250W				
73	Civil CAD Files	Please provide civil CAD drawings if possible.			See GMC drawings.	4.5.24	4.15.24		
ISSUE DATE = 4.10.24									
74	Pipe Supports	Is it acceptable to mount pipe supports in the locations shown for air piping on the side of the Precast SBR tanks?		Harper assumes yes.	Yes. Dutchland has exterior drilling and mouting spec. Follow the spec.	4.10.24	4.15.24		
75	Geotechnical Data	Please add the geotechnical reports to the specifications. Harper has distributed the reports dated 9.27.22 and 10.18.23.			Added to spec.	4.10.24	4.15.24		
76	Lightning Protection / Grounding	Please confirm the attached files for lightning protection and grounding provided for a sample project serve as an acceptable design basis for this project. The intention will still be to carry lightning protection as an allowance, but the scope outlined will help to refine the allowance.	See "Lightning Protection Systems Specifications", "Lightning Protection System Submittal", "Grounding Drawings", and "Lightning Protection Quote" Provided by Harper on 4.10.24.		Lightning protection basis of design concept is acceptable for the admin building, electrical buildings, UV/Filter canopy, and RAS/WAS building. However, it does not directly apply to process areas such as the BNRs, Post EQ, Sludge Buffer Tank, Level Correction Tank, Headworks, and IPS. In order to create an effective zone of protection in those areas, pole mounted dissipation devices will be required. Grounding basis of design concept is	4.10.24	4.12.24		
77	IPS Pump Comments	Please see attatched comments from KSB on the submersible pump specs. <i>Hover over the highlights or double click to see comments.</i>	See "Submersible Pump Specs" Provided by Harper on 4.10.24.		Spec was revised based on KSB's comments.	4.10.24	4.15.24		
78	VFDs	Please confirm that Danfoss is an acceptable VFD manufacturer?		Harper assumes yes as there is a significant cost difference between Yaskawa VFDs and Danfoss VFDs.	Yes, Danfoss, Allen-Bradley, and Siemens are all acceptable manufacturers.	4.10.24	4.12.24		

Pendleton-Clemson WWTP
100% Design

Item	Trade	Question	Relevant Documents	Harper Assumption or Recommendation	Engineer Response	Issue Date	Reply Date	Addendum No	Comments
79	Aqua Coordination	See email sent by Ryan Victory on 4.10.24 regarding questions and concerns from Aqua.			See email responses provided by Jay Xin on 4.12.24	4.10.24	4.12.24		
80	Motor Requirements Spec	Please provide spec section 46 05 13 Motor Requirements.			Disrgard the spec reference. Motor spec will be reviewed by GMC during submittal phase.	4.10.24	4.15.24		
ISSUE DATE = 4.12.24									
81	Drawing Scale	Please note that sheets C-202 thru C-205 have incorrect drawing scales.			Corrected	4.12.24	4/15/2024		
ISSUE DATE = 4.15.24									
82	UV Rehabilitation	EW2 reached out to us on behalf of themselves, Trojan, and PTS regarding the UV rehab specifications. They have concerns that the spec employs language typically written for a new system and in some cases is not in alignment with the scope they suggested at 90%. If the scope form 90% is agreeable, is it acceptable to remove the UV spec section 46 66 56 and use the Trojan / PTS scope?	Trojan / PTS		Yes, the spec was based on our typical UV spec for Trojan products. [GMC] will revise the spec accordingly to reflect the rehab scope rather than new equipment.	4.15.24	4.16.24		

The background image shows a complex industrial facility, likely a refinery or chemical plant. It features a dense network of large, metallic pipes, some of which are insulated. There are several large storage tanks or vessels, some with ladders and platforms. The scene is filled with various mechanical components, valves, and instruments. The lighting is somewhat dim, with some bright spots from overhead lights. The overall color palette is dominated by metallic greys and blues, with some red and yellow accents from safety equipment.

SECTION SIX

ATTACHMENTS



1/11/2024

Pendleton Clemson –

Jim,

Please see below follow up for recommendations for Clemson, Pendleton site. Following these guidelines will ensure the plant will be able to continue to operate their equipment for the foreseeable future under design conditions.

1. Immediate Need (Parts to be replaced)

Per a site visit from Sherri Bos, there is a list of parts that should be purchased and replaced ASAP to ensure disinfection is met.

- 13 wiper cylinders (326411)
- 2 cases of Acticlean Gel (901507)
- 20 L hydraulic oil (4426022-020)
- 64 lamps / sleeve combination kits

Labor to complete this work will be provided by Piedmont Technical Services and quoted and purposed separately.

2. System Control Center Upgrade

System Control Center (SCC). PLC Upgrade: Scope of Supply:

Controller Upgrade: Upgrade the L35e Control Logix processor to an L33er Control Logix processor. The current power supply onsite will need to be upgraded to accommodate the new processor and communications card. An upload of the existing logic running at site is recommended prior to the initial conversion into the new processor. If an upload is unavailable, Trojan will utilize the latest copy of the sites program that has been saved to our servers. There is a risk of logic or data loss/differences when an uploaded copy is unavailable. PLC and HMI IP addresses should also be provided by the site

-The L33er processors do not contain an onboard serial port (L35e series processors did), thus a 3rd party communications card (Prosoft) will be utilized. This communications card and L33er PLC will be programmed, tested and ready for install in the existing I/O rack.

PLC Upgrade Hardware and Programming

QTY	DESCRIPTION	UNIT MODEL NUMBER / COMMENT
1	Processor: AB CompactLogix 1769-L33ER	Part # 916772
1	Prosoft Communications Card MVI69E-MBS (Modbus)	Part # 917411
1	PLC Programming, Testing\Simulation.	
1	Documentation: One electronic copy of the following documentation will be supplied by Trojan. Appropriate corrected sections of the O&M Manuals to reflect the new hardware. (Electrical drawings, Controls Narrative)	Included
	Total PLC Upgrade Price USD\$	
	HMI Option	
1	Panelview Plus 7-700 Upgrade kit. Includes SD card and adaptor plate	917662-001
1	HMI Programming, Testing\Simulation.	
	Total HMI Upgrade Price USD\$	

Service by Trojan Certified Technician

Certified Trojan Technician will be required to commission the SCC hardware upgrade. The following site service will be required to complete the inspection, commissioning, and startup of the new L33er processor and associated hardware. We estimate 1 day onsite for the upgrade.

Description	Time (days)	Total Price (US\$)
Travel	1	
Site Days	1	
Total Service Price USD\$		

Site Responsibility:



1. Site will be responsible for making the SCC available during processor switchover and allowing Trojan equipment to be put in **Local** for up to one (8) eight-hour day. This will allow UV disinfection to take place, but the system will only be available in local at 100% power.
2. Supply of PLC and HMI IP addresses

3. Replacement Level Controller with a Motorized Weir Gate

The existing Golden Harvest Level Controller would be replaced by a Whipps stainless steel gate as follows:

- Quantity : One (1)
- Gate Size - Model : 66" Wide x 23" High - Model 923DI Self Contained Stainless Steel Weir Gate
- Invert To Floor : 5.24 ft
- Max Design Head : 2 ft seating - 2 ft unseating
- Description : The downward opening stainless steel weir gate will have the following features :
 - SS304L construction; UHMW side and invert seals; The dual operating stems will be SS304 with plastic stem covers.
 - Mounting Style : Wall mounted with non-shrink grout and SS anchor studs.
 - Lifting Mechanism : Yoke mounted interconnected gearboxes with single 480 volt single phase electric actuator.
 - Anchor Bolts : 1/2" anchor studs and nuts included.

A level sensor / transmitter will be provided by Trojan to be installed by the Contractor in the UV channel to provide a level reading to control the gate. Work to program the control of the gate will be performed by a Trojan Certified Technician.

Site Responsibility:

1. Site will be responsible for off loading, installation, motor and control conduit / wiring outside the equipment and control panel.
2. Termination of the wiring inside the control panel will be by others.
3. Limits to EMO actuators would be set by others.



Please let me know if you have any questions,

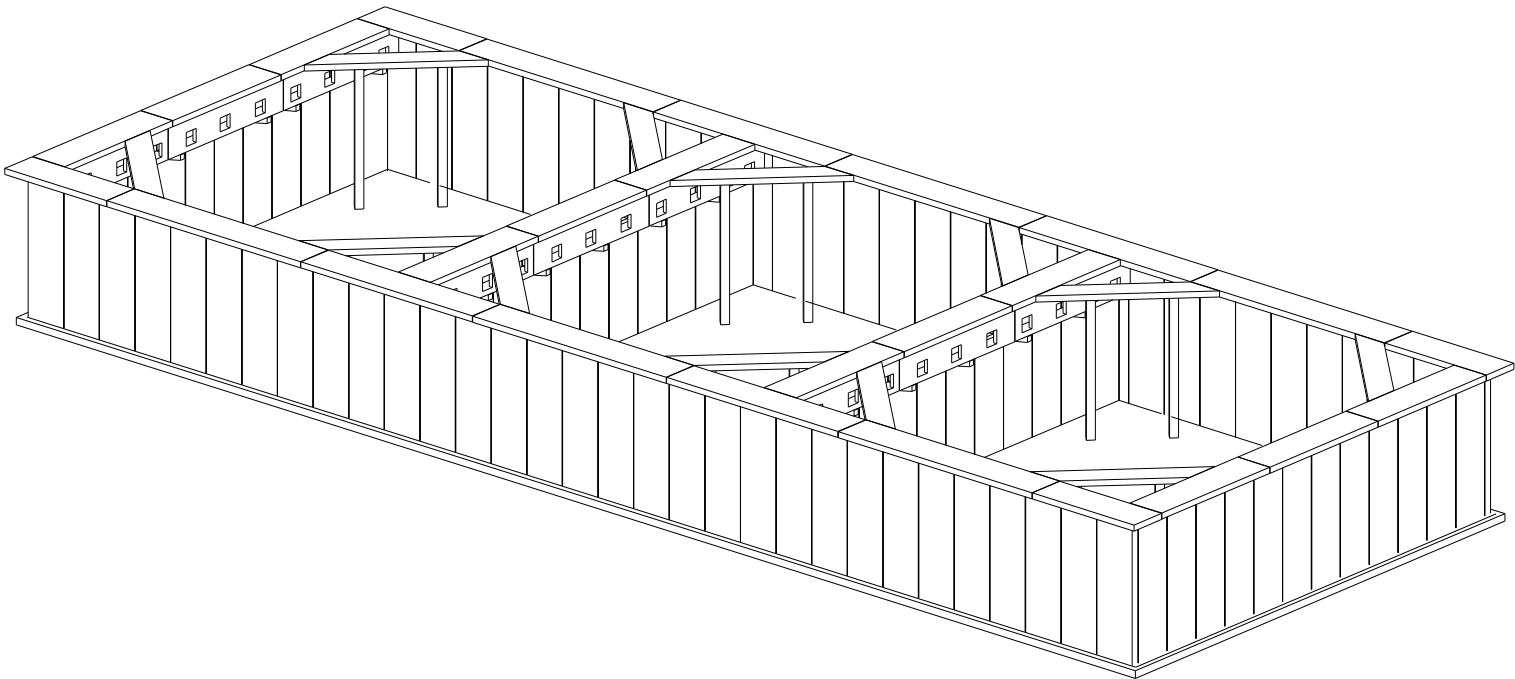
Best regards,
TROJAN TECHNOLOGIES

BARRON FUTRAL | Regional Account Manager – Aftermarket Parts Sales
SouthernUS@trojantechnologies.com
Mobile: (205) 597-3374
TROJAN TECHNOLOGIES

PENDLETON-CLEMSON REGIONAL WWTP EXPANSION

ERECTION DRAWINGS FOR BIOREACTOR TANK

ANDERSON COUNTY, SOUTH CAROLINA



PRELIMINARY	☒
PERMITTING	☐
BID DOCUMENT	☐
FINAL DESIGN	☐
MANUFACTURING	☐
AS BUILT	☐

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MANUFACTURER:



160 Route 41 | Gap, PA 17527-9410

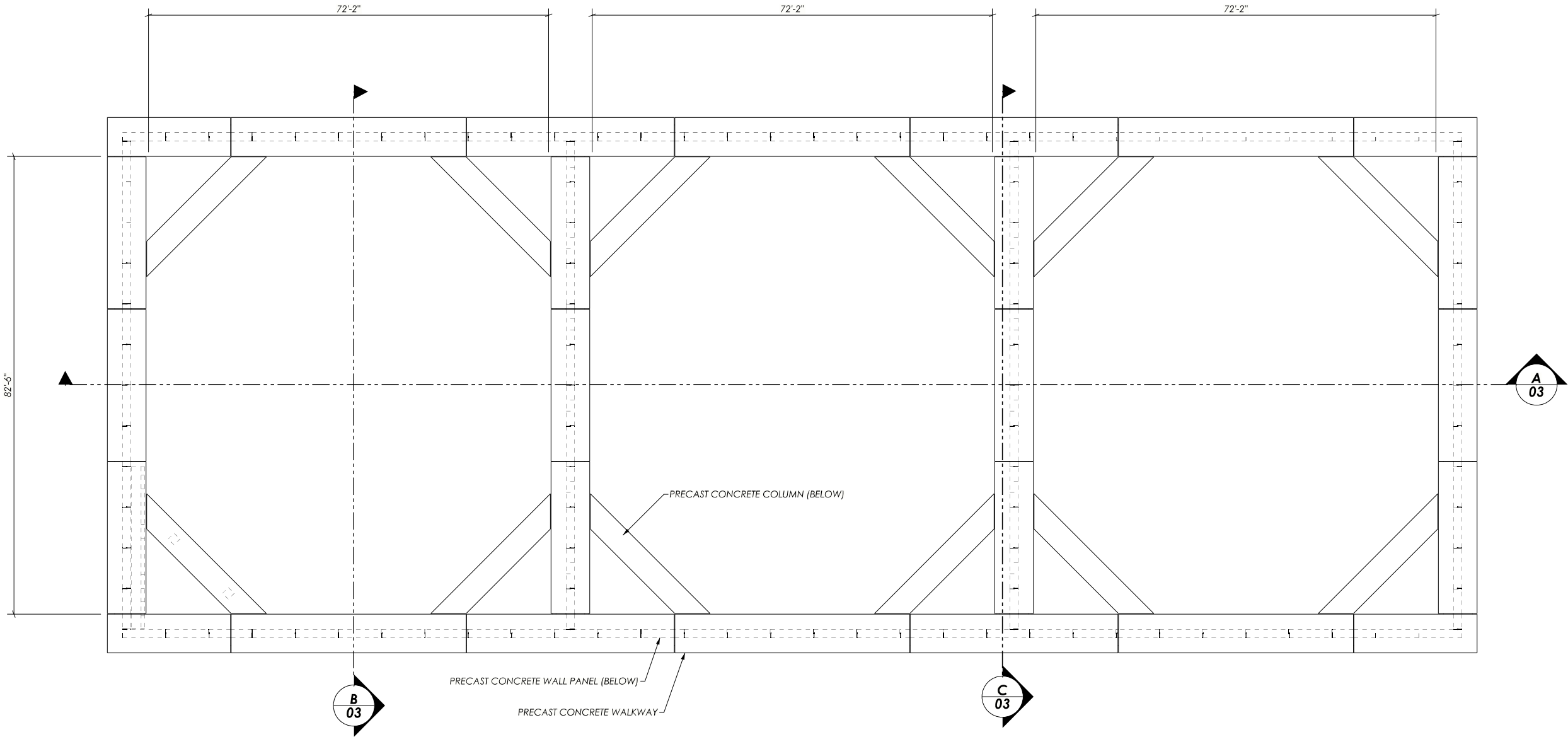
Phone 717.442.8282 | Fax 717.442.9330

www.dutchlandinc.com   

INDEX OF DRAWINGS:

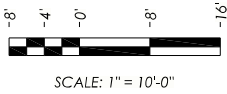
REV.	ISSUE DATE	SHEET #	TITLE
0	XX/XX/XXXX	01	KEY PLAN
0	XX/XX/XXXX	02	WALL PLAN
0	XX/XX/XXXX	03	SECTIONS
0	XX/XX/XXXX	04	ISOMETRIC VIEW

Attachment 2



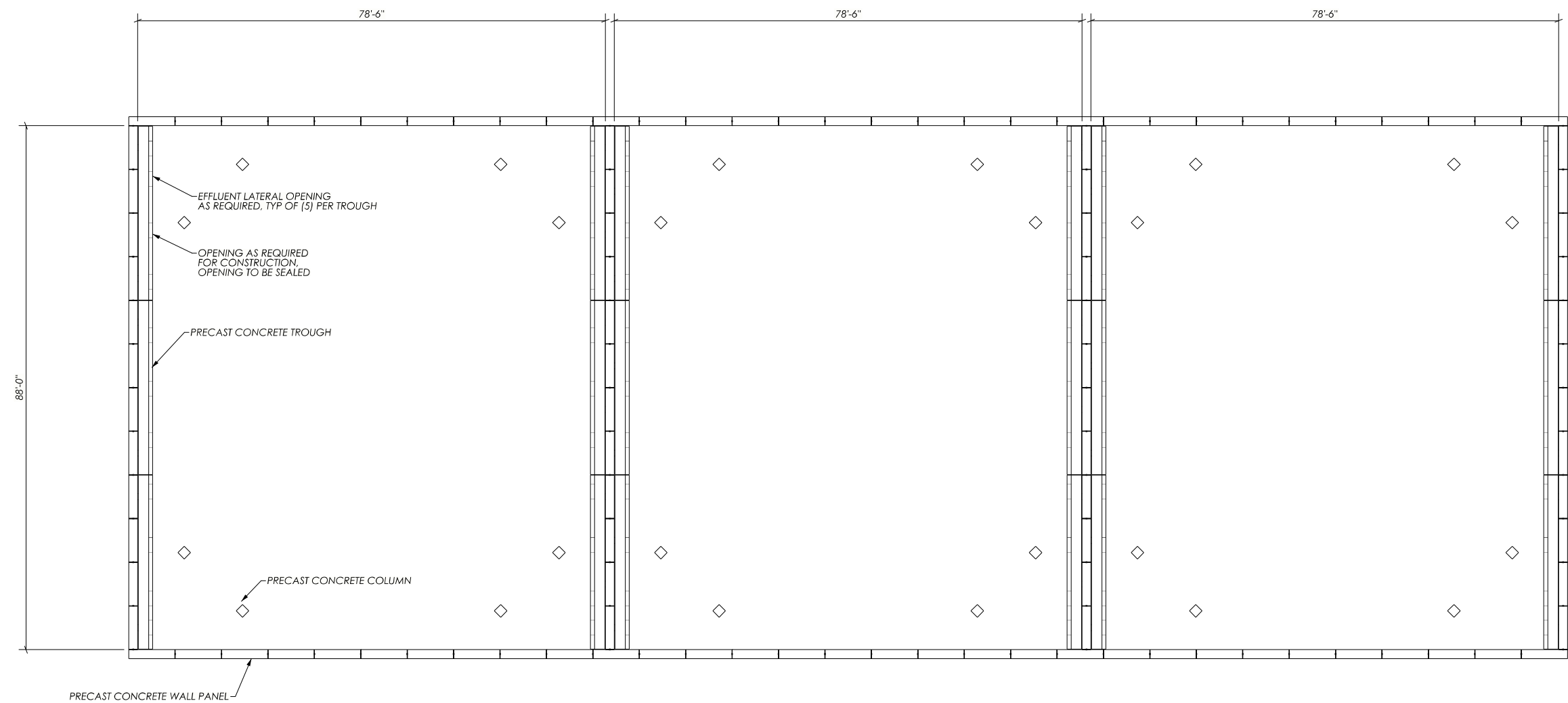
KEY PLAN

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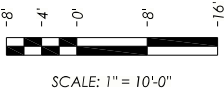
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Attachment 2



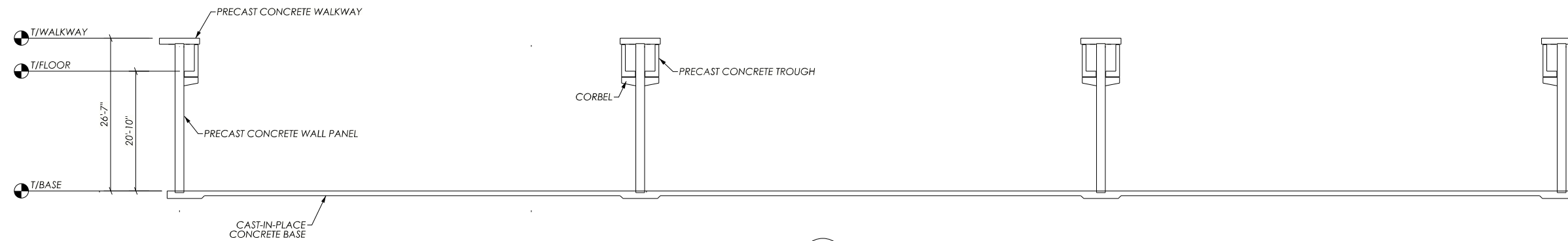
WALL PLAN

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2/27/2024

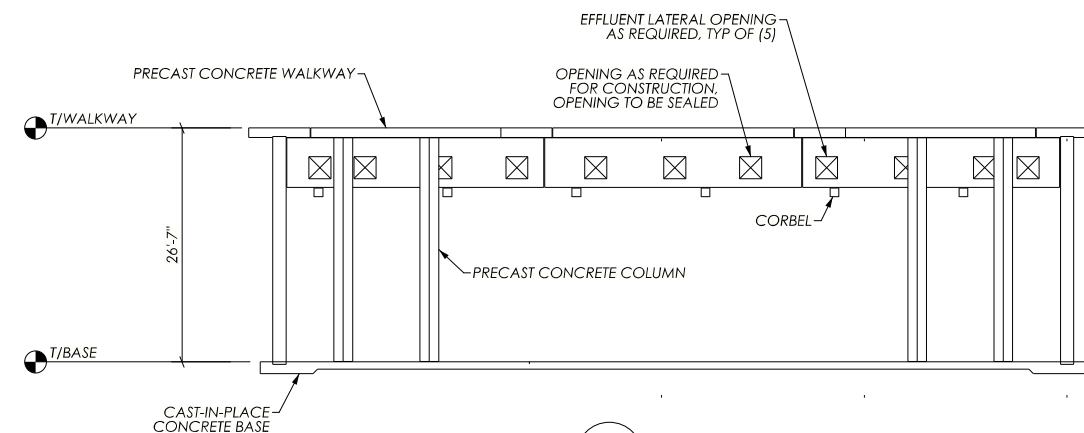


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Project: PENDLETON-CLEMSON REGIONAL WWTP EXPANSION BIOREACTOR TANK ANDERSON COUNTY, SOUTH CAROLINA	WALL PLAN			
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	Project Manager: XX			
	Drawn By: EDE			
	Checked By: XXX			
	Issue Date:			
	Sheet No. 02			

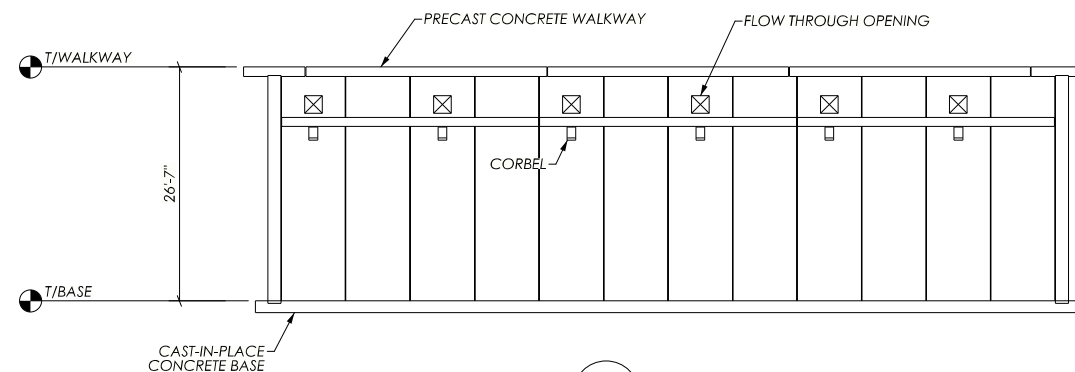
Attachment 2



A SECTION
01



B
01 SECTION



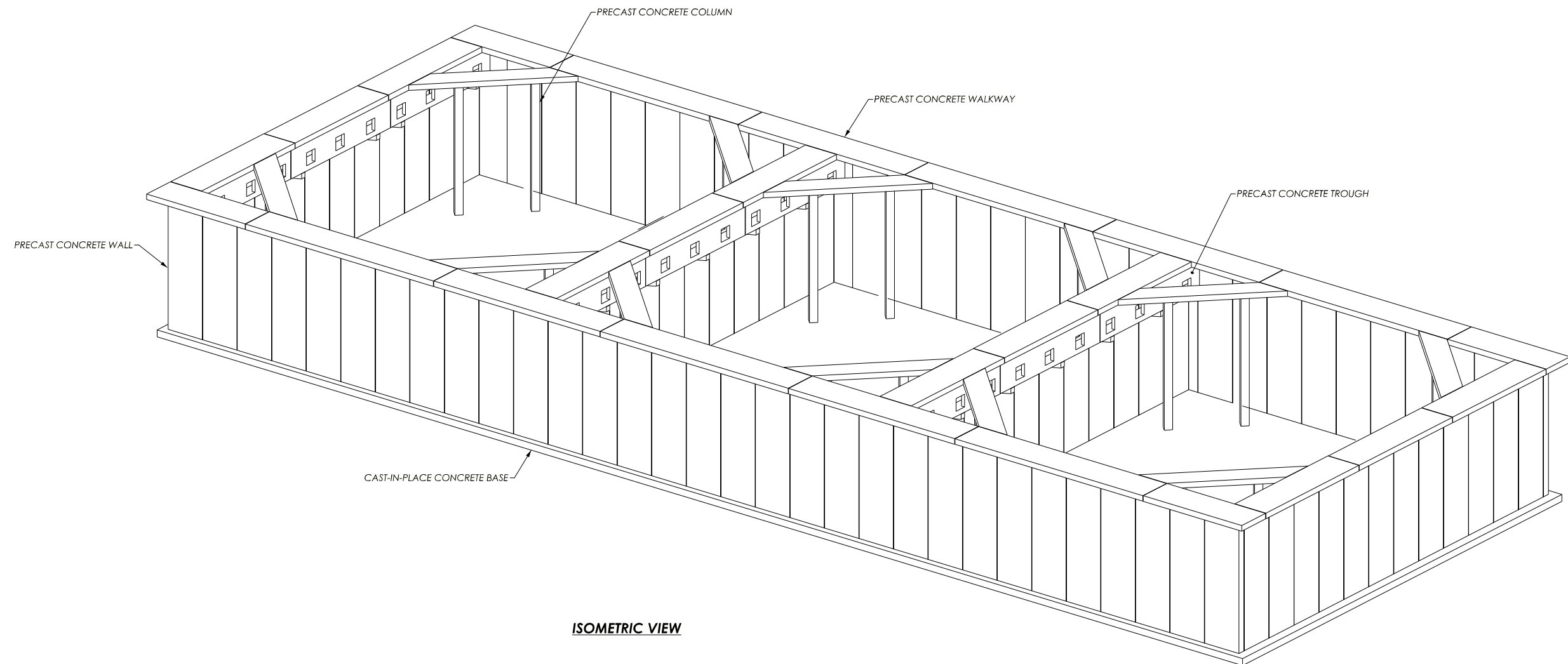
C **SECTION**
01

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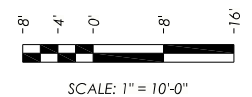
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Project: PENDLETON-CLEMSON REGIONAL WWTP EXPANSION BIOREACTOR TANK ANDERSON COUNTY, SOUTH CAROLINA		
SECTIONS		
Job Number: E2023.0074 Project Manager: XX Drawn By: EDE Checked By: XXX Issue Date: Sheet No. 03		

Attachment 2



ISOMETRIC VIEW

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ISOMETRIC VIEW	Project: PENDLETON-CLEMSON REGIONAL WWTP EXPANSION BIOREACTOR TANK ANDERSON COUNTY, SOUTH CAROLINA		THE INFORMATION CONTAINED HEREIN IS PROPRIETARY TO DUTCHLAND, LLC IS PROTECTED BY COPYRIGHT AND/OR OTHER INTELLECTUAL PROPERTY LAWS AND SHOULD NOT BE DISCLOSED, TRANSFERRED, REPRODUCED, OR IN WRITING, OR REPRODUCED, EXCEPT AS BY DUTCHLAND, LLC	SEAL	NO.	REVISIONS	DATE	BY

Attachment 3



RELEASED FOR CONSTRUCTION

[illegible]

DESIGNED BY
JDB

DRAWN BY
RBS

DATE
12/17/2007

CHECKED BY
HKO

PROJ. NO.
0438

FILE NO.
10-S-1

SHEET NO.

10-S-1



DESIGN SOUTH
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engineers architects planners
ONE LINWA BOULEVARD
ANDERSON, SOUTH CAROLINA. 29621
(864) 226 - 6111

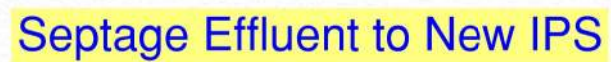


**PENDLETON/ CLEMSON REGIONAL
WWTF UPGRADE**

DESIGNED BY JDB	CHECKED BY HKO
DRAWN BY RBS	PROJ. NO. 0438
DATE 12/17/2007	FILE NO. 10-S-1

SHEET NO.
10-S-1

Attachment 3



Plan view of the foundation showing a central pile cap with dimensions and a note: "Grout Slope to NE Corner of Structure".

— AVG 6" Thickness
for sloping

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**PENDLETON/ CLEMSON REGIONAL
WWTF UPGRADE**

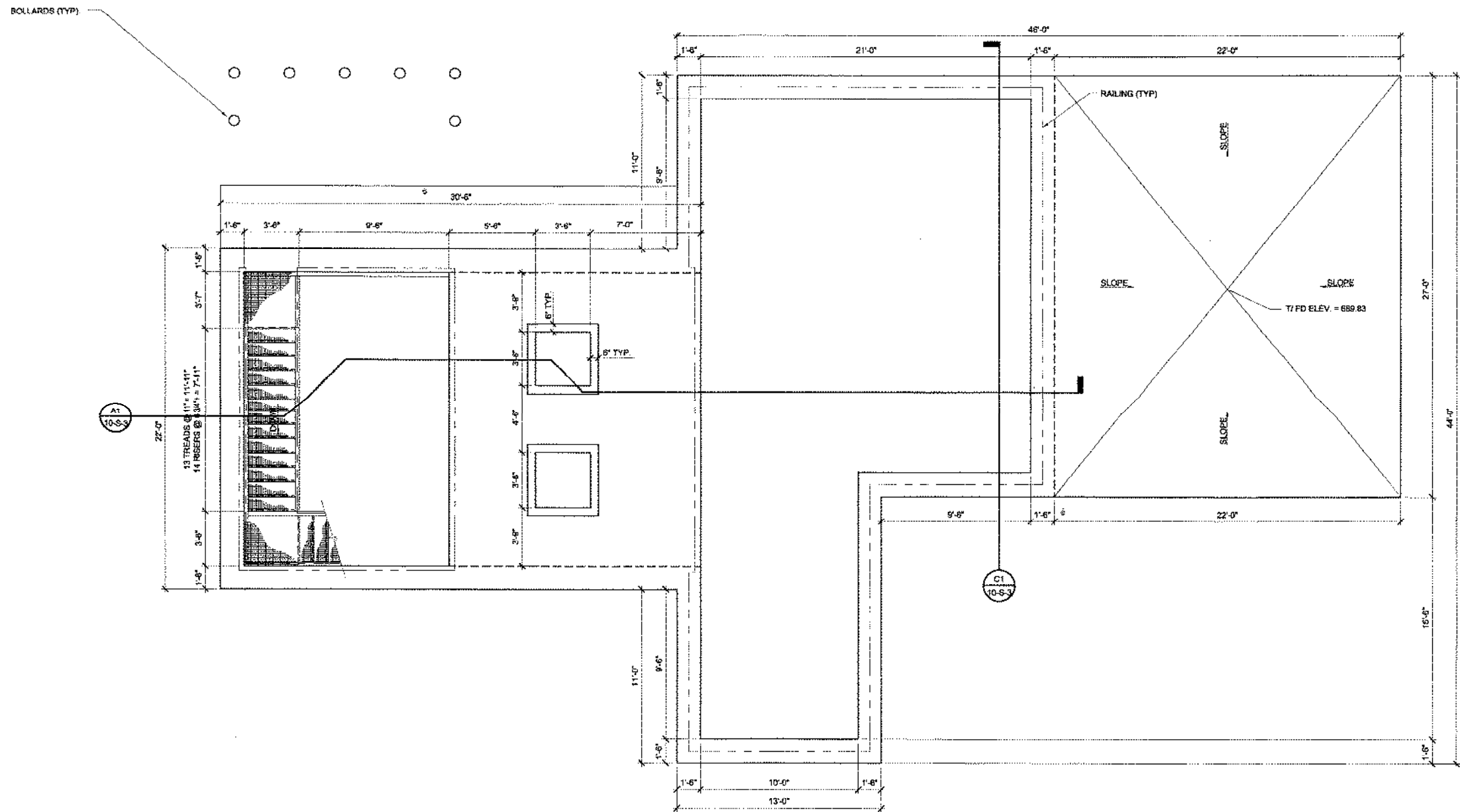
DESIGNED BY JDB	CHECKED BY HKO
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RELEASED FOR CONSTRUCTION

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Attachment 3

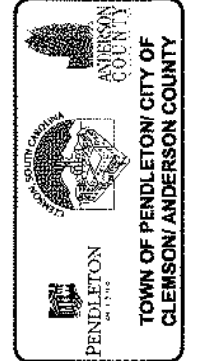
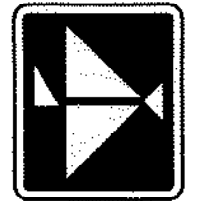


A1
UPPER PLAN

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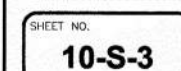


PENDLETON/ CLEMSON REGIONAL
WMTF UPGRADE
HEADWORKS
UPPER PLAN

DESIGNED BY: HKO
DRAWN BY: RBS
DATE: 12/17/2007
CHECKED BY: HKO
PROJ. NO.: 0438
FILE NO.: 10-S-2

SHEET NO.
10-S-2

Attachment 3



DRAWING FILE: T:\Projects\SC\Pendleton, Town of\CGRE220027 - Pendleton-Clemson WWTPO\DWG\CAD\01 BID DRAWINGS\03 CIVIL\C-301.dwg
PLOTTED: Mar 11, 2024 - 5:03pm



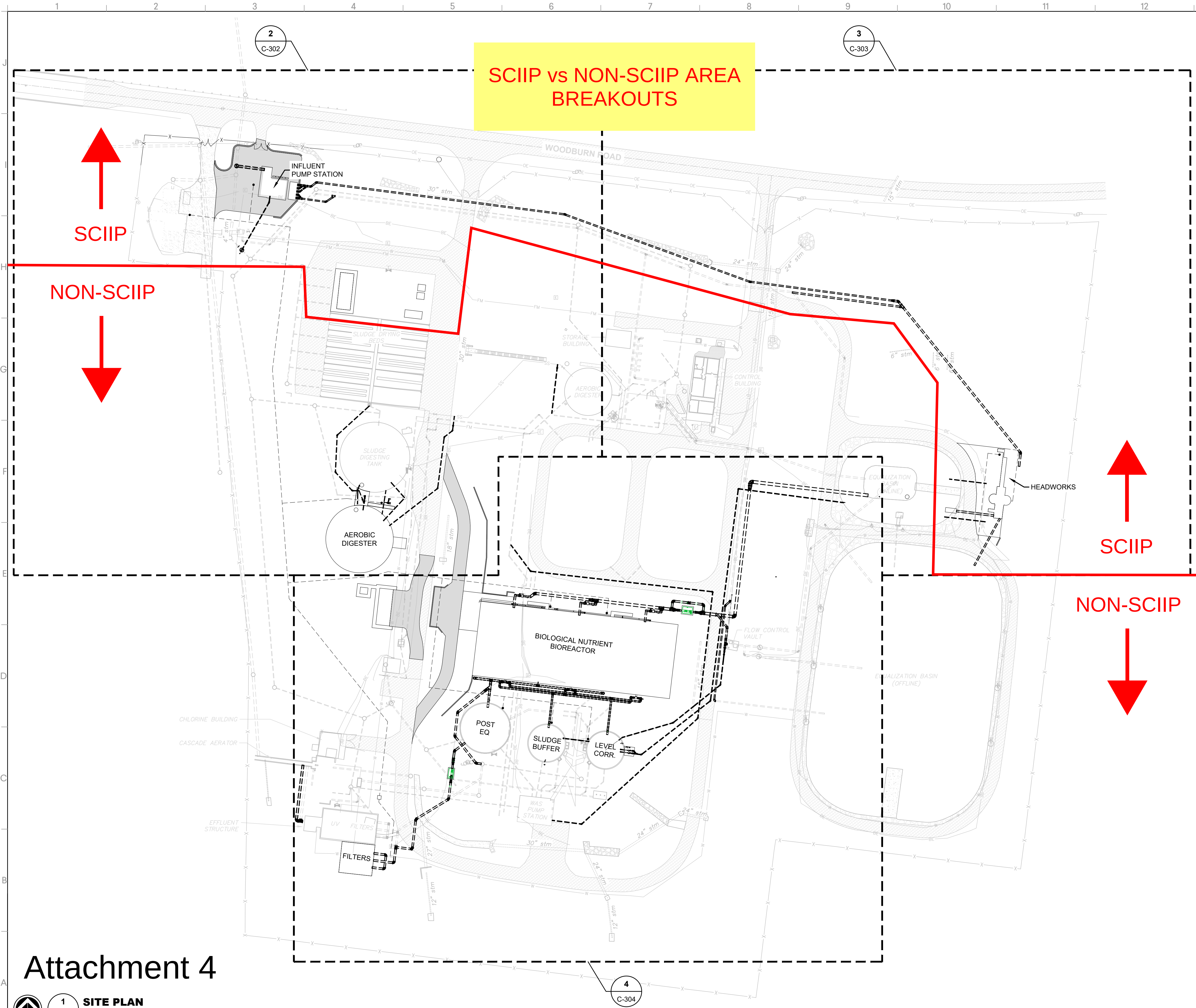
1

C-301

SITE PLAN

SCALE: 1" = 60'-0"

Attachment 4



- PIPING NOTES:**
- CONTRACTOR SHALL INCLUDE ANY REQUIRED BENDS TO AVOID ANY PIPING CONFLICTS DUE TO LIMITED AREA OF CONSTRUCTION AND UNFAVORABLE GRADE.
 - ALL BURIED PIPE MUST HAVE MINIMUM COVER DEPTH OF 30" OR AS OTHERWISE INDICATED IN THE SPECIFICATIONS OR DETAILS.
 - ALL NECESSARY APPURTENANCES REQUIRED TO MAKE THE PROCESS PIPING FULLY FUNCTIONAL SHALL BE PROVIDED BY THE CONTRACTOR. THIS INCLUDES BUT NOT LIMITED TO MIXING RINGS, INJECTORS, SPARGERS, TAPS, FLANGE ADAPTERS, COUPLINGS, PIPE SUPPORTS, ETC.
 - CONTRACTOR SHALL VERIFY VALVE LOCATIONS AND INTENDED USE AS REQUIRED BY THE PROCESS MANUFACTURER. IF VALVE RELOCATION IS DESIRED, IT SHALL BE AT THE ENGINEER'S DISCRETION.
 - ELECTRICAL CONDUIT AND YARD PIPING CONFLICTS SHALL BE RESOLVED IN THE FIELD BY THE INSPECTOR/ENGINEER.
 - CONTRACTOR SHALL PROVIDE HEAT TRACING, INSULATION AND ELECTRICAL APPURTENANCES FOR ALL EXTERIOR ABOVE GROUND PIPING AND POLYETHYLENE TANKS PER SPECIFICATION GOVERNING WATER AND SEWER PIPING. AIR PIPING IS EXCLUDED FROM THIS REQUIREMENT.
 - CONTRACTOR SHALL REFER TO EROSION CONTROL AND GRADING PLANS FOR SEQUENCING REQUIRED BY DISTURBANCE.
 - VALVES, PIPES, MOTORS, ELECTRICAL PANELS, ETC. SHALL BE POSITIONED SO THAT THEY DO NOT INTERFERE WITH PEDESTRIAN TRAFFIC.
 - PIPE PENETRATIONS THROUGH ALUMINUM GRATING SHALL BE CLEAN PENETRATIONS AND MAINTAIN A MAXIMUM OF A 1" BETWEEN THE EDGE OF THE GRATING AND O.D. OF THE PIPE. GRATING SUPPORTS SHALL BE DESIGNED SUCH THAT PENETRATIONS DO NOT COMPROMISE THE INTEGRITY OF THE GRATING. BANDING & SUPPORT FOR SPECIFIED LOADS IS REQUIRED TO PROVIDE CLEAN PENETRATIONS.

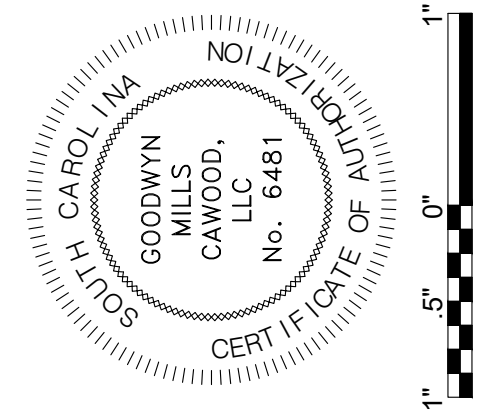
ISSUE DATE	
30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
100% Submittal	03/08/2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTPO EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

CIVIL SITE PLAN
YARD PIPING

C-301



GMC
117 Welborn St.
Greenville, SC 29601
T 864.527.0460

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Project information
- 2. Work covered by Contract Documents
- 3. Phased construction
- 4. Contractor-furnished
- 5. Access to site
- 6. Coordination with occupants
- 7. Work restrictions
- 8. Specification and drawing conventions
- 9. Miscellaneous provisions

- B. Related Requirements:

- 1. Section 01 50 00 - Temporary Facilities and Controls for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: **Pendleton-Clemson Regional WWTP Expansion**

- 1. Project Location: **865 Woodburn Rd, Pendleton, SC 29670**

- B. Owner(s): **Town of Pendleton; City of Clemson; Anderson County**

- 1. Owner's Representative(s):

- a. Town of Pendleton: Steve Miller, Town Administrator
- b. City of Clemson: Benjie McGill, Utilities Director
- c. Anderson County: Derrick Singleton, Wastewater Manager

- C. Engineer: **Goodwyn Mills Cawood; Greenville, SC**

- D. Engineer's Sub-Consultants: The Engineer has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Electrical Engineer: **Goodwyn Mills Cawood; Greenville, SC**
2. Structural Engineer: **Day Structures; Prattville, AL**

E. Contractor: **HARPER General Contractors; Greenville, SC**

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. The construction and modifications consist of the following:
 - a. Clearing and grubbing, civil/site work, etc.
 - b. Construction of new influent pump station and force main; installation of coarse mechanical screen, conveyor, and influent pumps; installation of bridge crane; combine existing and new force mains.
 - c. Construction of new headworks structure and piping to EQ basins; installation of fine rotary drum screens, conveyor and washing compactor; installation of grit removal and dewatering equipment; installation of new Parshall Flume.
 - d. Removal of existing liner and installation of new concrete liner at EQ No.1
 - e. Installation of bypass connection at existing flow control valve and flow meter.
 - f. Construction of biological nutrient removal (BNR) basins; installation of blowers and diffusers; installation of process control instruments; installation of basin control valves; installation of sludge pipes and effluent weir assemblies.
 - g. Conversion of existing 60-ft secondary clarifier to post EQ basin; installation of piping and valves at post EQ basin.
 - h. Installation of post EQ mag flow meter and flow control valve.
 - i. Conversion of existing 45-ft secondary clarifier (No.1) to water level correction tank; installation of submersible pumps; installation of piping, valves, and fittings; rehabilitation of tank interiors.
 - j. Conversion of existing 45-ft secondary clarifier (No.2) to sludge buffer tank; modification of WAS force main to digesters; installation of telescoping valve and piping to level correction tank.
 - k. Construction of concrete pad and canopy for tertiary filters; installation of tertiary filter; installation of filter piping and valves.
 - l. Rehabilitation of UV modules; integration of existing UV equipment to plant SCADA system; installation of weir gate.
 - m. Installation of submersible reuse water pump, storage tank, piping and fittings, etc.
 - n. Demolition of existing effluent compound weir and modification to concrete.
 - o. Modification of cascade aerator baffle wall into compound weir; relocation of effluent level transducer.
 - p. Rehabilitation of existing aerobic digesters; installation of new decanters.
 - q. Construction of new aerobic digester; installation blowers, diffusers, and decanters.
 - r. Installation of digested sludge withdraw piping, valves, and quick disconnect.
 - s. Gratings and handrails at process structures.
 - t. Miscellaneous valving and piping.
 - u. Electrical work and controls.

B. Type of Contract:

1. Project will be constructed under a single prime contract with HARPER General Contractors, selected as the Construction Manager at Risk (CMAR).

1.5 WORK SEQUENCE

- A. Contractor shall arrange the Work so that at no time shall it cause unnecessary interruption to the operation of existing facilities. Contractor shall prepare and submit to Engineer for approval, a complete detailed working schedule setting forth the sequence of operations the Contractor proposes to follow.
- B. Before commencing Work of each phase, submit an updated copy of Contractor's construction schedule showing the sequence, commencement and completion dates, and move -in dates of Owner's personnel for Startup.
- C. The Contractor shall complete the influent pump station and coordinate the connection to the plant's piping as indicated in the plans no less than 3 months prior to the startup of the Wastewater Treatment Plant. Wastewater must be supplied to the site for equipment startup, prior to substantial completion.

1.6 CONTRACTOR-FURNISHED AND INSTALLED PRODUCTS

- A. Contractor shall furnish all products indicated in the bid documents. The Work includes unloading, handling, storing, and protecting Contractor-furnished products as directed and turning them over to Owner at Project closeout.

1.7 WORK BY OWNER

- A. General: Cooperate fully with Owner so that work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

1.8 CONTRACTOR-FURNISHED AND INSTALLED PRODUCTS

- A. Contractor shall furnish all products indicated in the bid documents. The Work includes unloading, handling, storing, and protecting Contractor-furnished products as directed and turning them over to Owner at Project closeout.

1.9 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other Contractors on portions of Project.
- B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Driveways, Walkways and Entrances: Keep driveways and loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

- a. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.10 COORDINATION WITH OCCUPANTS

- A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
 1. Engineer will prepare a Certificate of Substantial Completion for each specific phase of the project.
 2. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.

1.11 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Working hours shall be generally limited to 7am to 5pm; Contractor shall contact the Engineer/Owner when working hours are extended beyond normal business hours or when weekend construction is expected to occur.
- C. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to neighbors with the Owner.
 1. Obtain Engineer's written permission before proceeding with disruptive operations.
- D. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1.12 ADVERSE WEATHER

- A. General:
 1. Notice of rain delay days with the documentation of the aforementioned sources herein and on-site records must be submitted by the Contractor to the Inspector/Engineer on the first working day of every month for the previous month or at the monthly construction meeting as determined at the preconstruction meeting.
- B. Definition:

1. Adverse weather is defined as the occurrence of a condition that prevents construction activity exposed to weather conditions or access to the site for more than four (4) hours in a day.
2. Adverse weather may also include, if appropriate, “dry-out” or “mud” days.
3. Adverse weather includes days that temperature does not rise above the required temperature for a construction activity.

C. Qualifications:

1. Adverse weather conditions having a direct effect on construction progress are to be handled as follows:
 - a. Precipitation is to be measured by the Contractor using a precipitation gauge on-site. For each month, the number of days (24 hours) that the site experiences precipitation of 0.10 inches or more shall be totaled, confirmed with the Owner/Inspector, and reported to the Engineer.
 - b. For each month, the total number of days of 0.10 inches or more of precipitation shall be compared to the number of expected days for that month. The number of expected days of 0.10 inches or more of precipitation shall be established as follows:
 - 1) Identify National Oceanic and Atmospheric (NOAA) weather stations as shown at <https://www.ncdc.noaa.gov/cdo-web/search> within a 100-mile radius of the project location.
 - a) If multiple weather stations are found within 100 miles of the project site, the weather station that is the closest to the site shall be used. Compile rain data from the previous 5 years and total the number of days with precipitation of 0.10 inches or more.
 - b) If a weather station is not found within a 100-mile radius of the site, the following schedule shall be used:

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
7	7	7	7	6	7	8	7	4	5	6	7
(Data from NOAA, > 0.10” Daily Precipitation, January 2010 – February 2023, Pendleton, SC)											

- c. Rain delay days will be approved by the Engineer and added to the contract duration only if they exceed the number of expected days for that given month.
2. Adverse weather conditions having an indirect effect due to precipitation are to be handled as follows:
 - a. Precipitation that occurs beyond the standard baseline which results in “dry-out” or “mud” days.
 - 1) The standard baseline is based on the NOAA’s Point Precipitation Frequency (PPF) Estimate for the construction area using the latitude and longitude for a 1-year average recurrence interval and a 60-min time period. This can be found at <http://dipper.nws.noaa.gov/hdsc/pfds/>.
3. Adverse weather conditions due to temperature are as follows:

- 1) Cold Weather concreting shall be per ACI 306.
 - a) The Contractor shall have a calibrated thermometer onsite which is logged by the inspector and Contractor prior to any concrete pours during cold weather.
 4. Adverse weather conditions due to wind speeds are as follows:
 - a. Wind speeds exceeding those permissible to use equipment or to perform certain tasks safely, including but not limited to operating crane(s) or other aerial equipment for construction or erection of a building structure.
 - 1) The Contractor shall have a calibrated wind speed gauge on-site.
 5. Adverse weather conditions resulting in compromised project site conditions are as follows:
 - a. Project site conditions such as mud, pooling of water, ice, or standing snow subsequent to the actual precipitation days, prevent the performance of activities such as, but not limited to, mass grading, building pad grading, foundations, piping, excavations, backfill, concrete, masonry, etc. operations.
- D. Weather Delay Days:
1. Adverse weather delay day may be counted if adverse weather prevents work on the project during an event where:
 - a. Precipitation days for a specific month is greater than the recorded monthly average for a project location indicated above.
 - 1) The number of average rain days shall be subtracted from the number of recorded rain days and the difference shall be the allotted time.
 - b. Precipitation for a given day is greater than the NOAA's PFF estimate indicated above.
 - 1) One (1) day for each day or consecutive days of precipitation that exceeds the standard baseline.
 - c. Precipitation of 3.0 inches over a 24-hour period.
 - 1) The number of allotted days shall be at the discretion of the Engineer/Owner based on site conditions, working conditions, and type of construction.
 - 2) Temperature per ACI 306.
- E. Exceptions:
1. The Contractor shall take into account that certain construction activities are more affected by adverse weather and seasonal conditions than other activities, and that "dry-out" or "mud" days are not eligible to be counted as an Adverse Weather Delay Day until the standard baseline is exceeded. Hence, the Contractor should allow for an appropriate

number of additional days associated with the Standard Baseline days in which such applicable construction activities are expected to be prevented and suspended.

F. Record Keeping:

1. All Adverse Weather events shall be recorded by the on-site management team.
2. On-site records of daily rain and/or temperature readings shall be kept by the Contractor and may be accepted to verify weather and/or temperature variations which prevent earthwork, foundation and slabs, and/or roofing materials installation. The Inspector shall also be required to maintain on-site records of daily rain and/or temperature.

1.13 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations.

1.14 WARRANTIES

- A. Warranties shall conform to the requirements of the General Conditions.
- B. All equipment supplied by the Contractor under these Specifications shall be warranted by the Contractor and the equipment manufacturers for a period of one (1) year. Warranty period shall commence on the date of Substantial Completion.
- C. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail due to workmanship, design and materials during the warranty period, it shall be replaced by the Contractor and the unit(s) restored to service at no expense to the Owner.
- D. The manufacturer's warranty period shall run concurrently with the Contractor's warranty or guarantee period. No exception to this provision shall be allowed. The Contractor shall be responsible for obtaining equipment warranties from each of the respective suppliers or manufacturers for all the equipment specified.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Testing and inspecting allowances.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
 - 1. Divisions 2 through 50

1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Engineer of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Engineer's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Engineer from the designated supplier.

1.4 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified by Engineer.
- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 ALLOWANCES

A. Lump Sum

1. Allowance shall include cost to Contractor of specific products and materials ordered by Owner under allowance and shall include taxes, freight, and delivery to Project site.
2. Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner under allowance shall be included as part of the Contract Sum and not part of the allowance.
3. At Project closeout, credit unused amounts remaining in these allowances to Owner by Change Order.

B. Testing and Inspection

1. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.
2. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.
3. Costs of services not required by the Contract Documents are not included in the allowance.
4. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.7 UNUSED MATERIALS

- A. Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 1. If requested by Engineer, prepare unused material for storage by Owner when it is not economically practical to return the material for credit. If directed by Engineer, deliver unused material to Owner's storage space. Otherwise, disposal of unused material is Contractor's responsibility.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. The following allowances shall be included in Contract Sum in accordance with the allowance type described above. Should the below allowances not be shown on the project proposal, the Contractor shall include them in the total bid cost.

Allowance No.	Description	Allowance Type	Amount
1.			
2.			
3.			
4.			

- B. Allowance No.1: XXXX: Include the sum of \$XXXX for XXXXXX, described below.
- C. Allowance No.2: XXXX: Include the sum of \$XXXX for XXXXXX, described below.
- D. Allowance No.3: XXXX: Include the sum of \$XXXX for XXXXXX, described below.
- E. Allowance No.4: XXXX: Include the sum of \$XXXX for XXXXXX, described below.

END OF SECTION 01 21 00

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SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 MINOR CHANGES IN THE WORK

- A. Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Engineer are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within ten (10) days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Engineer.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Engineer.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Proposal Request Form: Use form acceptable to the Engineer.

1.4 CHANGE ORDER PROCEDURES

- A. Change Order Procedures shall conform to the requirements of the General Conditions.
- B. A change in the project work that is consistent with the objective of the project and outside the scope of the project requires the execution and approval of a Change Order.
- C. On Owner's approval of a Work Changes Proposal Request, Engineer will issue a Change Order for signatures of Owner and Contractor on form approved by Engineer.
- D. Construction Manager at Risk (CMAR) Projects:
 1. Guaranteed Maximum Price (GMP) efforts will be at defined project completion stages (30%, 60%, 90%, etc.) and at each GMP effort, the CMAR shall provide specific amounts associated with "Design Development/Construction Contingency" and "Owner's Contingency" included in the GMP.
 2. Both the "Design Development/Construction Contingency" and "Owner's Contingency" will require detail, review, and acceptance by Owner/Engineer.
 3. After the development of a 100% GMP, the "Design Development/Construction Contingency" and "Owner's Contingency" identified in the 100% GMP amount shall be final.
 4. Design Development/Construction Contingency shall be used to address items associated with change orders that are consistent with the objective of the project and both within and outside of the scope of the project.
 - a. In the event a change in the project work that is consistent with the objective of the project and outside the scope of the project, the execution and approval of a Change Order is required.
 - b. In the event a change in the project work that is consistent with the objective of the project and within the scope of the project, the execution and approval of a Change Order is not required.
 5. Owner's Contingency shall be used to address items associated with change orders that are consistent with the objective of the project and outside the scope of the project.

1.5 CONSTRUCTION CHANGE DIRECTIVE

- A. Work Change Directive: Engineer may issue a work Change Directive on form included in Project Manual. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

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SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
 - 2. Section 01 26 00 - Contract Modification Procedures for administrative procedures for handling changes to the Contract.
 - 3. Section 01 32 00 - Construction Progress Documentation for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.2 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Engineer at earliest possible date, but no later than fourteen (14) days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Sub-schedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 - 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one (1) line item for each Specification Section where a submittal is required.
1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Engineer.
 - c. Engineer's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 2. Arrange schedule of values consistent with format of Contract Documents used (EJCDC, AIA, etc.).
 3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of 5% of the Contract Sum.
 - a. Include separate line items under contractor and principal subcontracts for Project closeout requirements in an amount totaling no less than 2.5 % of the Contract Sum and subcontract amount.
 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
 7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
 8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by

measured quantity. Use information indicated in the Contract Documents to determine quantities.

9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by engineer and contractor and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: Submit Application for Payment to Engineer by the 25th day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
 1. Submit draft copy of Application for Payment five (5) days prior to due date for review by Engineer.
- C. Application for Payment Forms: Use form consistent with Contract Documents (EJCDC, AIA, etc.) for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.

2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal:
1. Deliverable:
 - a. Digital: Submit one (1) signed and notarized copy of each Application for Payment to Engineer by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 2. Contractor's Affidavit of Payment to Subcontractors
 - a. Shall be submitted with each Application for Payment.
 3. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. List of Contractor's staff assignments.
 6. Copies of building and other local/state permits.
 7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 8. Report of preconstruction conference.
 9. Certificates of insurance and insurance policies.
 10. Performance and payment bonds.
 11. Data needed to acquire Owner's insurance.
- H. Application for Payment at Substantial Completion: After Engineer issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

- I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. "Contractor's Affidavit of Payment of Debts and Claims."
 5. "Contractor's Affidavit of Release of Liens."
 6. "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

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SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Requests for Information (RFIs).
 - 4. Project Web site.
 - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements.
- C. Related Requirements:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
 - 2. Section 01 32 00 - Construction Progress Documentation, for preparing and submitting Contractor's construction schedule.

1.2 DEFINITIONS

- A. RFI: Request from Engineer seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: No less than fifteen (15) days prior to starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office and at existing treatment facility. Keep list current at all times.

1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Engineer will return RFIs submitted to Engineer by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.

5. Name of Engineer.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: As acceptable to the Engineer.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Engineer Action: Engineer will review each RFI, determine action required, and respond. Allow seven (7) working days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Engineer's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.
 3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 - Contract Modification Procedures.
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within five (5) days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Include the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Engineer

4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Engineer's response was received.
- F. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within five (5) days if Contractor disagrees with response.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.6 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within seven days of the meeting.
- B. Preconstruction Conference: Engineer will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than fifteen (15) days before mobilization.
1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.
 - k. Submittal procedures.
 - l. Preparation of record documents.

- m. Use of the premises.
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for moisture and mold control.
 - s. Procedures for disruptions and shutdowns.
 - t. Construction waste management and recycling.
 - u. Parking availability.
 - v. Office, work, and storage areas.
 - w. Equipment deliveries and priorities.
 - x. First aid.
 - y. Security.
 - z. Progress cleaning.
4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Engineer and Owner of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.

- x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Engineer, but no later than ninety (90) days prior to the scheduled date of Substantial Completion.
- 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 - 2. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for preparing operations and maintenance data.
 - e. Requirements for delivery of material samples, attic stock, and spare parts.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures.
 - 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at minimum monthly intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

- a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of proposal requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Conduct Project coordination meetings as necessary. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

- a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Change Orders.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's construction schedule.
3. Construction schedule updating reports.
4. Weekly construction reports.
5. Material location reports.
6. Site condition reports.
7. Special reports.
8. Preconstruction photographs.
9. Periodic construction photographs.
10. Final completion construction photographs.
11. Preconstruction video recordings.
12. Periodic construction video recordings.
13. Web-based construction photographic documentation.

- B. Related Requirements:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
2. Section 01 33 00 - Submittal Procedures, for submitting schedules and reports.
3. Section 01 40 00 - Quality Requirements, for submitting a schedule of tests and inspections.
4. Section 01 70 00 - Execution and Closeout Procedures, for submitting photographic documentation as project record documents at Project closeout.
5. Section 01 79 00 - Demonstration and Training, for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:

1. PDF electronic file.

- B. Startup construction schedule.

- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

- D. Construction Reports: Submit, at minimum, monthly intervals.

- E. Material Location Reports: Submit, at minimum, monthly intervals.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.
- G. Special Reports: Submit at time of unusual event.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed (NTP) to date of Substantial Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each process or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than sixty (60) days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 2. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 - Submittal Procedures in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 - 3. Startup and Testing Time: Include no fewer than thirty (30) days for startup and testing.
 - 4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
 - 5. Punch List and Final Completion: Include not more than thirty (30) days for completion of punch list items and Final Completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 - 1. Phasing: Arrange list of activities on schedule by phase.
 - 2. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Environmental control.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

- E. Recovery Schedule: When periodic update indicates the Work is fourteen (14) or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within thirty (30) days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three (3) months or longer to complete, indicate an estimated completion percentage in 10 % increments within the time bar.

2.3 REPORTS

- A. Monthly Construction Reports: Prepare a Monthly construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site.
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 - 7. Accidents.
 - 8. Meetings and significant decisions.
 - 9. Unusual events (see special reports).
 - 10. Stoppages, delays, shortages, and losses.
 - 11. Emergency procedures.
 - 12. Orders and requests of authorities having jurisdiction.
 - 13. Change Orders received and implemented.
 - 14. Work Directives received and implemented.
 - 15. Services connected and disconnected.
 - 16. Equipment or system tests and startups.
 - 17. Partial completions and occupancies.
 - 18. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within two (2) days of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule two (2) days before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Engineer, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

3.2 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1. Date and Time: Include date and time in file name for each image.
 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Engineer.
- C. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Engineer.
1. Flag construction limits before taking construction photographs.
 2. Take photographs to show existing conditions adjacent to property before starting the Work.
 3. Take photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Periodic Construction Photographs: Take photographs at necessary intervals with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Engineer-Directed Construction Photographs: From time to time, Engineer will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- F. Final Completion Construction Photographs: Take color photographs after date of Substantial Completion for submission as project record documents.
1. Do not include date stamp.

END OF SECTION 01 32 00

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SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final completion construction photographs.
 - 4. Preconstruction video recordings.
 - 5. Periodic construction video recordings.
 - 6. Web-based construction photographic documentation.
- B. Related Requirements:
 - 1. Section 01 33 00 - Submittal Procedures, for submitting photographic documentation.
 - 2. Section 01 79 00 - Demonstration and Training, for submitting video recordings of demonstration of equipment and training of Owner's personnel.
 - 3. Section 02 41 16 - Structure Demolition, for photographic documentation before building demolition operations commence.
 - 4. Section 02 41 19 - Selective Structure Demolition, for photographic documentation before selective demolition operations commence.

1.3 CAPTURE OF DIGITAL DOCUMENTATION

- A. Key Plan: Develop key plan of Project site and building with notation of vantage points marked for location and direction of each photograph or video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs for Existing Conditions and Construction Documentation:
 - 1. Digital Camera: Minimum sensor resolution of six (6) megapixels.
 - 2. Format: Minimum 3200 x 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
 - 3. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project.
 - b. Name and contact information for photographer.

- c. Date photograph was taken.
- d. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
- e. Unique sequential identifier keyed to accompanying key plan.

C. Video Recordings:

- 1. Identification: With each submittal, provide the following information:
 - a. Name of Project.
 - b. Name and address of photographer.
 - c. Date video recording was recorded.
 - d. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - e. Weather conditions at time of recording.

1.4 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Upon request submit the following:
 - 1. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of six (6) megapixels, and at an image resolution of not less than 3200 x 2400 pixels.
 - 2. Digital Video Recordings: Provide high-resolution, digital video disc in format acceptable to Engineer.
 - 3. Digital images and video recordings shall be organized by processes and submitted to Engineer on an USB flash drive.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Contractor shall take construction photographs throughout the duration of the project.
- B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.

- C. Digital Images: Submit digital images, if requested, exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 - 1. Date and Time: Include date and time in file name for each image.
 - 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Engineer.
- D. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Engineer.
 - 1. Flag construction limits before taking construction photographs.
 - 2. Take photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- E. Periodic Construction Photographs: Take photographs at necessary intervals with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- F. Final Completion Construction Photographs: Take color photographs after date of Substantial Completion for submission as project record documents.
 - 1. Do not include date stamp.

END OF SECTION 01 32 33

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SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
 - 2. Section 01 29 00 - Payment Procedures, for submitting Applications for Payment and the schedule of values.
 - 3. Section 01 32 00 - Construction Progress Documentation, for submitting schedules and reports, including Contractor's construction schedule.
 - 4. Section 01 78 23 - Operation and Maintenance Data, for submitting operation and maintenance manuals.
 - 5. Section 01 78 39 - Project Record Documents, for submitting record Drawings, record Specifications, and record Product Data.
 - 6. Section 01 79 00 - Demonstration and Training, for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.3 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 3. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Engineer's final release or approval.
 - g. Scheduled date of fabrication.
- B. Engineer's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Engineer for Contractor's use in preparing submittals.
1. Engineer will furnish Contractor one (1) set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and record documents.
 - a. Engineer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings are available in Revit and CAD files.
- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently, unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

- a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- D. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow fourteen (14) days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow fifteen (15) days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Engineer's consultants, Owner, or other parties is indicated, allow twenty-one (21) days for initial review of each submittal.
- E. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space on label or beside title block to record Contractor's review and approval markings and action taken by Engineer.
 3. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of subcontractor.
 - g. Name of supplier.
 - h. Name of manufacturer.
 - i. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal and a sequential number (e.g., 06 10 00.01). The sequential number denotes the number of submittals within a specification section, not for a project as a whole. Resubmittals shall include a second decimal and an alphabetic suffix (e.g., 06 10 00.01.A).
 - j. Number and title of appropriate Specification Section.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Other necessary identification.
4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

- a. Submit one (1) copy of submittal to concurrent reviewer in addition to specified number of copies to Engineer.
5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form.
 - a. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
 - 1) Project name.
 - 2) Date.
 - 3) Destination (To:).
 - 4) Source (From:).
 - 5) Name and address of Engineer.
 - 6) Name of Construction Manager.
 - 7) Name of Contractor.
 - 8) Name of firm or entity that prepared submittal.
 - 9) Names of subcontractor, manufacturer, and supplier.
 - 10) Category and type of submittal.
 - 11) Submittal purpose and description.
 - 12) Specification Section number and title.
 - 13) Specification paragraph number or drawing designation and generic name for each of multiple items.
 - 14) Drawing number and detail references, as appropriate.
 - 15) Indication of full or partial submittal.
 - 16) Transmittal number
 - 17) Submittal and transmittal distribution record.
 - 18) Remarks.
 - 19) Signature of transmitter.
- F. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.
 4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Engineer.

- d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of firm or entity that prepared submittal.
 - g. Names of subcontractor, manufacturer, and supplier.
 - h. Category and type of submittal.
 - i. Submittal purpose and description.
 - j. Specification Section number and title.
 - k. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - l. Drawing number and detail references, as appropriate.
 - m. Location(s) where product is to be installed, as appropriate.
 - n. Related physical samples submitted directly.
 - o. Indication of full or partial submittal.
 - p. Transmittal number.
 - q. Submittal and transmittal distribution record.
 - r. Other necessary identification.
 - s. Remarks.
5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
- a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- G. Options: Identify options requiring selection by Engineer.
- H. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
- J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- K. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

1.4 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Submit electronic submittals via email as PDF electronic files.
 - a. Engineer will return annotated file. Annotate and retain one (1) copy of file as an electronic Project record document file.
 - 2. Action Submittals: Submit one electronic copy of each submittal unless otherwise indicated. Engineer will not return copies.
 - 3. Informational Submittals: Submit one electronic copy of each submittal unless otherwise indicated. Engineer will not return copies.
 - 4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before or concurrent with Samples.
 - 6. Submit Product Data in the following format:

- a. PDF electronic file.
 - b. One (1) paper copy of Product Data unless otherwise indicated. Engineer will not return paper copy.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Engineer's digital data drawing files is otherwise permitted.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 - 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 x 11 inches but no larger than 30 x 42 inches.
 - 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
 - b. One (1) opaque (bond) copy of each submittal.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
 - 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
 - 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.

- b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
- 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit one (1) set of samples to the Engineer and Owner for review.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three (3) sets of paired units that show approximate limits of variations.
- E. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 - Project Management and Coordination.
- F. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 00 - Construction Progress Documentation.
- G. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00 - Payment Procedures.
- H. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00 - Quality Requirements.
- I. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 70 00 - Execution and Closeout Procedures.
- J. Maintenance Data: Comply with requirements specified in Section 01 78 23 - Operation and Maintenance Data.
- K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.
- L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

- M. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- N. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- Q. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- R. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- S. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- T. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- U. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- V. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- W. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads.

Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

1.5 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally-signed PDF electronic files, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 70 00 - Execution and Closeout Procedures.
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER'S ACTION

- A. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

- B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Engineer without action.

END OF SECTION 01 33 00

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SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Quality control.
 - 2. Testing and inspection services.
 - 3. Manufacturers' field services.
 - 4. Shop Testing.
 - 5. Field Testing.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer.

- C. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five (5) previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 INSPECTION AND TESTING LABORATORY SERVICES

- A. Owner will employ and pay for the services of a Resident Project Representative (RPR)
- B. Owner will employ and pay for the services of an independent testing laboratory to perform all specified services and testing related to the design of mixes, products and equipment, to Engineer's review of proposed materials and equipment before, during and after incorporation in the Work and to retest materials and equipment which fail original tests.
 - 1. Employment of the laboratory shall in no way relieve Contractor's obligations to perform the Work of the Contract.
 - 2. Retesting or re-inspection required because of nonconformance with specified or indicated requirements shall be performed by same independent firm on instructions from Engineer. Payment for retesting or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

1.5 ACCEPTABLE TESTING AGENCIES

- A. Goodwyn Mills Cawood; Greenville, SC**

1.6 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two (2) or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

1.7 ACTION SUBMITTALS

- 1. Indicate manufacturer and model number of individual components.

1.8 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Engineer.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Engineer.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.

1.9 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within ten (10) days of Notice to Proceed, and not less than five (5) days prior to preconstruction conference. Submit in format acceptable to Engineer. Identify personnel, procedures, controls, instructions, tests, records, and

forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 - 3. Owner-performed tests and inspections indicated in the Contract Document.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Engineer has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.10 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.

12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspection.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representatives making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.
- 1.11 QUALITY ASSURANCE
- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
 - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 3. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspecting will be performed.
 - 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.

6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- K. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 - Submittal Procedures.
- L. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- M. Retesting/Reinspection: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspection, for construction that replaced Work that failed to comply with the Contract Documents.
- N. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- O. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
- P. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- Q. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
 1. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Engineer.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 70 00 - Execution and Closeout Requirements.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities. This information is believed to be accurate as of the date of the Contract Documents.
- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities. Information is subject to change and is up to date as of the date of the Contract Documents.
 - 1. COE - Army Corps of Engineers; www.usace.army.mil.
 - 2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
 - 3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
 - 4. DOD - Department of Defense; www.quicksearch.dla.mil.
 - 5. DOE - Department of Energy; www.energy.gov.
 - 6. EPA - Environmental Protection Agency; www.epa.gov.
 - 7. FAA - Federal Aviation Administration; www.faa.gov.
 - 8. FG - Federal Government Publications; www.gpo.gov/fdsys.
 - 9. GSA - General Services Administration; www.gsa.gov.
 - 10. HUD - Department of Housing and Urban Development; www.hud.gov.
 - 11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
 - 12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 - 13. SD - Department of State; www.state.gov.
 - 14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
 - 15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 - 16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
 - 17. USDJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
 - 18. USP - U.S. Pharmacopeial Convention; www.usp.org.
 - 19. USPS - United States Postal Service; www.usps.com.

- D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
- E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

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SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 01 10 00 – Summary, for work restrictions and limitations on utility interruptions.
 - 2. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to Engineer, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Sewer service use charges shall be by the Contractor utilizing portable facilities.
- C. Water Service: Water-service use charges for water used by all entities for construction operations shall be by the Contractor.
- D. Electric Power Service: Electric-power-service use charges for electricity used by all entities for construction operations shall be by the Contractor.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction (DHEC), whichever is more stringent.
- C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.

3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Engineer and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 2. Conference room of sufficient size to accommodate meetings of ten (10) individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one (1) receptacle on each wall. Furnish room with conference table, chairs, and 4 foot square tack and marker boards.
 3. Drinking water and private toilet.
 4. Coffee machine and supplies.
 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 - 72 °F.
 6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 1. Store combustible materials apart from building.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service overhead or underground or as indicated.
- I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- J. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel.
 - 1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Engineer's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
 - 2. Provide superintendent with cellular telephone for use when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Maintain support facilities until Engineer schedules Substantial Completion inspection. Remove before Final Completion.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
 - 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 - 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 - 2. Prepare subgrade and install subbase and base for temporary roads.
 - 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
 - 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 32 12 16 - Asphalt Paving.
- D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- E. Parking: Provide temporary parking areas for construction personnel.
- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted. Subcontractors are not authorized to have signage.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary construction signs as required by funding agencies.
 - b. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touchup signs so they are legible at all times.
- G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 70 00 - Execution and Closeout Requirements.

- H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
- I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- J. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.
- K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Section 01 10 00 - Summary.
- C. Temporary Erosion and Sedimentation Control: Comply with authorities having jurisdiction, and requirements specified in Section 31 25 00 - Erosion and Sedimentation Controls.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- F. Site Enclosure Fence: Before construction operations begin furnish and install site enclosure fence that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
- G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
 - 2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies
 - 3. Insulate partitions to control noise transmission to occupied areas.
 - 4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 - 5. Protect air-handling equipment.
 - 6. Provide walk-off mats at each entrance through temporary partition.

3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.
 - 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 - 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use permanent HVAC system to control humidity.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Engineer.
 - c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Maintenance: Maintain facilities in good operating condition until removal.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- B. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 70 00 - Execution and Closeout Requirements.

END OF SECTION 01 50 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within seven (7) days of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within fifteen (15) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 01 33 00 - Submittal Procedures.
 - b. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 - Submittal Procedures. Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two (2) or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

6. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

- A. Warranty requirements shall conform with the General Conditions followed by Specification Section 01 10 00.

1.8 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Engineer will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article and/or Section 01 25 00 – Substitution of Major Equipment Items to obtain approval for use of an unnamed product.

- B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered.
4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered,

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Matching Specification: Where Specifications require "match Engineer's sample", provide a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 - Substitution of Major Equipment Items and Products for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer from manufacturer's full range" or similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

1.9 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:
 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners, if requested.
 5. Samples, if requested.
 6. The Contractor shall also include in the price bid the modifications necessary for the comparable product to be utilized. This includes but is not limited to, electrical and mechanical changes, engineering time to assess the changes, modifications to buildings, programmable controls and structural modifications.

PART 2 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 70 00 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Field engineering.
2. Closeout procedures.
3. Starting of systems.
4. Demonstration and instructions.
5. Testing, adjusting, and balancing.
6. Project record documents.
7. Operation and maintenance data.
8. Manual for materials and finishes.
9. Manual for equipment and systems.
10. Spare parts and maintenance products.
11. Product warranties and product bonds.
12. Examination.
13. Preparation.
14. Execution.
15. Cutting and patching.
16. Protecting installed construction.
17. Final cleaning.

B. Related Requirements:

1. Section 01 33 00 - Submittal Procedures, for submitting copies of submittals for operation and maintenance manuals.
2. Section 01 78 23 - Operation and Maintenance Data, for submitting operation and maintenance manuals.

1.2 FIELD ENGINEERING

- A. Employ land surveyor registered in state of South Carolina acceptable to Engineer.
- B. Locate protect survey control and reference points. Promptly notify Engineer of discrepancies discovered.
- C. Control datum for survey is indicated on Drawings.
- D. Verify setbacks and easements; confirm Drawing dimensions and elevations.
- E. Provide field engineering services. Establish elevations, lines, and levels using recognized engineering survey practices.

- F. Protect survey control points prior to starting Site Work; preserve permanent reference points during construction.
- G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Engineer.

1.3 CLOSEOUT PROCEDURES

- A. Prerequisites to Substantial Completion: Complete following items before requesting Certification of Substantial Completion, either for entire Work or for portions of Work:
 - 1. Submit operation and maintenance manuals, Project record documents, and other similar final record data in compliance with this Section.
 - 2. Complete facility startup, testing, adjusting, balancing of systems and equipment, demonstrations, and instructions to Owner's operating and maintenance personnel as specified in compliance with this Section.
 - 3. Conduct inspection to establish basis for request that Work is substantially complete. Create comprehensive list (initial punch list) indicating items to be completed or corrected, value of incomplete or nonconforming Work, reason for being incomplete, and date of anticipated completion for each item. Include copy of list with request for Certificate of Substantial Completion.
 - 4. Obtain and submit releases enabling Owner's full, unrestricted use of Project and access to services and utilities. Include certificate of occupancy, operating certificates, and similar releases from authorities having jurisdiction and utility companies.
 - 5. Deliver tools, spare parts, extra stocks of material, and similar physical items to Owner.
 - 6. Discontinue or change over and remove temporary facilities and services from Project Site, along with construction tools, mockups, and similar elements.
 - 7. Perform final cleaning according to this Section.
- B. Substantial Completion Inspection:
 - 1. When Contractor considers Work to be substantially complete, submit to Engineer:
 - a. Written certificate that Work, or designated portion, is substantially complete.
 - b. List of items to be completed or corrected (initial punch list).
 - 2. Within seven (7) days after receipt of request for Substantial Completion, Engineer will make inspection to determine whether Work or designated portion is substantially complete.
 - 3. Should Engineer determine that Work is not substantially complete:
 - a. Engineer will promptly notify Contractor in writing, stating reasons for its opinion.
 - b. Contractor shall remedy deficiencies in Work and send second written request for Substantial Completion to Engineer.
 - c. Engineer will re-inspect Work.
 - d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer and Owner's inspection.
 - 4. When Engineer finds that Work is substantially complete, Engineer shall:

- a. Prepare Certificate of Substantial Completion on EJCDC C-625 - Certificate of Substantial Completion accompanied by Contractor's list of items to be completed or corrected as verified and amended by Engineer and Owner (final punch list).
 - b. Submit Certificate to Owner and Contractor for their written acceptance of responsibilities assigned to them in Certificate.
 5. After Work is substantially complete, Contractor shall:
 - a. Allow Owner occupancy of Project under provisions stated in Certificate of Substantial Completion.
 - b. Complete Work listed for completion or correction within time period stipulated.
- C. Prerequisites for Final Completion: Complete following items before requesting final acceptance and final payment.
 1. When Contractor considers Work to be complete, submit written certification that:
 - a. Contract Documents have been reviewed.
 - b. Work has been examined for compliance with Contract Documents.
 - c. Work has been completed according to Contract Documents.
 - d. Work is completed and ready for final inspection.
 2. Submittals: Submit following:
 - a. Final punch list indicating all items have been completed or corrected.
 - b. Final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
 - c. Specified warranties, workmanship/maintenance bonds, maintenance agreements, and other similar documents.
 - d. Accounting statement for final changes to Contract Sum.
 - e. Contractor's affidavit of payment of debts.
 - f. Contractor affidavit of release of liens.
 - g. Consent of surety to final payment.
 3. Perform final cleaning for Contractor-soiled areas according to this Section.
- D. Final Completion Inspection:
 1. Within seven (7) days after receipt of request for final inspection, Owner and Engineer will make inspection to determine whether Work or designated portion is complete.
 2. Should Engineer consider Work to be incomplete or defective:
 - a. Engineer will promptly notify Contractor in writing, listing incomplete or defective Work.
 - b. Contractor shall remedy stated deficiencies and send second written request to Work is complete.
 - c. Engineer will re-inspect Work.
 - d. Redo and Inspection of Deficient Work: Repeated until Work passes inspection.

1.4 STARTING OF SYSTEMS

- A. Coordinate schedule for startup of various equipment and systems.
- B. Notify Engineer and owner seven (7) days prior to startup of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute startup under supervision of manufacturer's representative or Contractors' personnel according to manufacturer's instructions.
- G. When specified in individual Specification Sections, require Manufacturer to provide authorized representative who will be present at Site to inspect, check, and approve equipment or system installation prior to startup and will supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly, as well as a certificate/field report from the manufacturer from his inspection of the installation.

1.5 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel as equipment becomes available for use and not later than fourteen (14) days prior to date of Substantial Completion.
- B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- C. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at designated location.
- D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.6 TESTING, ADJUSTING, AND BALANCING

- A. Contractor with Engineer approval will appoint and employ services of independent firm to perform testing, adjusting, and balancing. Contractor shall pay for services.
- B. Reports will be submitted by independent firm to Engineer indicating observations and results of tests and indicating compliance or noncompliance with requirements of Contract Documents.

1.7 PROJECT RECORD DOCUMENTS

- A. Maintain on Site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, product data, and Samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates used.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings: Legibly mark each item to record actual construction as follows:
 - 1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
 - 2. Include locations of concealed elements of the Work.
 - 3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
 - 4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
 - 5. Identify and locate existing buried or concealed items encountered during Project.
 - 6. Measured depths of foundations in relation to finish floor datum.
 - 7. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 8. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 9. Field changes of dimension and detail.
 - 10. Details not on original Drawings.
- G. Submit marked-up paper copy documents to Engineer with claim for final Application for Payment.

1.8 OPERATION AND MAINTENANCE DATA

- A. See Section 01 78 23 - Operation and Maintenance Data for operation and maintenance manuals.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that existing Site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual Specification Sections.
- D. Verify that utility services are available with correct characteristics and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance according to manufacturer's instructions.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer-required or -recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

3.3 EXECUTION

- A. Comply with manufacturer's installation instructions, performing each step-in sequence. Maintain one (1) set of manufacturer's installation instructions at Project Site during installation and until completion of construction.
- B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.
- D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
 - 1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.
 - 2. Physically separate products in place, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
 - 3. Exposed Joints: Provide uniform joint width and arrange to obtain best visual effect. Refer questionable visual-effect choices to Engineer for final decision.

- E. Allow for expansion of materials and building movement.
- F. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with entire Project.
 - 1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.
 - 2. Coordinate enclosure of Work with required inspections and tests to minimize necessity of uncovering Work for those purposes.
- G. Mounting Heights: Where not indicated, mount individual units of Work at industry recognized standard mounting heights for particular application indicated.
 - 1. Refer questionable mounting heights choices to Engineer for final decision.
- H. Adjust operating products and equipment to ensure smooth and unhindered operation.
- I. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by manufacturer.

3.4 CUTTING AND PATCHING

- A. Employ skilled and experienced installers to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements affecting:
 - 1. Structural integrity of element.
 - 2. Integrity of weather-exposed or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of element.
 - 4. Visual qualities of sight-exposed elements.
 - 5. Work of Owner or separate contractor.
- C. Execute cutting, fitting, and patching including excavation and fill to complete Work and to:
 - 1. Fit the several parts together, to integrate with other Work.
 - 2. Uncover Work to install or correct ill-timed Work.
 - 3. Remove and replace defective and nonconforming Work.
 - 4. Remove samples of installed Work for testing.
 - 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute Work by methods to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.
- E. Cut masonry and concrete materials using masonry saw or core drill.
- F. Restore Work with new products according to requirements of Contract Documents.
- G. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.
- H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

- I. At penetrations of fire-rated walls, partitions, ceiling, or floor construction, completely seal voids with fire-rated material to full thickness of penetrated element.
- J. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
- K. Identify hazardous substances or conditions exposed during the Work to Engineer for decision or remedy.

3.5 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual Specification Sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

3.6 FINAL CLEANING

- A. Execute final cleaning prior to final Project assessment.
 - 1. Employ experienced personnel or professional cleaning firm.
- B. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces, and vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures to sanitary condition with appropriate cleaning materials.
- D. Clean filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean Site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from Site.

END OF SECTION 01 70 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. Section 01 33 00 - Submittal Procedures, for submitting copies of submittals for operation and maintenance manuals.

1.2 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Engineer will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Engineer.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.

2. Two (2) paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least fifteen (15) days before commencing demonstration and training. Engineer will return copy with comments.
 1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within fifteen (15) days of receipt of Engineer's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 1. List of documents.
 2. List of systems.
 3. List of equipment.
 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 1. Title page.
 2. Table of contents.
 3. Manual contents.

- B. Title Page: Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Engineer.
 8. Names and contact information for major consultants to the Engineer that designed the systems contained in the manuals.
 9. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, binders, in thickness necessary to accommodate contents, sized to hold 8-1/2 x 11-inch and 11 x 17 paper (Z folded); with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two (2) or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders, if necessary, to provide essential information for proper operation or maintenance of equipment or system.

- b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
 1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 1. Standard maintenance instructions and bulletins.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name, organization, phone number, and email of service agent.

- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- C. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- D. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared Record Drawings in Section 01 78 39 - Project Record Documents.
- E. Comply with Section 01 70 00 - Execution and Closeout Procedures for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23

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SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 01 70 00 - Execution and Closeout Procedures, for general closeout procedures.
 - 2. Section 01 78 23 - Operation and Maintenance Data, for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Submit copies of marked-up record prints as follows:
 - a. Initial Submittal:
 - 1) Submit electronic files or one (1) hard copy set. Engineer will review and return, with comments as necessary.
 - b. Final Submittal:
 - 1) After incorporation of Engineer's comments, submit electronic files and one (1) hard copy set of final marked-up record prints to the Engineer and electronic files and one (1) hard copy set to the Owner.
 - c. Engineer will be responsible for generating record drawings based on the Contractor's marked-up record prints and delivering three (3) hard copy sets to the Owner.
- B. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one (1) set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued. Contractor shall maintain a set of marked up prints on the job site for review prior to pay request approval.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Work Change Directive.
 - k. Changes made following Engineer's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Format: Annotated PDF electronic file with comment function enabled.
 - 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 - 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Engineer.
 - e. Name of Contractor.

2.2 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one (1) copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer's reference during normal working hours.

END OF SECTION 01 78 39

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SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
- B. Furnish demonstration and training instruction time as a subsidiary obligation of the price bid.
- C. Related Requirements
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 - Quality Requirements, experienced in operation and maintenance procedures and training.

1.3 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Engineer.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor has delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.

- f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 - Operation and Maintenance Data.
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Engineer will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Engineer with at least seven (7) days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Cleanup: Restore systems and equipment to condition existing before initial training use.

END OF SECTION 01 79 00

SECTION 01 81 00 – GEOTECHNICAL DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes report of explorations and tests of subsurface conditions at the site.
- B. Related Requirements
 - 1. Section 31 20 00 – Earth Moving
 - 2. Section 31 23 19 – Dewatering
 - 3. Section 31 50 00 – Excavation Support and Protection

1.2 INVESTIGATION

- A. Soil and subsurface investigations were conducted at the site, the results of which are to be found in the Report of Geotechnical Exploration issued by Goodwyn Mills Cawood (GMC), dated September 27, 2022, GMC Project Number GGRE220008, in Appendix A. Results of additional investigations at Project site were conducted on October 18, 2023, which can be found in Appendix B.
- B. Bidders are urged to examine soils investigation data and to make their own investigation of the site before bidding. The information in the report provided is not a warranty of existing site conditions.
- C. Boring results and soil improvement recommendations are included in the plans.

1.3 INTERPRETATION

- A. Soil investigation data is provided only for information and the convenience of bidders.
- B. Owner and Engineer disclaim responsibility for interpretations of geotechnical data by bidders, as in projecting soil-bearing values, rock profiles, soil stability and the presence, level, and extent of underground water.
- C. Bidders are urged to examine the GMC Geotechnical Report that addresses the purpose, basis, and warranties relevant to that report.
- D. Owner and Engineer disclaim all responsibility for the existence of other soil and subsurface investigations previously prepared for Owner, Engineer, or others. It is the sole responsibility of the Bidder to obtain other soil and subsurface investigations that may be available for interpretation, at no additional cost to the Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01 81 00

SECTION 02 41 16 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of buildings as indicated in Demo sheets in Drawings.
2. Abandoning in-place and removing below-grade construction.
3. Disconnecting, capping or sealing, and abandoning in-place and removing site utilities.
4. Salvaging items for reuse by Owner.

B. Related Requirements:

1. Section 01 10 00 – Summary, for use of the premises and phasing requirements.
2. Section 01 32 00 - Construction Progress Documentation, for preconstruction photographs taken before building demolition.
3. Section 02 41 19 - Selective Demolition, for partial demolition of buildings, structures, and site improvements.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Demolish: To forcefully tear down or take apart a structure.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated as salvaged or reinstalled, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at the project site.
 - 1. Inspect and discuss condition of construction to be demolished.
 - 2. Review structural load limitations of existing structures.
 - 3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review and finalize protection requirements.
 - 5. Review procedures for noise control and dust control.
 - 6. Review procedures for protection of adjacent buildings.
 - 7. Review items to be salvaged and returned to Owner.

1.5 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
 - 1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain.
- B. Schedule of Building Demolition Activities: Indicate the following:
 - 1. Detailed sequence of demolition work, with starting and ending dates for each activity.
 - 2. Temporary interruption of utility services.
 - 3. Shutoff and capping or re-routing of utility services.
- C. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by demolition operations. Comply with Section 01 32 33 - Photographic Documentation. Submit before the Work begins.
- D. Statement of Refrigerant Recovery (if applicable): Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 QUALITY ASSURANCE

1.8 FIELD CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

- B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
 - 1. Provide no less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
 - 2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
 - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.
- C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Before building demolition, Owner will remove the following items:
 - a. Items to be determined in predemolition conference
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. On-site storage or sale of removed items or materials is not permitted.

1.9 COORDINATION

- A. Arrange demolition schedule so as not to interfere with Owner's on-site operations or operations of adjacent occupied buildings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

2.2 SOIL MATERIALS

- A. Satisfactory Soils: Comply with requirements in Section 31 20 00 - Earth Moving.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations. Comply with Section 01 32 33 - Photographic Documentation.

3.2 PREPARATION

- A. Salvaged Items: Comply with the following:
 - 1. Clean salvaged items of dirt and demolition debris.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.
 - 1. Owner will arrange to shut off utilities when requested by Contractor.
 - 2. Arrange to shut off utilities with utility companies.
 - 3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 - 4. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
 - 5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.
- B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of demolition.
- C. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations.
 - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
 - 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
 - a. Provide at least **72** hours' notice to occupants of affected buildings if shutdown of service is required during changeover.
- D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 01 50 00 - Temporary Facilities and Controls.
 - 1. Protect adjacent buildings and facilities from damage due to demolition activities.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 - 4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
 - 6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
 - 7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- E. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION, GENERAL

- A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.

2. Maintain fire watch during and for at least **30** minutes after flame-cutting operations.
 3. Maintain adequate ventilation when using cutting torches.
 4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- C. Explosives: Use of explosives is not permitted.

3.6 DEMOLITION BY MECHANICAL MEANS

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
- C. Salvaged Items:
1. All equipment shall be turned over the Owner.
- D. Below-Grade Construction:
1. New Construction Areas: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending 5 feet outside footprint indicated for new construction. Abandon below-grade construction outside this area.
 2. Non-Construction Areas: Remove below-grade construction, including basements, foundation walls, and footings, to at least 36 inches below grade, or to the depths indicated on the Drawings. Water retaining structures, in addition to the previous statement, shall receive 6" cored holes in the bottom of structure (unless otherwise shown, core a minimum of four (4) holes, 90° apart), or fracture structure bottoms by mechanical means to allow for drainage.
- E. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within five (5) feet outside footprint indicated for new construction. Abandon utilities outside this area.

1. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Section 31 20 00 - Earth Moving.

3.7 SITE RESTORATION

- A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Section 31 20 00 - Earth Moving.
- B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.8 REPAIRS

- A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
 1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Do not burn demolished materials.

3.10 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.
 1. Clean roadways of debris caused by debris transport.

END OF SECTION 02 41 16

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SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure per Demo sheets in Drawings.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.
4. Protecting existing work to remain.
5. Cleaning soled materials that are to remain.
6. Disconnecting and capping utilities.
7. Removing debris and equipment.
8. Removal of items indicated on Drawings.
9. Salvageable items to be retained by the Owner as indicated on the Drawings and during pre-construction meeting.

B. Related Requirements:

1. Section 01 10 00 – Summary, for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Demolish: To forcefully tear down or take apart a structure.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- D. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces that might be misconstrued as damage caused by demolition operations. Comply with Section 01 32 33 - Photographic Documentation. Submit before Work begins.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.8 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.10 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs or video and survey/3D scan.
 - 1. Comply with requirements specified in Section 01 32 33 - Photographic Documentation.
 - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
 - 3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 - Temporary Facilities and Controls.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and

finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain fire watch during and for at least two (2) hours after flame-cutting operations.
 6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Work in Historic Areas: Selective demolition may be performed only in areas of Project that are not designated as historic. In historic spaces, areas, and rooms, or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling."
- D. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.

5. Protect items from damage during transport and storage.

E. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

- F. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction and/or recycle or dispose of them.
 1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 19

SECTION 03 20 00 – ANCHORAGE IN CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the requirements for cast-in-place, mechanical, and adhesive anchors for concrete.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
1. Section 03 30 00 – Cast-in-Place Concrete
 2. Division 26 – Electrical
 3. Division 43 – Process Gas and Liquid Handling, Purification and Storage Equipment
 4. Division 46 – Water and Wastewater Equipment

1.3 SUBMITTALS

- A. Submit product information to the Engineer for approval in accordance with Section 01 33 00.

PART 2 - PRODUCTS

2.1 WEDGE TYPE ANCHORS

- A. Anchors shall feature a stainless-steel split expansion ring; a threaded stud body; and integral cone expander, nut and washer.
- B. Anchor bodies smaller than 3/4 inch, excluding countersunk anchors, shall be made from AISI 316 and shall have the following minimum bolt fracture loads:

Anchor Diameter (in.)	Minimum Fracture Load (lb)
1/4	2,900
3/8	7,200
1/2	12,400
5/8	21,900

- 2.2 Anchor bodies 3/4 inch and larger, and all stainless-steel post nut anchor bodies, shall be made from AISI 316 stainless steel and shall have the following minimum mechanical properties:

Anchor Diameter (in.)	Min. Tensile Strength (ksi)	Min. Yield Strength (ksi)
$\leq 5/8$	90	76
$\geq 3/4$	76	64

- A. All nuts shall meet the dimensional requirements of ASTM F 594.
- B. Washers shall meet the dimensional requirements of ANSI B18.22.1, Type A, plain.
- C. Expansion sleeve for anchors shall be made from AISI 316. All nuts and washers shall be made from AISI 316.
- D. Anchor size and depth shall be as shown on drawings.
- E. Manufacturers:
 - 1. Trubolt as manufactured by ITW-Redhead, Inc.
 - 2. Kwik Bolt 3 as manufactured by Hilti, Inc.
 - 3. Or pre-approved equal

2.3 ADHESIVE ANCHOR SYSTEM

- A. Adhesive anchor system shall consist of an injectable two-part epoxy.
- B. Application system shall be in accordance with manufacturer's recommendations. System shall keep the two components separated until application of product directly into drilled hole.
- C. System shall thoroughly blend the two parts by means of a static mixer nozzle.
- D. Injection adhesive shall be formulated to include resin and hardener to provide optimal curing speed as well as high strength and stiffness.
- E. Anchor rods shall be as shown on drawings or as specified in other sections of these specifications.
 - 1. Anchor rods shall be furnished with chamfered ends so that either end will accept a nut and washer.
 - 2. Alternately, anchor rods shall be furnished with a 45° chisel point on one end to allow for easy insertion into the adhesive-filled hole.
- F. Nuts and washers shall be provided for anchor rods in the same material as the anchor rod.
- G. Manufactures
 - 1. HIT RE 500 Epoxy Adhesive Anchor as manufactured by Hilti, Inc.
 - 2. G5 Adhesive Anchoring System as manufactured by ITW-Redhead, Inc.
 - 3. Or equal

2.4 CAST-IN-PLACE ANCHORS BOLTS

- A. Cast-in-place anchors shall be made of corrosion resistant material in accordance with the dimensions shown on drawings.
 - 1. As a minimum, provide ASTM F1554 Grade 36 steel cast-in-place anchors.
 - 2. If anchor bolt size is not shown on drawings, Contractor shall provide anchors capable of providing four (4) times the load applied to the bolt.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Layout anchors before drilling into concrete to ensure proper placement. Following manufacturer's recommendation for spacing of anchors. Notify Engineer of conflicts between existing conditions and requirements by manufacturer.
- B. Install anchors per manufacturer's recommendations.
- C. Embedment length shall be per manufacturer's recommendations for load conditions.
- D. Check all equipment anchors after equipment has operated. Retighten any loose anchors.

END OF SECTION 03 20 00

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SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Section 03 20 00 – Anchorage in Concrete
 - 2. Division 31 – Earthwork

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, vapor-retarder installation, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness concrete repair procedures, and concrete protection.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Engineer.
- E. Samples: For color finishes, normal weight aggregates, fiber reinforcement, reglets, waterstops, vapor retarder/barrier, and form liners.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Waterstops.
 - 6. Curing compounds.
 - 7. Floor and slab treatments.
 - 8. Bonding agents.
 - 9. Adhesives.
 - 10. Vapor retarders.
 - 11. Semi-rigid joint filler.
 - 12. Joint-filler strips.
 - 13. Repair materials.
- C. Material Test Reports: From a qualified testing agency.
- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer. Placing drawings indicating fabrication and erection of forms for specific finished concrete surfaces. Show form construction including jointing, special form joints or reveals, location and pattern of form tie placement, and other items that affect exposed concrete visually.
 - 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: Acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.8 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 °F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain average concrete temperature below 90 °F at time of placement. Maximum concrete temperature at time of placement shall be 95 °F. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301.
 2. ACI 117.
 3. ACI 350.
 4. ACI 308.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
 3. Overlaid Finnish birch plywood.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

- E. Void (Carton) Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- H. Form-Release Agent: Commercially formulated (maximum VOC content of 350 mg/L) form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- I. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60, deformed bars, assembled with clips.
- C. Plain-Steel Wire: ASTM A 1064, as drawn.
- D. Deformed-Steel Wire: ASTM A 1064.
- E. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.
- F. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064, flat sheet.
- G. Galvanized-Steel Welded-Wire Reinforcement: ASTM A 1064, plain, fabricated from galvanized-steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Zinc Repair Material: ASTM A 780.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

2.5 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 1. Portland Cement: ASTM C 150, Type I or Type II.
 - a. The cement shall be low alkali, less than 0.60 percent. All cement used in concrete that will be in contact with wastewater shall have a tricalcium aluminate ($\text{Ca}_3\text{Al}_2\text{O}_6$) content of less than 8 percent.
 - b. Use one brand of cement throughout the Project unless otherwise acceptable to the Engineer.
 2. Fly Ash: ASTM C 618, Class F or C.
- C. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. Normal weight river gravel and natural sand are acceptable for use as aggregate materials in concrete. All normal weight aggregates shall conform to ASTM C33.
 1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
- D. Lightweight Aggregate: ASTM C 330, 1-inch-nominal maximum aggregate size.
- E. Air-Entraining Admixture: ASTM C 260.
- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 1. Water-Reducing Admixture: ASTM C 494, Type A.
 2. Retarding Admixture: ASTM C 494, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
- G. Water: ASTM C 94 and potable.

2.6 FIBER REINFORCEMENT

- A. Synthetic Micro-Fiber: Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.
- B. Synthetic Micro-Fiber: Fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

2.7 WATERSTOPS

- A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints, factory fabricated corners, intersections, and directional changes.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Sika Greenstreak
 - b. Williams Products, Inc.
 - c. JP Specialties, Inc.
 - d. Or approved equal.
 - 2. Profile: Ribbed with center bulb and/or Ribbed without center bulb.
 - 3. Dimensions: 6 inches by 3/8 inch thick; nontapered.
- B. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints, factory fabricated corners, intersections, and directional changes.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BoMetals, Inc.
 - b. Sika Greenstreak.
 - c. JP Specialties, Inc.
 - d. Or approved equal.
 - 2. Profile: Ribbed with center bulb and/or Ribbed without center bulb.
 - 3. Dimensions: 6 inches by 3/8 inch thick; nontapered.
- C. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Barrier-Bac; Inteplast Group, Ltd.
 - b. JP Specialties, Inc.
 - c. Sika Greenstreak.
 - d. Or approved equal.
- D. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adeka Ultra Seal/OCM, Inc.
 - b. Sika Greenstreak.
 - c. Or approved equal.

2.8 VAPOR RETARDERS

- A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.

2.9 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. Kaufman Products, Inc.
 - d. Sika Corporation.
 - e. SpecChem, LLC.
 - f. Or approved equal.

- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

- D. Water: Potable.

- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. W. R. Meadows, Inc.
 - d. Or approved equal.

- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.

- b. Euclid Chemical Company (The); an RPM company.
 - c. L&M Construction Chemicals, Inc.
 - d. TK Products.
 - e. Or approved equal.
- G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Dayton Superior.
 - c. Euclid Chemical Company (The); an RPM company.
 - d. L&M Construction Chemicals, Inc.
 - e. W. R. Meadows, Inc.
 - f. Or approved equal.
- H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Dayton Superior.
 - c. Euclid Chemical Company (The); an RPM company.
 - d. L&M Construction Chemicals, Inc.
 - e. W. R. Meadows, Inc.
 - f. Or approved equal.
- I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dayton Superior.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. L&M Construction Chemicals, Inc.
 - d. W. R. Meadows, Inc.
 - e. Or approved equal.

2.10 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 according to ASTM D 2240.

- C. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types I and II, nonload bearing or Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.022-inch-thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.11 REPAIR MATERIALS

- A. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.12 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned based on laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
 - 2. Combined Fly Ash and Pozzolan: 25 percent.
 - 3. Slag Cement: 50 percent.
 - 4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 - 5. Silica Fume: 10 percent.

6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 7. Combined Fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Normal-weight concrete.
1. Minimum Compressive Strength: -As indicated in Structural General Notes at 28 days.
 2. Maximum W/C Ratio: 0.55.
 3. Slump Limit: 3 inches. 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
 5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
- B. Foundation Walls: Normal-weight concrete.
1. Minimum Compressive Strength: As indicated in Structural General Notes at 28 days.
 2. Maximum W/C Ratio: 0.50
 3. Slump Limit: 3 inches. 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture plus or minus 1 inch.
 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
 5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
- C. Slabs-on-Grade: Normal-weight concrete.
1. Minimum Compressive Strength: As indicated in Structural General Notes at 28 days.
 2. Maximum W/C Ratio: 0.50
 3. Minimum Cementitious Materials Content: 470 lb/cu. yd.
 4. Slump Limit: 3 inches, plus or minus 1 inch.

5. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
6. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
7. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
8. Maximum W/C Ratio: 0.50.

D. Suspended Slabs: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated in Structural General Notes at 28 days.
2. Maximum W/C Ratio: 0.50.
3. Minimum Cementitious Materials Content: 470 lb/cu. yd.
4. Slump Limit: 3 inches, plus or minus 1 inch.
5. Air Content: 4 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
6. Air Content: -4.5 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
7. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
8. Maximum W/C Ratio: 0.50.

E. Water Retaining Structures.

1. Minimum Compressive Strength: As indicated in Structural General Notes at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Minimum Cementitious Materials Content: 535 lb/cu. yd.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Air Content: 4.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
6. Air Content: 4.5 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.

F. Concrete Toppings: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated in Structural General Notes at 28 days.
2. Minimum Cementitious Materials Content: 600 lb/cu. yd.
3. Slump Limit: 3 inches, plus or minus 1 inch.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: Do not allow air content of trowel-finished toppings to exceed 3 percent.
6. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of 50 lb/cu. yd.
7. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 1.5 lb/cu. yd.

G. Building Frame Members: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated in Structural General Notes at 28 days.
2. Maximum W/C Ratio: 0.50.
3. Slump Limit: 4 inches. 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

4. Air Content: 4.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

H. Building Walls: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated in Structural General Notes at 28 days.
2. Maximum W/C Ratio: 0.50.
3. Slump Limit: 4 inches. 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

2.14 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.15 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
1. When air temperature is between 85 and 90 °F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 °F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 °F for 48 hours after placing concrete with a 72 hour pour back for adjacent pours. Concrete has to

be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the work. split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR-RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
1. Lap joints 6 inches and seal with manufacturer's recommended tape.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.6 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated on Contractor's submitted and approved construction joint layout. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete as soon as cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOP INSTALLATION

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricated joints in waterstops according to manufacturer's written instructions.

3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.
- B. Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, damp proofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.
- C. Smooth Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:
 1. Perform no later than one day after form removal.
 2. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
 3. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
 4. Smooth-Rubbed Finish: Apply to the top of exposed concrete walls and the outside exposed face to 1' below grade on all new concrete structures and new concrete additions.
- D. Grout Cleaned Finish: Provide grout-cleaned finish on scheduled concrete surfaces that have received smooth-formed finish treatment.
 1. Combine 1 part Portland cement to 1-1/2 parts fine sand by volume, complying with ASTM C144 or ASTM C404, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint. Blend standard Portland cement and white Portland cement in amounts determined by trial patches so that final color of dry grout will match adjacent surfaces.
 2. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.
- E. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and where indicated.
 - 1. After placing slabs, finish surface to tolerances of F(F) 15 (floor flatness) and F(L) 13 (floor levelness) measured according to ASTM E 1155. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.
- C. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and where indicated.
 - 1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Finish surfaces to tolerances of F(F) 18 (floor flatness) and F(L) 15 (floor levelness) measured according to ASTM E 1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- D. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system.
 - 1. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances of F(F) 20 (floor flatness) and F(L) 17 (floor levelness) measured according to ASTM E 1155. Grind smooth any surface defects that would telegraph through applied floor covering system.
- E. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom.
- F. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.
- G. Nonslip Aggregate Finish: Apply nonslip aggregate finish to concrete stair treads, platforms, ramps, sloped walks, and where indicated.

1. After completing float finishing and before starting trowel finish, uniformly spread 25 lb of dampened nonslip aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as specified.
2. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose nonslip aggregate.

3.12 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct concrete bases 6 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 3. Minimum Compressive Strength: 4000 psi at 28 days.
 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 6. Prior to pouring concrete, place, and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 301 and ACI 306.1 for cold-weather protection and ACI 301 and ACI 305.1 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Required for all water retaining structures. Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: For non-liquid retaining structures and floors only. Comply with ASTM C171. Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies in writing that the curing compound does not interfere with bonding of floor covering used on Project.
 - 4. Curing and Sealing Compound: For non-liquid retaining structures and floors only. Comply with ASTM C171. Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least three (3) month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's

written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish blending with adjacent finished concrete. Cure in same manner as adjacent concrete.
 6. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.16 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a-qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Concrete placement, including conveying and depositing.
 5. Curing procedures and maintenance of curing temperature.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 °F and below or 80 °F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 9. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
 11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Engineer.
 12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing for laboratory and office buildings.
- F. For floors required for sloping, the slope must be within 1/16" tolerances of that required in the plans.

3.17 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

3.18 WET TESTING

A. General

- 1. All new, water-retaining concrete structures shall be tested for water-tightness by the testing procedure described below and in accordance with ACI 350.1.
- 2. All testing work shall be performed by the Contractor in the presence of the Engineer. The Engineer shall be notified at least five (5) days in advance of the time at which testing will be performed.

B. Testing Water

- 1. Water for wet testing shall be furnished by the Contractor. The source of the water must be approved by the Engineer prior to filling of the structure. As a general rule, plant effluent water is acceptable for use as testing water; however, this must be confirmed by the Engineer.
- 2. Once testing is complete, testing water shall be disposed of in a manner acceptable to the Engineer and, unless otherwise permitted by the Engineer, shall not be allowed to enter other parts of the system.

C. Test Equipment

- 1. All temporary equipment needed for wet testing must be provided by the Contractor (e.g. connections between the structure to be tested and the water source, pumping equipment, metering devices, pressure or vacuum gauges, temporary flanges, valves, bulkheads, bracing, blocking, and other equipment that may be necessary to perform the testing).
- 2. All temporary equipment shall be removed upon satisfactory completion of wet testing.

D. Test Preparation

- 1. Unless otherwise specified, wet testing shall be performed after installation of pipe sleeves and before placement of backfill, cleaning, disinfection, installation of process equipment, or any other activities that would hinder visual inspection of the structure during the test.
- 2. Exposed concrete surfaces of the structure (including the floor) shall be cleaned of all foreign material and debris prior to the test. Standing water in or outside the structure that would interfere with the observation of the exposed concrete surfaces of the structure shall be removed. The concrete surfaces and concrete joints shall be thoroughly inspected for potential points of leakage, and those areas shall be repaired prior to filling the structure with water.
- 3. Adjacent structures having common walls shall be tested individually at different times to allow examination of the dividing walls for leaks.
- 4. Pipe connections or openings to structures, if not provided with drip tight valves, shall be temporarily plugged during testing. Where slide gates, sluice gates or similar devices are

located, the Contractor shall provide bulkheads or the means to make them drip tight, and shall measure any leakage.

5. Filling of the structure shall not begin before the designed compressive strength of all concrete elements of the structure has been reached or before fourteen (14) days after all concrete walls or base slabs have been placed.

E. Test Procedure

1. Soaking Period: Fill the unlined concrete structure to 1 foot above the maximum operating water surface level and maintain that water level for a minimum of 72 hours, to minimize absorption of water into the concrete during testing. Identify and repair all visible leaks during the soaking period.
2. Testing Period: At the end of this soaking period, once all leaks have been repaired and the water level brought back to the required elevation, the testing period shall begin. Mark the water level with a weight suspended from a string and measure its elevation with a surveyor's level. Allow the structure to sit for a minimum of 48 hours. Following this period, identify and repair all visible leaks. Record and submit to the Engineer measurements of the water level at the beginning and end of the testing period.
3. Evaporation/Precipitation: During the testing period, suspend a bucket or pan in the structure and fill it halfway with testing water. Record and submit to the Engineer measurements of the water level at the beginning and end of the testing period, for use in accounting for any evaporation and precipitation that may have occurred during testing.

F. Leakage

1. Leakage requiring repair shall be defined as any moisture on the exterior surface of the structure, ranging from damp spots to dripping or trickling to shooting streams of water. All visible leakage is to be repaired even if magnitude is within allowable leakage.
2. Allowable leakage: For unlined tanks with a side-water depth of 25 feet or less, the net loss of water volume (including evaporation/precipitation) shall not exceed 0.1 percent in 24 hours.

G. Test Conclusion

1. If the leakage observed during testing (including evaporation/precipitation) is less than the allowable leakage, the structure shall be considered sufficiently water-tight. If it is greater than the allowable, the structure shall be drained, necessary repairs shall be made, and the structure shall be re-tested.

END OF SECTION 03 30 00

SECTION 03 39 00 - CONCRETE CURING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Initial and final curing of horizontal and vertical concrete surfaces.
- B. Related Requirements
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Cast-in-place or in-situ concrete for structural building frames, slabs on fill or grade, and other concrete components associated with construction.

1.2 REFERENCE STANDARDS

- A. American Concrete Institute
 - 1. ACI 301 - Specifications for Structural Concrete
 - 2. ACI 302.1 - Guide to Concrete Floor and Slab Construction
 - 3. ACI 308.1 - Specification for Curing Concrete
 - 4. ACI 318 - Building Code Requirements for Structural Concrete and Commentary
 - 5. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures and Commentary
- B. ASTM International
 - 1. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete
 - 2. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - 3. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
 - 4. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals
- B. Product Data: Submit manufacturer's information on curing compounds, mats, paper, and film, including compatibilities and limitations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Qualifications Statement: Submit qualifications for manufacturer.

1.4 QUALITY ASSURANCE

- A. Perform Work according to ACI 350.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials onsite in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Membrane-Curing Compound
 - 1. Description: Comply with ASTM C171.
- B. Water: Potable; not detrimental to concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application examination.
- B. Verify that substrate surfaces are ready to be cured.

3.2 APPLICATION

A. Horizontal Surfaces

1. Comply with ACI 308.1, using Section 7 (Addition of Water: Water-Absorbent Materials) and Section 3 (Moisture Retention: Liquid Membrane-Forming Curing Compounds).
2. Absorptive Mat
 - a. Saturate burlap-PE and place burlap-side down over floor slab areas.
 - b. Lap ends and sides.
 - c. Maintain in place for seven (7) days.
3. Membrane-Curing Compound: Apply curing compound uniformly at the rate recommended by the manufacturer.

B. Vertical Surfaces

1. Comply with ACI 308.1, using Water Absorbent Materials method.
2. Spraying: Spray water over surfaces and maintain wet for seven days.
3. Membrane-Curing Compound: Apply compound uniformly at the rate recommended by the manufacturer.

3.3 PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Do not permit traffic over unprotected floor surfaces.

3.4 ATTACHMENTS

A. Liquid Retaining Structures

1. Description: Absorptive mats.
2. Type: Burlap-PE.

B. Elevated Slabs

1. Description: Membrane-curing compound.
2. Type: Acrylic.
3. Color: Clear.

C. Concrete Pavement

1. Description: Membrane-curing compound.
2. Color: Opaque.

D. Other Floor Areas

1. Description: Membrane-curing compound.
2. Type: Acrylic.
3. Color: Translucent.

END OF SECTION 03 39 00

SECTION 03 41 00 - PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Precast structural concrete.

- B. Related Requirements:

- 1. Section 03 30 00 - Cast-in-Place Concrete for concrete topping and placing connection anchors in concrete.
 - 2. Section 05 50 00 - Metal Fabrications for kickers and other miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and, if required, water-absorption tests.

- C. Shop Drawings:

- 1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.
 - 2. Detail fabrication and installation of precast structural concrete units, including connections at member ends and to adjoining construction.
 - 3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
 - 4. Indicate separate face and backup mixture locations and thicknesses.
 - 5. Indicate type, size, and length of welded connections by AWS standard symbols.
 - 6. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
 - 7. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 8. Include and locate openings larger than ten (10) inches. Where additional structural support is required, include header design.
 - 9. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
 - 10. Indicate relationship of precast structural concrete units to adjacent materials.
 - 11. Indicate estimated camber for precast floor slabs with concrete toppings.
 - 12. Indicate shim sizes and grouting sequence.

13. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer
- B. Welding certificates
- C. Material Certificates: For the following:
 1. Cementitious materials
 2. Reinforcing materials and prestressing tendons
 3. Admixtures
 4. Bearing pads
 5. Insulation
 6. Structural-steel shapes and hollow structural sections
- D. Material Test Reports: For aggregates, by a qualified testing agency.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance, to erect Category S1 - Simple AND/OR Category S2 - Complex Structural Systems.
- C. Quality-Control Standard: For manufacturing procedures, testing requirements, and quality-control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1, "Structural Welding Code - Steel."
 2. AWS D1.4, "Structural Welding Code - Reinforcing Steel."

1.6 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Support units during shipment on non-staining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
 - 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
 - 2. Place adequate dunnage of even thickness between each unit.
 - 3. Place stored units so identification marks are clearly visible, and units can be inspected.
- C. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.
- D. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 - Quality Requirements, to design precast structural concrete units.
- B. Design Standards: Comply with ACI 318 and with design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.
- C. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated.
- D. Structural Performance: Provide precast structural concrete units and connections capable of withstanding the design loads within limits and under conditions indicated in the plans and specifications and as required by the IBC.
 - 1. Design precast structural concrete framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements. Maintain precast structural concrete deflections within limits of ACI 318.
 - a. Thermal Movements: Allow for in-plane thermal movements resulting from annual ambient temperature changes of +20 °F to +100 °F.

2.2 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

2.3 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed
- C. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60 or ASTM A 706, deformed bars, assembled with clips.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- E. Deformed-Steel Welded Wire Reinforcement: ASTM A 497 or ASTM A 1064, flat sheet
- F. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.4 PRESTRESSING TENDONS

- A. Pretensioning Strand: ASTM A 416, Grade 250 or Grade 270, uncoated, seven-wire, low-relaxation strand
- B. Unbonded Post-Tensioning Strand: ASTM A 416, Grade 270, uncoated, seven-wire, low-relaxation strand
- C. Post-Tensioning Bars: ASTM A 722, uncoated high-strength steel bar

2.5 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated
 1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials:
 1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of three (3) percent.
 2. Metakaolin: ASTM C 618, Class
 3. Silica Fume: ASTM C 1240, with optional chemical and physical requirement.
 4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse aggregates complying with required class. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

- D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.
- E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15% chloride ions or other salts by weight of admixture.
 - 1. Water-Reducing Admixtures: ASTM C 494, Type A
 - 2. Retarding Admixture: ASTM C 494, Type B
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D
 - 4. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E
 - 5. High-Range, Water-Reducing Admixture: ASTM C 494, Type F
 - 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G
 - 7. Plasticizing Admixture: ASTM C 1017, Type I
 - 8. Plasticizing and Retarding Admixture: ASTM C 1017, Type II
 - 9. Corrosion-Inhibiting Admixture: ASTM C 1582

2.6 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36
- B. Carbon-Steel-Headed Studs: ASTM A 108, Grade 1010 through 1020, cold finished, AWS D1.1, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.
- C. Carbon-Steel Plate: ASTM A 283, Grade C
- D. Malleable-Iron Castings: ASTM A 47, Grade 32510 or Grade 35028
- E. Carbon-Steel Castings: ASTM A 27, Grade 60-30
- F. High-Strength, Low-Alloy Structural Steel: ASTM A 572
- G. Carbon-Steel Structural Tubing: ASTM A 500, Grade B or Grade C
- H. Wrought Carbon-Steel Bars: ASTM A 675, Grade 65
- I. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563; and flat, unhardened steel washers, ASTM F 844.
- J. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 OR SSPC-Paint 25 according to SSPC-PA 1.
- K. Welding Electrodes: Comply with AWS standards.

- L. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

2.7 BEARING PADS

- A. Provide one of the following bearing pads for precast structural concrete units as recommended by precast fabricator for application:
 - 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100% polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D 2240; minimum tensile strength 2250 psi, ASTM D 412.
 - 2. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D 2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
 - 3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; 80 to 100 Shore, Type A durometer hardness, ASTM D 2240; complying with AASHTO's "AASHTO LRFD Bridge Design Specifications," Division II, Section 18.10.2; or with MIL-C-882E.
 - 4. Frictionless Pads: PTFE, glass-fiber reinforced, bonded to stainless- or mild-steel plate, or random-oriented-fiber-reinforced elastomeric pads; of type required for in-service stress.
 - 5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.8 ACCESSORIES

- A. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install structural precast concrete units.

2.9 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06% by weight of cement when tested according to ASTM C 1218.
- B. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881, of type, grade, and class to suit requirements.

2.10 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
 - 1. Limit use of fly ash to 20% replacement of portland cement by weight and ground granulated blast-furnace slag to 20% of portland cement by weight; metakaolin and silica fume to 10% of portland cement by weight.

- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested according to ASTM C 1218.
- D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45
- E. Water Absorption: For structural precast concrete with an engineered finish, limit water absorption to 6% by weight or 14% by volume, tested according to ASTM C 642, except for boiling requirement.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.11 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and de-tensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
- B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
 - 1. Edge and Corner Treatment: Uniformly chamfered

2.12 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1 and AWS C5.4, "Recommended Practices for Stud Welding."

- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.
- D. Cast-in openings larger than six (6) inches in any dimension. Do not drill or cut openings or prestressing strand without Engineer's approval.
- E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
 - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified in ASTM A 775, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 - 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 - 3. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 - 4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one (1) full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses and specified in-place loads.
- G. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- H. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
- I. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.
- J. Comply with PCI MNL 116 procedures for hot- and cold-weather concrete placement.
- K. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that does not show in finished structure.
- L. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure units until

compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

- M. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Engineer's approval.

2.13 FABRICATION TOLERANCES

- A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 116 product dimension tolerances as well as position tolerances for cast-in items.

2.14 COMMERCIAL FINISHES

- A. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than 1/4 inch in width that occur more than once per 2 sq. in. Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to 1/8 inch.
- B. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.

2.15 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.
 - 1. Allow testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.
- B. Strength of precast structural concrete units is considered deficient if units fail to comply with ACI 318 requirements for concrete strength.
- C. Patching: If core test results are satisfactory and precast structural concrete units comply with requirements, clean and dampen core holes and solidly fill with same precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
- D. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Engineer's approval. Engineer reserves the right to reject precast units that do not match approved samples, sample panels, and

mockups. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting, cast-in-place concrete has attained minimum allowable design compressive strength and until supporting steel or other structure is structurally ready to receive loads from precast concrete units.

3.2 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.
- B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
- C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
- D. Field cutting of precast units is not permitted without approval of Engineer.
- E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.
- F. Welding: Comply with applicable requirements in AWS D1.1 and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
 - 1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.

2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil-thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
 3. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.
- G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
- H. Grouting or Dry-Packing Connections and Joints: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.
1. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces.
 2. Fill joints completely without seepage to other surfaces.
 3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 - 12.
 4. Place grout end cap or dam in voids at ends of hollow-core slabs.
 5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
 6. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Engineer.

3.4 FIELD QUALITY CONTROL

- A. Visually inspect field welds and test according to ASTM E 165 or to ASTM E 709 and ASTM E 1444. High-strength bolted connections are subject to inspections.
- B. Testing agency will report test results promptly and in writing to Contractor and Engineer.
- C. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.
- E. Prepare test and inspection reports.

3.5 REPAIRS

- A. Repair precast structural concrete units if permitted by Engineer.
 - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of twenty (20) feet.
- C. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- D. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Engineer.

3.6 CLEANING

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03 41 00

SECTION 03 41 37 - PRECAST POST-TENSIONED CONCRETE TANKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Precast post-tensioned concrete tanks for biological nutrient removal (BNR) basins.
2. Performance criteria, materials, design, production, and erection of rectangular precast post-tensioned concrete tanks for the entire project. The work performed under this Section includes all labor, material, equipment, related services, and supervision required for the manufacture and erection of the rectangular precast post-tensioned concrete tanks shown on the Contract Drawings.

B. Related Requirements:

1. Section 03 30 00 - Cast-in-Place Concrete for concrete topping and placing connection anchors in concrete.
2. Section 03 41 38 - Precast Post-Tensioned Concrete Tank Base Slabs.
3. Section 05 50 00 - Metal Fabrications for kickers and other miscellaneous steel shapes.
4. Section 46 53 54 - Biological Wastewater Treatment System.
5. Div 31 - Earthwork.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each precast concrete mixture. Include compressive strength and, if required, water-absorption tests.

C. Shop Drawings:

1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.
2. Indicate configuration, thickness, dimensions and details of cast-in-place concrete base slab.
3. Indicate size, spacing and details of all necessary base slab reinforcing.
4. Indicate plan views, elevations, sections, and details necessary to install the tank.
5. Indicate locations of all post-tensioned tendons.
6. Indicate tendon stressing sequence and force, and theoretical elongations for all post-tensioned tendons.

7. Include and locate all pipe penetrations. Indicate all penetration styles.
8. Coordinate and indicate openings required by other trades.
9. Indicate location of each precast concrete member by same identification mark placed on unit.
10. Indicate relationship of structural precast concrete members to adjacent materials.
11. Indicate locations and details of joint treatment.
12. Indicate shim sizes and grout requirements.
13. Indicate bearing pad sizes and materials.

- D. Comprehensive engineering design signed and sealed by a qualified professional engineer responsible for its preparation licensed in the State of South Carolina.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Tank Manufacturer/Supplier and Installer.

1. For Tank Manufacturer/Supplier and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names and addresses, names and addresses of engineers and owners, and other information specified.

- B. Material Certificates: Signed by Manufacturer(s) certifying that each of the following items complies with requirements.

1. Cementitious materials.
2. Aggregates.
3. Reinforcing materials and post-tensioning strands.
4. Admixtures.
5. Bearing pads.
6. Other components specified in Contract Documents with applicable standards.

- C. Welding certificates.

- D. Provide handling procedures, erection sequences, and temporary bracing as required for special conditions.

- E. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Installer Qualifications: A precast concrete erector qualified and designated a PCI-certified plant for Group C, Category C3.

- C. Quality-Control Standard: For manufacturing procedures, testing requirements, and quality-control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code - Steel."
 - 2. AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- E. Post-Tensioning Manufacturer Qualifications: Fabricating plant certified by PTI according to procedures set forth in PTI's "Manual for Certification of Plants Producing Unbonded Single Strand Tendons."
- F. Post-Tensioning Installer Qualifications: A qualified installer whose full-time Project superintendent has successfully completed PTI's Level 1 Unbonded PT - Field Installation course.
 - 1. Superintendent must receive training from post-tensioning supplier in the operation of stressing equipment to be used on Project.
- G. Post-Tensioning Inspector Qualifications: Personnel performing field inspections and measuring elongations shall have successfully completed PTI's Level 2 Unbonded PT - Inspector course.
- H. Design Standards: Comply with ACI 350, "Code Requirements for Environmental Concrete Structures" and the design recommendations of PCI MNL 120, "PCI Design Handbook – Precast and Prestressed Concrete," applicable to types of structural precast concrete members indicated.
- I. Quality-Control Standard: For manufacturing procedures and testing requirements and quality control recommendations for types of members required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Concrete Products."

1.6 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.
- B. Preinstallation Conference: Conduct conference at construction trailer provided by Contractor to comply with requirements in Section 01 31 00 - Project Management and Coordination.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Support units during shipment on non-staining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
 2. Place adequate dunnage of even thickness between each unit.
 3. Place stored units so identification marks are clearly visible, and units can be inspected.
- C. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.
- D. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Precast post-tensioned concrete tanks shall be manufactured by:
1. Dutchland.
 - a. Specifications and equipment arrangements for the equipment referenced are based on Dutchland. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

2.2 FORM MATERIALS

- A. Forms: Rigid, dimensionally stable, nonabsorptive material, warp and buckle free, that will provide precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required surface finishes.
1. Form-Release Agent: Commercially produced form-release agent that will not bond with, stain or affect hardening of precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

2.3 NON-PRESTRESSED REINFORCING STEEL

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.
- C. Welded Wire Reinforcement: ASTM A 1064, plain or deformed, flat sheet.
- D. Supports: Use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.4 BONDED PRESTRESSING TENDONS

- A. Bonded Prestressing Strand: ASTM A 416, Grade 270, 7-wire, low-relaxation, 0.6-inch-diameter strand.
- B. Anchorage Device and Coupler Assembly: Assembly of strand, wedges, and anchorage device or coupler complying with static and fatigue testing requirements and capable of developing 95 percent of actual breaking strength of strand.

2.5 UNBONDED PRESTRESSING TENDONS

- A. ACI Publications: Comply with ACI 423.7, "Specification for Unbonded Single Strand Tendon Materials and Commentary."
- B. Prestressing Strand: ASTM A 416, Grade 270, 7-wire, low-relaxation, 0.6-inch-diameter strand with corrosion inhibitor conforming to ACI 423.7, with polypropylene tendon sheathing.
- C. Post-Tensioning Coating: Compound with friction-reducing, moisture-displacing, and corrosion-inhibiting properties; chemically stable and nonreactive with prestressing steel, nonprestressed reinforcement, sheathing material, and concrete.
- D. Tendon Sheathing:
 - 1. Virgin high-density polyethylene or polypropylene with a minimum thickness of 50 mils.
 - 2. Continuous over the length of tendon to provide watertight encapsulation of strand.
- E. Anchorage Device and Coupler Assembly: Assembly of strand, wedges, and anchorage device or coupler complying with static and fatigue testing requirements and capable of developing 95 percent of actual breaking strength of strand.
 - 1. Anchorage devices and coupler assemblies shall be fully encapsulated with either plastic or epoxy coating.
- F. Encapsulation System: Watertight encapsulation of prestressing strand consisting of the following:
 - 1. Wedge-Cavity Caps: Attached to anchorages with a positive mechanical connection and filled with post-tensioning coating.
 - 2. Sleeves: Attached to anchorage device with positive mechanical connection; overlapped a minimum of 4 inches with sheathing and filled with post-tensioning coating.
 - 3. The encapsulation system shall meet the hydrostatic pressure testing requirements of ACI 423.7, except with a hydrostatic pressure of 10 psi, instead of the specified 1.25 psi.

2.6 CONCRETE MATERIALS

- A. Hydraulic Cement:
 - 1. Portland Cement: ASTM C 150, Type II or Type I/II.

2. Blended Cement: ASTM C 595 with (MS) designation for moderate sulfate resistance, excluding Type IS ≥ 70). Blended cements that include ASTM C 1157 cements shall not be permitted.
 3. Concrete mixtures shall include either fly ash or slag as shown below, but within the limits stipulated in 2.12.A, unless the proposed combination of cementitious materials has been tested in accordance with ASTM C 1012 and resulted in expansion of not more than 0.10 percent at 6 months.
 - a. At least 15 percent fly ash replacement by mass, or
 - b. At least 50 percent slag replacement by mass.
 4. Different types of cement shall not be mixed or used alternately without specific written approval by the Precast Tank Engineer. Different brands of cement may be used when authorized in writing by the Precast Tank Engineer. A resubmittal will be required if different brands are proposed during the Project.
- B. Supplementary Cementitious Materials:
1. Fly Ash: ASTM C 618, Class F with alkali content (%Na₂O_{eq}) less than 3.0%.
 2. Slag: ASTM C 989, Grade 100 or 120, ground granulated blast furnace slag.
 3. Silica Fume: ASTM C 1240.
- C. Fine and Coarse Aggregates: ASTM C33, 3/4-inch maximum size.
1. All aggregates shall be evaluated in accordance with ASTM C 1778 for potential alkali-silica reactivity (ASR). All aggregates shall be considered reactive unless they have been examined in accordance with ASTM C 295 and found to be non-reactive.
 2. Concrete mixtures using potentially reactive aggregates, except as permitted by 2.3.C.c, shall include either fly ash or slag as shown below, but within the limits stipulated in 2.4.C.
 - a. At least 25 percent fly ash replacement by mass where Portland cement alkali content is less than 1.00%, or at least 35 percent fly ash replacement by mass where Portland cement alkali content is 1.00 to 1.25%, or
 - b. At least 50 percent slag replacement by mass where Portland cement alkali content is less than 1.00%, or at least 65 percent slag replacement by mass where Portland cement alkali content is 1.00% to 1.25%.
 - c. Portland cement alkali loading shall not exceed 3.0 lb/yd³ (LBA). Alkali loading shall be calculated as shown below:
 - 1) $LBA = \text{Portland cement content (lbs)} \times \text{alkali content (\% Na}_2\text{O}_{eq}) / 100$.
 3. Aggregates meeting the requirements below may be considered non-reactive.
 - a. ASTM C 1260, Potential Alkali Reactivity of Aggregates (Mortar-Bar Method). Average expansion of less than 0.10 percent at 16 days after casting.
 - b. ASTM C 1567, Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregates (Accelerated Mortar-Bar Method). Average expansion of less than 0.10 percent at 16 days after casting.
 4. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
- D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.

- E. Air Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride or more than 0.15 percent chloride ions or other salts by weight of admixture.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. Water-Reducing and Accelerating Admixture ASTM C494/C 494M, Type E.
 - 5. High Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type A and F.
 - 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 7. Plasticizing Admixture for Flowable Concrete: ASTM C 1017/C 1017M.

2.7 STEEL EMBEDDED MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M
- B. Carbon-Steel Headed Studs: ASTM A 108, Grades 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with the minimum mechanical properties of PCI MNL 116, Table 3.2.3.
- C. Deformed-Steel Wire or Bar Anchors: ASTM A 1064 or ASTM A 706.
- D. Zinc-Coated Finish: For exterior steel items and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123, after fabrication.
 - 1. Galvanizing Repair Paint: Zinc paint with dry film containing not less than 94 percent zinc dust by weight and complying with DOD-P-21035B or SSPC-Paint 20.

2.8 STAINLESS-STEEL EMBEDDED MATERIALS

- A. Stainless-Steel Plate: ASTM A 666, Type 304, Type 316, or Type 201, of grade suitable for application.
- B. Stainless-Steel Bolts and Studs: ASTM F 593, alloy 304 or 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless-steel washers.
- C. Stainless-Steel Headed Studs: ASTM A 276, with minimum mechanical properties for studs as indicated under MNL 116, Table 3.2.3.

2.9 BEARING PADS AND OTHER ACCESSORIES

- A. Provide one of the following bearing pads for structural precast concrete members as recommended by tank supplier for application:
 - 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore A

- durometer according to ASTM D 2240, minimum tensile strength 2250 psi per ASTM D 412.
 - 2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer according to ASTM D2240. Capable of supporting a compressive stress of 3000 psi with no cracking, splitting or delaminating in the internal portions of the pad.
 - 3. High-Density Plastic: Multimonomer, nonleaching, plastic strip capable of supporting loads with no visible overall expansion.
- B. Erection Accessories: Provide steel plates and brackets, clips, hangers, high density plastic shims, and other accessories required to install precast concrete members.

2.10 GROUT MATERIALS

- A. Grout for Bonded Tendons: Provide cement grout for bonded tendons as indicated below:
- 1. Maximum Water-Cementitious Materials Ratio: 0.43
 - 2. Limit use of fly ash to 15 percent replacement of portland cement by weight.
 - 3. Limit use of slag to 20 percent replacement of portland cement by weight.
 - 4. Add High-Range, Water-Reducing admixture on-site as necessary for placement.
 - 5. Provide admixtures to prevent bleeding and grout settlement. Material shall be added to the mix on-site.
 - a. Acceptable Products: Sika Intraplast-N®, or equal.
 - 6. Grout shall not contain water-soluble chloride ions in excess of 0.06 percent by weight of cementitious materials.
- B. Nonshrink Grout: Premixed, prepackaged, non-metallic, shrink-resistant grout complying with ASTM C 1107, Grade C. Grout shall not contain chlorides.
- 1. Acceptable Products:
 - a. SikaGrout 212, or equal.
 - b. SikaGrout 328, or equal.

2.11 PATCHING MATERIALS

- A. One-component, polymer-modified, premixed patching material containing selected silica aggregates and portland cement, suitable for vertical and overhead applications. Do not use material containing chlorides or other chemicals known to be deleterious to prestressing steel or material that is reactive with prestressing steel, anchorage device material, or concrete.
- 1. Acceptable Products:
 - a. ProSpec® BlendCrete, or equal.

2.12 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of concrete required.

1. The inclusion of either fly ash or slag in the concrete mix is mandatory.
 2. Where fly ash is used:
 - a. The minimum fly ash content shall be 15 percent replacement of cementitious material by weight, and the maximum content shall be 35%.
 - b. Additional fly ash shall not be included in concrete mixed with Type IS or IP cement.
 3. Where slag is used:
 - a. The minimum slag content shall be 15 percent replacement of cementitious material by weight, and the maximum content shall be 65%.
 - b. Additional slag shall not be included in concrete mixed with Type IS or IP cement.
 4. The inclusion of both fly ash and slag shall not be permitted without specific written approval by the Precast Tank Engineer.
 5. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 350 when tested in accordance with ASTM C 1218.
 6. Limit use of silica fume to 10 percent replacement of Portland cement by weight.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at Tank Supplier's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 350 or PCI MNL 116 when tested in accordance with ASTM C 1218/C 1218M.
- D. Normal-weight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete.
- E. Furnish precast concrete as indicated below:
1. Compressive Strength (28 Days): 5,000 psi minimum.
 2. Maximum Water-Cementitious Materials Ratio: 0.40.
 3. Slump Flow: 24 inches, ± 4 inches
 4. Minimum cementitious content: 610 pounds per cubic yard
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 6%, $\pm 1\text{--}1\frac{1}{2}\%$.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- H. Concrete Mixture Adjustments: Concrete mixture design adjustments may be made if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.13 FORM FABRICATION

- A. Form: Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete placement and vibration operations and temperature changes, and for prestressing and detensioning operations. Coat contact surfaces of forms with release agent

before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

- B. Maintain forms to provide completed structural precast concrete members of shapes, lines, and dimensions within fabrication tolerances specified.

- 1. Edge and Corner Treatment: Uniformly chamfered or as built-in on standard forms.

2.14 FABRICATION

- A. Cast-in Plates, Inserts, Angles, and Other Hardware: Fabricate hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware and secure in place during precasting operations. Locate hardware where it does not affect position of main reinforcement or concrete placement.

- 1. Weld headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

- B. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.

- 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy coated reinforcing exceeds limits specified in ASTM A 775, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 - 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Locate and support reinforcement by plastic tipped or corrosion resistant metal or plastic chairs, runners, bolsters, spacers, hangers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.
 - 3. Provide cover requirements in accordance with ACI 350. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete.
 - 4. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces in accordance with ACI 350 and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

- C. Reinforce structural precast concrete members to resist handling, transportation, and erection stresses, and specified in-place loads, whichever governs.

- D. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

- E. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete members.

- F. Place self-consolidating concrete with minimal vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.

- G. Comply with PCI MNL 116 procedures for hot and cold-weather concrete placement.

- H. Identify pickup points of precast concrete members and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast concrete member on a surface that will not show in finished structure.
- I. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure members until compressive strength is high enough to ensure that stripping does not have an effect on the performance of final product.

2.15 WATERSTOPS

- A. Flexible PVC Waterstops: Corp of Engineers CRD-C 572 for embedding in concrete construction joints to prevent the passage of fluids through joints. Factory-fabricate corners, intersections and directional changes.
 - 1. Profile: Ribbed without center bulb.
 - 2. Dimensions: 9 inches by 3/8-inch-thick, non-tapered.
 - 3. Acceptable Products:
 - a. Greenstreak PVC Waterstop #646, or equal.
- B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free, hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete.
 - 1. Acceptable Products:
 - a. Greenstreak Hydrotite CJ-1030-4M, or equal.
- C. Self-Expanding Extrudable Waterstops: Extrudable, swelling, bentonite-free, one-part polyurethane.
 - 1. Acceptable Products:
 - a. SikaSwell S-2, or equal

2.16 RELATED MATERIALS

- A. Joint/Crack Filler: ASTM C 920, Type S, Grade NS, Class 35 one-part polyurethane, elastomeric sealant, for sealing precast panel joints and minor cracks.
 - 1. Acceptable Products:
 - a. Sikaflex®-1a, or equal
- B. Sealant/Adhesive Primer: Specially formulated primer to promote adhesion of sealants and adhesives to concrete.
 - 1. Acceptable Products:
 - a. Sikaflex® 429/202, or equal

- C. Joint Sealant, Epoxy: High-build, two-part, protective, solvent-free epoxy.
 - 1. Acceptable Products:
 - a. Sikagard® 62, or equal
- D. Joint Sealant, Urethane: Liquid-applied, elastomeric, urethane.
 - 1. Acceptable Products:
 - a. CIM 1000, or equal
- E. Epoxy Injection Adhesive: Two-part, moisture-tolerant, epoxy injection adhesive.
 - 1. Acceptable Products:
 - a. Sikadur® 52, or equal
- F. Chemical Grout: Expanding, polyurethane, chemical grout.
 - 1. Acceptable Products:
 - a. SikaFix® HH+, or equal
 - b. SikaFix® HH Hydrophilic, or equal

2.17 FABRICATION TOLERANCES

- A. Fabricate structural precast concrete members of shapes, lines and dimensions indicated, so each finished member complies with PCI MNL 135 product tolerances as well as position tolerances for cast-in items.

2.18 FINISHES

- A. Form Finish:
 - 1. Standard Grade: Normal plant-run finish produced in forms that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are acceptable. Fill air holes greater than 1/4 inch in width that occur in high concentration (more than one per 2 square inches). Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Allowable joint offset limited to 1/8 inch.
- B. Smooth steel-trowel finish unformed surfaces. Consolidate concrete, bring to proper level with straightedge, float and trowel to a smooth, uniform finish.

2.19 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 116 requirements. If using self-consolidating concrete also test and inspect according to ASTM C 1610, ASTM 1611, and ASTM C 1621.

- B. Strength of precast concrete members will be considered deficient if units fail to comply with ACI 350 concrete strength requirements.
- C. Testing: If there is evidence that strength of precast concrete members may be deficient or may not comply with ACI 350 requirements, fabricator shall employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42 and ACI 350.
 - 1. Test results shall be reported in writing on the same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports shall include the following:
 - a. Project identification name and number.
 - b. Date when tests were performed.
 - c. Name of Tank Supplier.
 - d. Name of concrete testing agency.
 - e. Identification letter, name, and type of precast concrete member(s) represented by core tests; design compressive strength; type of failure; actual compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- D. Patching: If core test results are satisfactory and precast concrete members comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture or repair material, and finish to match adjacent precast concrete surfaces.
- E. Acceptability. Structural precast concrete members that do not comply with acceptability requirements in PCI MNL 116, including concrete strength, and manufacturing tolerances, are unacceptable. Chipped, spalled or cracked members may be repaired. Replace unacceptable units with precast concrete members that comply with requirements.

2.20 DRILLING

- A. Drilling on walls and walkways of post-tensioned concrete tanks shall conform to the following requirements:
 - 1. Walls: Up to 4" embedment allowed everywhere with the exception of within 3" of a tendon and at tendon anchorage locations. Contractor shall refer to the erection drawings for locations and details.
 - 2. Walkways: Up to 4 1/4" embedment allowed everywhere with the exception of reinforcement and tendon anchorage locations. Contractor shall refer to the erection drawings for locations and details.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General Contractor shall prepare subgrade in accordance with Div 31 - Earthwork.

3.2 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting, cast-in-place concrete has attained minimum allowable design compressive strength and until supporting steel or other structure is structurally ready to receive loads from precast concrete units.
- D. Owner's Geotechnical Engineer shall inspect and approve the subgrade supporting the tank.
- E. Unsatisfactory conditions shall be corrected to the satisfaction of the Owner's Geotechnical Engineer.
- F. General Contractor shall notify Tank Supplier in writing that supporting subgrade has been approved by the Owner's Geotechnical Engineer.
- G. Proceed with base slab construction only after unsatisfactory conditions have been corrected.
- H. The stone sub-base shall be prepared, leveled, and graded to within $\pm$ one inch of stone grade, as indicated on the approved Tank Supplier's Shop (Erection) drawings.
- I. Excavation shall include a minimum of four feet in plan beyond the perimeter of the approved exterior wall line.
- J. Site access roads:
 - 1. Shall be provided and maintained by the General Contractor throughout the installation of the base slab and precast tank structure.
 - 2. Shall be cleared, leveled, stoned, and free of mud to provide 14-feet of vertical clearance and 14-feet of horizontal clearance.
 - 3. Shall be capable of handling 80,000 pounds GVWR.
 - 4. Shall support live loaded trucks operating under their own power.
 - 5. Shall allow drop-deck, spread axle combinations with 53-ft trailers. This includes a 60-foot-long sweep radius for corners and egress/regress to roadways.
- K. Crane and concrete pump pads:
 - 1. Shall be provided and maintained by the General Contractor.
 - 2. Shall be cleared, leveled, stoned, and free of mud.
 - 3. Tank Supplier shall communicate the required locations and sizes of the pads with the General Contractor.

3.3 CAST-IN-PLACE CONCRETE BASE SLAB

- A. Install the base slab in accordance with Section 03 41 38 - Precast Post-Tensioned Concrete Tank Base Slabs.

3.4 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.
- B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
- C. Install post-tensioning tendons as soon as practical.
- D. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
- E. Field cutting of precast units is not permitted without approval of tank Manufacturer or Engineer.
- F. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.
- G. Welding: Comply with applicable requirements in AWS D1.1 and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
 - 1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
 - 2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil-thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
 - 3. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.
- H. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
 - 1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
- I. Grouting or Dry-Packing Connections and Joints: Indicate joints to be grouted and any critical grouting sequences on Shop (Erection) Drawings. Grout open spaces at keyways, connections and joints where required or indicated with non-shrink, non-metallic grout. Retain flowable grout in place until it gains sufficient strength to support itself. Fill joints completely without

seepage to other surfaces. Alternatively, pack spaces with stiff dry pack grout material, tamping until voids are filled. Promptly remove grout material from exposed surfaces before it hardens.

1. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces.
2. Fill joints completely without seepage to other surfaces.
3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 - 12.
4. Place grout end cap or dam in voids at ends of hollow-core slabs.
5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
6. Keep grouted joints damp for not less than 24 hours after initial set.

3.5 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by tank Manufacturer and Engineer.

3.6 TENDON INSTALLATION

- A. Inspect prestressing strand for damage before installing tendons.
- B. Inspect sheathing for damage before installing tendons. Repair damaged areas by restoring post-tensioning coating and repairing or replacing tendon sheathing.
 1. Ensure that sheathing is watertight and there are no air voids.
 2. Follow tape repair procedures in PTI's "Field Procedures Manual for Unbonded Single Strand Tendons."
- C. Immediately remove and replace tendons that have damaged strand.

3.7 TENDON STRESSING

- A. Stressing jacks and gauges shall be individually identified and calibrated to known standards at intervals not exceeding six months. Exercise care in handling stressing equipment to ensure that proper calibration is maintained.
- B. Stress tendons only under supervision of a qualified post-tensioning superintendent.
- C. Tendon stressing shall not begin until grout strength in the joints has attained at least 2,500 psi compressive strength.
- D. Tendon stressing shall be performed in the sequence indicated on the Shop (Erection) Drawings.
- E. Mark and measure elongations according to PTI's "Field Procedures Manual for Unbonded Single Strand Tendons." Measure elongations to closest 1/8-inch.

- F. Tendon elongations shall be recorded and compared to the theoretical elongations indicated on the Shop (Erection) Drawings. Prestressing will be considered acceptable if gage pressures shown on stressing record correspond to required stressing force and theoretical and measured elongations agree.
- G. In the event that measured elongations exceed the tolerances indicated on the Shop (Erection) Drawings, the Precast Tank Engineer shall be notified for resolution.

3.8 TENDON FINISHING

- A. Strand tails may be cut once prestressing has been deemed acceptable.
- B. Do not cut strand tails or cover anchorages of tendons where elongations exceed tolerances until all discrepancies have been resolved to the satisfaction of the Precast Tank Engineer.
- C. Cut strand tails as soon as possible after approval of elongations.
- D. The tendon tails shall be cut using hydraulic shears.
- E. The strand length protruding beyond the wedges after cutting of the tendon tail shall be between 0.5-inch and 0.75-inch.
- F. Wedge-cavity caps shall be installed within one working day after cutting tendon tails.
- G. Patch stressing pockets within one day of cutting strand tail. Clean inside surface of pocket to remove laitance or post-tensioning coating before installing patch material. Finish patch material flush with adjacent concrete.
- H. If stressing pockets are not able to be filled within ten days after tendon tail cutting, then temporary protection shall be provided.

3.9 GROUTING OF BONDED TENDONS

- A. Execute grouting within 10 days after approval of tendon elongations. If grouting will not be performed within this time period, provide weather protection for the jacking access pockets.
- B. Pump grout through ports into the ducts under pressure.
- C. Temperature of concrete walls at time of grouting shall be above 35 °F and shall be maintained above 35 °F until field-cured 2-inch grout cubes reach a minimum of 800 psi.
- D. Grout temperatures shall not be above 90° F during mixing and pumping.
- E. Patch jacking access pockets.

3.10 FIELD QUALITY CONTROL

- A. Visually inspect field welds and test according to ASTM E 165 or to ASTM E 709 and ASTM E 1444. High-strength bolted connections are subject to inspections.

- B. Testing agency will report test results promptly and in writing to Contractor and Engineer.
- C. Place no concrete for the base slab until the subgrade has been inspected and approved by the Owner's Geotechnical Engineer.
- D. Testing: Owner will engage accredited independent testing and inspecting agency to perform field tests and prepare reports.
 - 1. Testing agency will report test results promptly and in writing to Contractor, Engineer of Record and Tank Supplier.
- E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- F. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.
- G. Prepare test and inspection reports.

3.11 PROTECTION OF PRESTRESSED REINFORCEMENT

- A. Do not expose tendons to electric ground currents, welding sparks, or temperatures that would degrade components.
- B. Prevent water from entering tendons during installation and stressing.
- C. Provide weather protection to stressing-end anchorages if strand tails are not cut within 10 days of stressing the tendons.

3.12 REPAIRS

- A. Repair precast structural concrete units if permitted by Engineer.
 - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.
- B. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- C. Repair base slab shrinkage cracks as required for watertightness. Rout a ¼-inch vee-notch along the crack and fill the crack with epoxy injection adhesive.
- D. Surface chips or spalls shall be cleaned and then patched with patching material.
- E. Misaligned grout ports or connection ports in walkways may be repaired by either enlarging the existing port, or drilling a new one, as required. Coordinate with the Precast Tank Engineer to avoid internal reinforcing and hardware.
- F. Damage that occurs during the shipping, installation or construction process shall be brought to the attention of the tank Manufacturer and Engineer for resolution.

- G. Additional repairs, if necessary, shall be performed as directed by the Precast Tank Engineer.
- H. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of twenty (20) feet.
- I. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- J. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Engineer.

3.13 CLEANING

- A. Clean grout, mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

3.14 TIGHTNESS TESTING

- A. Each cell of multi-cell tanks shall be considered a single containment structure and shall be tested individually, unless otherwise specified.
- B. The General Contractor shall commence tightness testing within five business days of notification that the structure is ready for testing.
- C. Testing shall be performed using the hydrostatic tightness test, which consists of two parts. Part 2 may be waived if approved by the Project Engineer-of-Record.
 - 1. Part 1 shall be a qualitative criterion.
 - 2. Part 2 shall be a quantitative criterion expressed as a maximum allowable volume loss of 0.05 percent per 24-hour period.
- D. No backfill may be placed against the walls or on the wall footings of the containment structures to be tested, unless otherwise specified.
- E. The initial filling of a new containment structure shall not exceed four feet per hour. Filling shall be continued until the water surface is at the design maximum liquid level, or either one inch below any fixed overflow level in covered containment structures or four inches in open containment structures, whichever is lower.

- F. Water for the initial filling shall be provided by the General Contractor. Use potable water unless otherwise specified.
- G. Part 1 – Qualitative Criteria:
1. If any water is observed on the containment structure exterior wall surfaces where moisture can be picked up on a dry hand, the containment structure shall be considered to have failed Part 1 of the hydrostatic test.
 2. Wet areas on top of the wall footing shall not be cause to fail Part 1 unless the water can be observed to be flowing.
 3. Although Part 2 of the test may begin prior to completion of repairs for Part 1, all defects causing the failure of Part 1 shall be repaired before acceptance of the containment structure.
 4. The standard repair procedure for areas failing Part 1 is to inject chemical grout into the affected area. Consult with the Precast Tank Engineer before commencing any such repairs.
- H. Part 2 – Quantitative Criteria:
1. Part 2 of the hydrostatic tightness test shall not be scheduled for a period when the forecast is for a difference of more than 35°F between the ambient temperature readings at the times of the initial and final level measurements of the water surface. The test shall also not be scheduled when the weather forecast indicates the water surface could freeze before the test is completed.
 2. The vertical distance to the water surface shall be measured to within 1/16 inch from a fixed point on the containment structure above the water surface. The initial measurement shall not be taken until at least 24 hours after the tank is completely filled. Measurements shall be recorded at 24-hour intervals.
 3. The test period shall be the theoretical time required to lower the water surface 3/8 inch, assuming a loss of water at the maximum allowable rate. However, the test period shall not be longer than five days.
 4. In uncovered containment structures, evaporation and precipitation shall be measured.
 5. At the end of the test period, the water surface shall be recorded to within 1/16 inch at the location of the original measurements. The water temperature and precipitation measurements shall be recorded.
 6. The change in water volume in the containment structure shall be calculated and corrected, if necessary, for evaporation, precipitation, and temperature. If the loss exceeds the required criterion, the containment shall be considered to have failed Part 2 of the test.
- I. Retesting:
1. A restart of the test shall be required when test measurements become unreliable due to unusual precipitation or other external factors.
 2. It shall be permitted to immediately retest a containment structure failing Part 2 of the hydrostatic test when Part 1 is passed. If the containment structure fails the second test or if not immediately retested after the first test failure, the interior of the containment structure shall be observed for probable problem areas by the Tank Supplier. The containment structure shall only be retested after the probable problem areas are repaired.
 3. Containment structures shall be retested until they meet the required Part 1 and Part 2 criteria. Repairs shall be made before each retest.

- J. The containment structure shall be deemed substantially complete upon successful completion of tightness testing. All final payments, including retainage, for all structural elements related to the precast, post-tensioned concrete tank, including the foundation system and cast-in-place base slab, shall be made at this time. This clause supersedes any conflicting clauses in the contract documents.

3.15 SPECIAL WARRANTY

- A. The Tank Supplier shall provide a two-year structural warranty to the Owner. The warranty shall at minimum include the following items:
1. The Tank Supplier shall provide a corporate guarantee not covered by any form of insurance or bond as a warranty for the precast post-tensioned concrete tank that warrants the tank is free from structural defect due to faulty design, workmanship, or structural materials.
 2. The Tank Supplier shall warrant the structural aspects of the tank for a period of two years from the substantial completion date of the precast post-tensioned concrete tank.
 3. The Owner must report in a timely manner any claim to the warranty in writing to the tank manufacturer within the effective coverage dates of the warranty.
 4. The Tank Supplier shall furnish, without charge to the Owner, all necessary labor and materials required to repair all structural defects subject to this warranty with a maximum cost of repair not exceeding the Tank Supplier's contract value of the tank and under the condition that the Tank Supplier has been paid in full for the project.
- B. Specific Exclusions from Warranty:
1. Maintenance items (sealants, coatings, equipment, plumbing, etc.), all non-structural items.
 2. Consequential damages, punitive damages, incidental costs, bodily injury, death, and damage to the property other than the tank.
 3. Emptying of tanks, inspection of tanks, processing of the water/wastewater, drying or cleaning of the tanks, filling of tanks, etc. complete in preparation for, and completion of repairs.
 4. Defects or issues caused by accident, abuse, misuse, storage or processing of corrosive liquids, improper maintenance, negligence, modifications, additions, or deletions not made by tank manufacturer, improper or defective application, acts of God, force majeure, untimely action by Owner to minimize damage or losses, unstable or improperly designed or constructed soil/subgrade, or defects caused by work supplied by any party other than the Tank Supplier.
 5. A loss or defect that is covered by insurance.
- C. All materials and labor for work performed by the Tank Supplier which is not covered under the standard two-year limited structural warranty shall be warranted for a period of one (1) year from substantial completion of the tank per the Contract Documents.

3.16 BACKFILL

- A. General Contractor shall place and compact backfill in accordance with Div 31 - Earthwork.

- B. Do not commence backfilling around the tank until the tank has been examined and approved by the Engineer of Record.
- C. The General Contractor shall be responsible to protect the tank from damage by construction activity, equipment and vehicles. Damaged structures shall be repaired or replaced to the satisfaction of the Tank Supplier.
- D. When backfilling against the tank, place backfill material in equal lifts and to similar elevations on opposite sides of structures in order to equalize opposing horizontal pressures, except where required for final grading.
- E. The excavation shall be kept free of water by the General Contractor at all times.

END OF SECTION 03 41 37

SECTION 03 41 38 - PRECAST POST-TENSIONED CONCRETE TANK BASE SLABS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Precast post-tensioned concrete tank base slabs for biological nutrient removal (BNR) basins.
2. This Section includes form materials, reinforcement, accessories, cast-in-place concrete, and slab finishing and curing for the base slabs of the precast post-tensioned concrete tanks for the entire project. The work performed under this Section includes all labor, material, equipment, related services, and supervision required for the mixing, placing and finishing of cast-in-place concrete.

B. Related Requirements:

1. Section 03 30 00 - Cast-in-Place Concrete for concrete topping and placing connection anchors in concrete.
2. Section 03 41 37 – Precast Post-Tensioned Concrete Tanks.
3. Section 05 50 00 - Metal Fabrications for kickers and other miscellaneous steel shapes.
4. Section 46 53 54 - Biological Wastewater Treatment System.
5. Div 31 - Earthwork.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Material test reports shall show compliance with the required standards and be less than one year old.
- B. Design Mixtures: For each concrete mixture. Include minimum required compressive strength and field experience records or trial mix data.
- C. Shop Drawings:
 1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.
 2. Indicate configuration, thickness, dimensions and details of cast-in-place concrete base slab.
 3. Indicate size, spacing and details of all necessary base slab reinforcing.
 4. Indicate plan views, elevations, sections, and details necessary to install the tank.
 5. Indicate locations of all post-tensioned tendons.

6. Indicate tendon stressing sequence and force, and theoretical elongations for all post-tensioned tendons.
 7. Include and locate all pipe penetrations. Indicate all penetration styles.
 8. Coordinate and indicate openings required by other trades.
 9. Indicate location of each precast concrete member by same identification mark placed on unit.
 10. Indicate relationship of structural precast concrete members to adjacent materials.
 11. Indicate locations and details of joint treatment.
 12. Indicate shim sizes and grout requirements.
 13. Indicate bearing pad sizes and materials.
- D. Comprehensive engineering design signed and sealed by a qualified professional engineer responsible for its preparation licensed in the State of South Carolina.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Tank Manufacturer/Supplier and Installer.
1. For Tank Manufacturer/Supplier and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names and addresses, names and addresses of engineers and owners, and other information specified.
- B. Material Certificates: Signed by Manufacturer(s) certifying that each of the following items complies with requirements.
1. Cementitious materials.
 2. Aggregates.
 3. Reinforcing materials and post-tensioning strands.
 4. Admixtures.
 5. Bearing pads.
 6. Other components specified in Contract Documents with applicable standards.
- C. Welding certificates.
- D. Provide handling procedures, erection sequences, and temporary bracing as required for special conditions.
- E. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Construct and erect concrete formwork and accessories in accordance with ACI 301, ACI 347 and ACI 350.
- B. Perform concrete reinforcing work in accordance with ACI 301 and ACI 350.
- C. Perform cast-in-place concrete work in accordance with ACI 301 and ACI 350.
- D. Conform to ACI 305R when concreting during hot weather.

E. Conform to ACI 306R when concreting during cold weather.

F. Referenced Standards:

1. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials"
2. ACI 301, "Specifications for Structural Concrete"
3. ACI 305R, "Guide to Hot Weather Concreting"
4. ACI 306R, "Guide to Cold Weather Concreting"
5. ACI 350, "Code Requirements for Environmental Engineering Concrete Structures"
6. ACI 350.5, "Specifications for Environmental Concrete Structures"
7. ASTM A 615, "Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement"
8. ASTM A 775, "Standard Specification for Epoxy-Coated Steel Reinforcing Bars"
9. ASTM A 934, "Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars"
10. ASTM A 1064, "Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete"
11. ASTM C 31, "Standard Practice for Making and Curing Concrete Test Specimens in the Field"
12. ASTM C 33, "Standard Specification for Concrete Aggregates"
13. ASTM C 39, "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens"
14. ASTM C 94, "Standard Specification for Ready-Mixed Concrete"
15. ASTM C 143, "Standard Test Method for Slump of Hydraulic-Cement Concrete"
16. ASTM C 150, "Standard Specification for Portland Cement"
17. ASTM C 172, "Standard Practice for Sampling Freshly Mixed Concrete"
18. ASTM C 231, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method"
19. ASTM C 260, "Standard Specification for Air-Entraining Admixtures for Concrete"
20. ASTM C 295, "Standard Guide for Petrographic Examination of Aggregates for Concrete"
21. ASTM C 494, "Standard Specification for Chemical Admixtures for Concrete"
22. ASTM C 595, "Standard Specification for Blended Hydraulic Cements"
23. ASTM C 618, "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete"
24. ASTM C 881, "Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete"
25. ASTM C 920, "Standard Specification for Elastomeric Joint Sealants"
26. ASTM C 989, "Standard Specification for Slag Cement for Use in Concrete and Mortars"
27. ASTM C 1012, "Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution"
28. ASTM C 1067, "Standard Practice for Conducting a Ruggedness Evaluation or Screening Program for Test Methods for Construction Materials"
29. ASTM C 1116, "Standard Specification for Fiber-Reinforced Concrete"
30. ASTM C 1157, "Standard Performance Specification for Hydraulic Cement"
31. ASTM C 1218, "Standard Test Method for Water-Soluble Chloride in Mortar and Concrete"
32. ASTM C 1260, "Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)"

33. ASTM C 1567, "Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
34. ASTM C 1778, "Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete"
35. ASTM D 4397, "Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications"
36. CRSI, "Manual of Standard Practice"

1.6 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.
- B. Preinstallation Conference: Conduct conference at construction trailer provided by Contractor to comply with requirements in Section 01 31 00 - Project Management and Coordination.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Support units during shipment on non-staining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
 2. Place adequate dunnage of even thickness between each unit.
 3. Place stored units so identification marks are clearly visible, and units can be inspected.
- C. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.
- D. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Precast post-tensioned concrete tank base slabs shall be supplied by:
 1. Dutchland
 - a. Specifications and equipment arrangements for the equipment referenced are based on Dutchland. Changes to the arrangement indicated in the specifications and in

the plan set shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

2.2 FORM MATERIALS AND ACCESSORIES

- A. Form Materials: At discretion of tank Manufacturer.
- B. Formed Construction Joints: Keyed joints as indicated on the tank Shop (Erection) drawings provided by the Tank Supplier. Provide holes in formwork to receive reinforcing across the joint.
- C. Vapor Retarder: ASTM D 4397, 6 mil thick, clear polyethylene film.

2.3 NON-PRESTRESSED REINFORCING STEEL

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Welded Wire Reinforcement: ASTM A 1064, plain or deformed, flat sheet.
- C. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for support of reinforcing.
- D. Fabricate concrete reinforcement in accordance with ACI 301, ACI 350 and CRSI Manual of Standard Practice.

2.4 CONCRETE MATERIALS

- A. Hydraulic Cement:
 - 1. Portland Cement: ASTM C 150, Type II or Type I/II.
 - 2. Blended Cement: ASTM C 595 with (MS) designation for moderate sulfate resistance, excluding Type IS ≥ 70). Blended cements that include ASTM C 1157 cements shall not be permitted.
 - 3. Concrete mixtures shall include either fly ash or slag as shown below, but within the limits stipulated in 2.4.C, unless the proposed combination of cementitious materials has been tested in accordance with ASTM C 1012 and resulted in expansion of not more than 0.10 percent at 6 months.
 - a. At least 15 percent fly ash replacement by mass, or
 - b. At least 50 percent slag replacement by mass.
 - 4. Different types of cement shall not be mixed or used alternately without specific written approval by the Precast Tank Engineer. Different brands of cement may be used when authorized in writing by the Precast Tank Engineer. A resubmittal will be required if different brands are proposed during the Project.
- B. Supplementary Cementitious Materials:
 - 1. Fly Ash: ASTM C 618, Class F with alkali content (%Na₂Oeq) less than 3.0%.
 - 2. Slag: ASTM C 989, Grade 100 or 120, ground granulated blast furnace slag.

- C. Fine and Coarse Aggregates: ASTM C33, 1-inch maximum size.
1. All aggregates shall be evaluated in accordance with ASTM C 1778 for potential alkali-silica reactivity (ASR). All aggregates shall be considered reactive unless they have been examined in accordance with ASTM C 295 and found to be non-reactive.
 2. Concrete mixtures using potentially reactive aggregates, except as permitted by 2.3.C.c, shall include either fly ash or slag as shown below, but within the limits stipulated in 2.4.C.
 - a. At least 25 percent fly ash replacement by mass where Portland cement alkali content is less than 1.00%, or at least 35 percent fly ash replacement by mass where Portland cement alkali content is 1.00 to 1.25%, or
 - b. At least 50 percent slag replacement by mass where Portland cement alkali content is less than 1.00%, or at least 65 percent slag replacement by mass where Portland cement alkali content is 1.00% to 1.25%.
 - c. Portland cement alkali loading shall not exceed 3.0 lb/yd³ (LBA). Alkali loading shall be calculated as shown below:
 - 1) $LBA = \text{Portland cement content (lbs)} \times \text{alkali content (\% Na}_2\text{Oeq)} / 100.$
 3. Aggregates meeting the requirements below may be considered non-reactive.
 - a. ASTM C 1260, Potential Alkali Reactivity of Aggregates (Mortar-Bar Method). Average expansion of less than 0.10 percent at 16 days after casting.
 - b. ASTM C 1567, Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregates (Accelerated Mortar-Bar Method). Average expansion of less than 0.10 percent at 16 days after casting.
- D. Concrete Reinforcing Fibers: ASTM C 1116, high-strength industrial-grade fibers.
- E. Water: Potable; free from deleterious material that may affect setting or strength of concrete.
- F. Air Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride or more than 0.15 percent chloride ions or other salts by weight of admixture.
1. Water-Reducing Admixture: ASTM C 494, Type A.
 2. Retarding Admixture: ASTM C 494, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 4. Water-Reducing and Accelerating Admixture ASTM C494, Type E.
 5. High Range, Water-Reducing Admixture: ASTM C 494, Type A and F.
 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.

2.5 CONCRETE MIXTURES

- A. Mix and deliver concrete in accordance with ASTM C 94, Option C.
- B. Select proportions for normal weight concrete in accordance with ACI 301, Method 1 or Method 2.

- C. Prepare design mixtures for each type of concrete required.
 - 1. The inclusion of either fly ash or slag in the concrete mix is mandatory.
 - 2. Where fly ash is used:
 - a. The minimum fly ash content shall be 15 percent replacement of cementitious material by weight, and the maximum content shall be 35%.
 - b. Additional fly ash shall not be included in concrete mixed with Type IS or IP cement.
 - 3. Where slag is used:
 - a. The minimum slag content shall be 15 percent replacement of cementitious material by weight, and the maximum content shall be 65%.
 - b. Additional slag shall not be included in concrete mixed with Type IS or IP cement.
 - 4. The inclusion of both fly ash and slag shall not be permitted without specific written approval by the Precast Tank Engineer.
 - 5. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 350 when tested in accordance with ASTM C 1218.
- D. Furnish concrete as indicated below:
 - 1. Compressive Strength (28 Days): 4,500 psi minimum
 - 2. Maximum Water-Cementitious Materials Ratio: 0.42
 - 3. Slump: 7 inches, ± 1 inch utilizing high-range, water-reducing admixture.
 - 4. Minimum cementitious content: 564 pounds per cubic yard
- E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 6%, $\pm 1\frac{1}{2}\%$.
- F. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- G. Do not use calcium chloride or admixtures containing calcium chloride.

2.6 WATERSTOPS

- A. Flexible PVC Waterstops: Corp of Engineers CRD-C 572 for embedding in concrete construction joints to prevent the passage of fluids through joints. Factory-fabricate corners, intersections and directional changes.
 - 1. Profile: Ribbed without center bulb.
 - 2. Dimensions: 6 inches by 3/8-inch-thick, non-tapered.
 - 3. Acceptable Products:
 - a. Greenstreak PVC Waterstop #679, or equal.
- B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free, hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete.
 - 1. Acceptable Products:

- a. Greenstreak Hydrotite® CJ-1030-4M, or equal.
- C. Self-Expanding Extrudable Waterstops: Extrudable, swelling, bentonite-free, one-part polyurethane.
 - 1. Acceptable Products:
 - a. SikaSwell® S-2, or equal

2.7 RELATED MATERIALS

- A. Crack Filler: ASTM C 881, two-part, moisture-tolerant, very-low-viscosity, epoxy injection adhesive for filling cracks.
 - 1. Acceptable Products:
 - a. Sikadur® 52, or equal
- B. Crack Sealer: ASTM C 920, Type S, Grade NS, Class 35 one-part polyurethane, elastomeric sealant, for sealing cracks.
 - 1. Acceptable Products:
 - a. Sikaflex®-1a, or equal

PART 3 - EXECUTION

3.1 PREPARATION

- A. Proceed with base slab construction only after unsatisfactory conditions have been corrected in accordance with Section 03 41 37 - Precast Post-tensioned Concrete Tanks.

3.2 FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements.
- B. Provide bracing to ensure stability of formwork.

3.3 EMBEDDED COMPONENTS AND OPENINGS

- A. Coordinate work of other sections in forming and setting openings, slots, keyways, sleeves, bolts, anchors, pipe sleeves and other embedded components.
- B. Install concrete accessories straight, level and plumb.
- C. Install water stops continuous without displacing reinforcing. Heat seal joints watertight.

- D. Place construction joint forms in accordance with base slab pouring sequence.

3.4 REINFORCEMENT PLACEMENT

- A. Place reinforcement, supported and secured against displacement.
- B. Ensure reinforcing is clean, free of loose scale, dirt or other foreign coatings.
- C. Space reinforcement bars with minimum clear spacing in accordance with ACI 350, but not less than 1-1/2 inches.
- D. Place reinforcement bars and maintain cover in accordance with tolerances listed in ACI 117 and ACI 350.

3.5 PLACING CONCRETE

- A. Install vapor retarder under base slab as indicated on the tank Shop (Erection) drawings provided by the Tank Supplier.
- B. Ensure reinforcement, embedded components and formwork is not displaced during concrete placement.
- C. Deposit concrete as closely as practicable to final position. Prevent segregation of mix.
- D. Place concrete continuously between predetermined construction joints. Subsequent placements shall use the same concrete mix as the initial placement.
- E. Consolidate concrete.
- F. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.
- G. Screed base slab level. Maintain slab flatness meeting the Conventional floor surface classification as measured using the Manual Straightedge Method per ACI 117, Table 4.8.6.1, unless indicated otherwise on the tank Shop (Erection) drawings provided by the tank Manufacturer.

3.6 FINISHING

- A. Steel-trowel finish unformed surfaces.
- B. In areas with floor drains, maintain slab level at walls and slope uniformly to drains.

3.7 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

1. Concrete, except high-early strength concrete, shall be maintained above 50° F and in a moist condition for at least the first three days after placement.
 2. When concrete could be exposed to more than one freezing and thawing cycle during construction, protect concrete from freezing until concrete strength of 3,500 psi is achieved. Strength shall be verified using field-cured cylinders.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.8 FIELD QUALITY CONTROL

- A. Place no concrete for the base slab until the subgrade has been inspected and approved by the Owner's Geotechnical Engineer.
- B. Perform field inspection and testing in accordance with ACI 301.
- C. Testing: Owner will engage accredited independent testing and inspecting agency to perform field tests and prepare reports.
1. Testing agency will report test results promptly and in writing to Contractor, Engineer of Record and Tank Supplier.
- D. Strength Test Samples:
1. Sampling Procedures: ASTM C 172
 2. Cylinder Molding and Curing Procedures: ASTM C 31, cylinder specimens, standard cured.
 3. When there are early-age strength requirements, strength shall be evaluated using field-cured cylinders.
 4. Sample concrete and make one set of five 4" x 8" cylinders for every 50 cubic yards or less of each class of concrete placed each day and for every 5,000 square feet of surface area.
 5. Make additional sets of three 4" x 8" cylinders at the discretion of the Tank Supplier when required to verify early-age strength.
- E. Field Testing:
1. Slump Test Method: ASTM C 143
 2. Air Content Test Method: ASTM C 231
 3. Temperature Test Method: ASTM C 1067
 4. Measure slump and temperature for each compressive strength concrete sample.
 5. Measure air content in air entrained concrete for each compressive strength concrete sample.
- F. Cylinder Compressive Strength Testing:
1. Test Method: ASTM C39
 2. Evaluation and Acceptance of Concrete: In accordance with ACI 350.
 3. Test three 4" x 8" cylinders at 28 days.
 4. Retain two cylinders for 56 days for testing when requested by Engineer.

5. Dispose of remaining cylinders when testing is not required.

3.9 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replace defective concrete. Repairs will be permitted provided structural adequacy, serviceability and durability of concrete elements comply with requirements of this section.

END OF SECTION 03 41 38

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SECTION 03 60 00 - GROUTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Portland Cement Grout
2. Rapid-Curing Epoxy Grout
3. Non-Shrink Cementitious Grout

B. Related Requirements:

1. Section 03 30 00 - Cast-in-Place Concrete: Cast-in-place or in-situ concrete for structural building frames, slabs on fill or grade, and other concrete components.

1.2 REFERENCE STANDARDS

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete for Buildings
2. ACI 318 - Building Code Requirements for Structural Concrete
3. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures

B. ASTM International:

1. ASTM C33 - Standard Specification for Concrete Aggregates
2. ASTM C40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
3. ASTM C150 - Standard Specification for Portland Cement
4. ASTM C191 - Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle
5. ASTM C307 - Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
6. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
7. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
8. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures

C. U. S. Army Corps of Engineers Concrete Research Division (CRD):

1. CRD-C621 - Non-Shrink Grout

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals
- B. Product Data: Submit manufacturer information regarding grout.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit instructions for mixing, handling, surface preparation, and placing epoxy-type and non-shrink grouts.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.5 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Maximum Conditions: Do not perform grouting if temperatures exceed manufacturer's recommendations.
- C. Minimum Conditions: Maintain minimum temperature per the manufacturer before, during, and after grouting, until grout has set.

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT GROUT

- A. Portland Cement: Comply with ASTM C150, Type I and II
- B. Water:

1. Potable
2. No impurities, suspended particles, algae, or dissolved natural salts in quantities capable of causing:
 - a. Corrosion of steel
 - b. Volume change increasing shrinkage cracking
 - c. Efflorescence
 - d. Excess air entraining

C. Fine Aggregate:

1. Washed natural sand
2. Gradation:
 - a. Comply with ASTM C33
 - b. Represented by smooth granulometric curve within required limits
3. Free from injurious amounts of organic impurities according to ASTM C40

D. Mix:

1. Portland cement, sand, and water
2. Do not use ferrous aggregate or staining ingredients in grout mixes.

2.2 RAPID-CURING EPOXY GROUT

A. Manufacturers:

1. L&M Construction Chemicals
2. Sika Corporation
3. WR Meadows
4. Or Approved Equal

B. Description:

1. High-strength, three-component epoxy grout formulated with thermosetting resins and inert fillers.
2. Rapid-curing, high adhesion, and resistant to ordinary chemicals, acids, and alkalis.

C. Performance and Design Criteria:

1. Compressive Strength:
 - a. 12,000 psi at seven (7) days
 - b. Comply with ASTM C579
2. Minimum Tensile Strength:
 - a. 2,000 psi
 - b. Comply with ASTM C307

3. Coefficient of Expansion:
 - a. 30 x 10⁻⁶ inch per °F
 - b. Comply with ASTM C531
4. Shrinkage:
 - a. Comply with ASTM C827

2.3 NON-SHRINK CEMENTITIOUS GROUT

A. Manufacturers:

1. Euclid Chemical Company
2. Sika Corporation
3. L&M Construction Chemicals
4. Or Approved Equal

B. Description:

1. Pre-mixed and ready-for-use formulation requiring only addition of water.
2. Non-shrink, non-corrosive, nonmetallic, non-gas forming, and no chlorides.

C. Performance and Design Criteria:

1. Certified to maintain initial placement volume or expand after set, and to meet following minimum properties when tested according to CRD-C621 for Type D non-shrink grout:
 - a. Setting Time:
 - 1) Initial: Approximately two (2) hours
 - 2) Final: Approximately three (3) hours
 - 3) Comply with ASTM C191
 - b. Maximum Expansion: 0.10% - 0.40%
 - c. Compressive Strength:
 - 1) One-Day: 4,000 psi
 - 2) Seven-Day: 7,000 psi
 - 3) 28-Day: 10,000 - 10,800 psi
 - 4) Comply with CRD-C621

2.4 FORMWORK

- A. As specified in Section 03 30 00 – Cast-In-Place Concrete

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify areas to receive grout.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Remove defective concrete, laitance, dirt, oil, grease, and other foreign material from concrete surfaces by brushing, hammering, chipping, or other similar means until sound and clean concrete surface is achieved.
- C. Roughen concrete lightly, but not to interfere with placement of grout.
- D. Remove foreign materials from metal surfaces in contact with grout.
- E. Align, level, and maintain final positioning of components to be grouted.
- F. Saturate concrete surfaces with clean water, and then remove excess water.

3.3 INSTALLATION

- A. Formwork:
 - 1. Construct leak proof forms anchored and shored to withstand grout pressures.
 - 2. Install formwork with clearances to permit proper placement of grout.
 - 3. As specified in Section 03 30 00 – Cast-In-Place Concrete.
- B. Mixing:
 - 1. Portland Cement Grout:
 - a. Use proportions of two parts sand and one part cement, measured by volume.
 - b. Prepare grout with water to obtain consistency to permit placing and packing.
 - c. Mix water and grout in two (2) steps:
 - 1) Pre-mix using approximately 2/3 of water.
 - 2) After partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing two to three minutes.
 - d. Mix only quantities of grout capable of being placed within thirty (30) minutes after mixing.
 - e. Do not add additional water after grout has been mixed.

- f. Minimum Compressive Strength: 2,400 psi in 48 hours and 7,000 psi in 28 days.
 2. Rapid-Curing Epoxy Grout:
 - a. Mix and prepare according to manufacturer instructions.
 - b. Minimum Compressive Strength: 2,400 psi in 48 hours and 7,000 psi in 28 days.
 3. Non-shrink Cementitious Grout:
 - a. Mix and prepare according to manufacturer instructions.
 - b. Minimum Compressive Strength: 2,400 psi in 48 hours and 7,000 psi in 28 days.
 4. Mix grout components in proximity to Work area and transport mixture quickly and in manner not permitting segregation of materials.
- C. Placing of Grout:
 1. Place grout material quickly and continuously.
 2. Do not use pneumatic-pressure or dry-packing methods.
 3. Apply grout from one side only to avoid entrapping air.
 4. Do not vibrate placed grout mixture or permit placement if area is being vibrated by nearby equipment.
 5. Thoroughly compact final installation and eliminate air pockets.
 6. Do not remove leveling shims for at least 48 hours after grout has been placed.
- D. Curing:
 1. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or by using wet burlap method.
 2. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
 3. After grout has attained its initial set, keep damp for minimum three (3) days.

3.4 FIELD QUALITY CONTROL

- A. Inspection and Testing:
 1. Comply with ACI 301 and as specified in Section.
 2. Submit proposed mix design of each class of grout to Engineer for review prior to commencement of Work.
 3. Tests of grout components may be performed to ensure compliance with specified requirements.

END OF SECTION 03 60 00

SECTION 05 40 00 - ALUMINUM HANDRAIL

PART 1 - GENERAL

1.1 SUMMARY

- A. The work covered by this section includes furnishing all labor, equipment and materials required to furnish and install aluminum component handrail including all fittings, anchors, bases and accessories, as required by the Contract Documents.
- B. All guardrails shall be furnished with a toeboard, except where concrete curbs are shown (if any).
- C. This section shall be used for all handrail except in areas where stairs and handrail are congruent as specified in Section 05 52 13.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
 - 1. Section 03 30 00 – Cast-in-Place Concrete
 - 2. Section 05 50 00 – Metal Fabrications
 - 3. Section 05 52 13 – Pipe and Tube Railings

1.3 SUBMITTALS

- A. Submit complete shop drawings and product data in accordance with the requirements of Section 01 33 00 – Submittal Procedures.
- B. Submit structural calculations, including anchorages, if requested by the Engineer.

1.4 STORAGE AND PROTECTION

- A. Handrails shall be properly packaged to prevent scratching and denting during shipment, storage and erection. Maintain protective wrapping until project is completed.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Component aluminum handrail system shall be designed and constructed in strict compliance with the requirements of OSHA and the International Building Code.
- B. Guardrails shall be designed to withstand a uniform horizontal load of 50 pounds per foot with a simultaneous vertical load of 100 pounds per foot applied to the top rail.
- C. Handrail shall be designed to withstand a uniform horizontal load of 50 pounds per foot applied to the top rail.
- D. In addition, guardrails, handrails shall be designed to withstand a concentrated load of 200 pounds applied in any direction, at any point on the railing system.

2.2 ACCEPTABLE PRODUCTS/MANUFACTURERS

- A. Component aluminum handrail system shall be "TUFrail" by Thompson Fabricating - Birmingham, AL., "Interna-Rail" by Hollaender Corp. - Cincinnati, OH., or approved equal.

2.3 MATERIAL AND CONSTRUCTION

- A. Handrail shall be the product of a company normally engaged in the manufacture of pipe railing. Railing shall be shop assembled in lengths not to exceed 24 feet for field erection.
- B. Post spacing shall be a maximum of six (6) feet. Posts and rails shall be a minimum of 1 1/2" schedule 40 aluminum pipe, alloy 6063-T6 or 6105-T5, ASTM B-429 or B-221.
- C. Handrail shall be made of pipe and fittings mechanically fastened together with stainless steel hardware. Handrail systems which use fittings that are glued or pop-riveted will not be acceptable.
- D. Toeboard shall conform to OSHA standards. Toeboard shall be a minimum of four (4) inches high and shall attach to the post using clamps which will allow for expansion and contraction between posts. Toeboard shall be set 1/4" above the walking surface.
- E. Wedge anchors shall be spaced 10d apart and 5d edge distance for no reduction in pullout strength. A safety factor of four (4) shall be used on pullout values published by the manufacturer. Wedge anchors shall be type 304 stainless steel.
- F. Openings in the railing shall guarded by a self-closing gate (OSHA 1910.23). Safety chains are not acceptable.
- G. All handrail and components shall be clear anodized per Aluminum Association M10C22A41 (215-R1). The pipe shall be plastic wrapped to protect the finish.
- H. All aluminum surfaces in contact with concrete, grout or dissimilar metals shall be protected with a coat of bituminous paint, mylar isolators or other approved material.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Field fabrication of the railing system is not permitted.
- B. Set handrails plumb within 1/8" of vertical and align horizontally to within 1/8" in twelve (12) feet.
- C. Install wedge anchors to proper depth to develop full pullout and shear values. Check all fasteners and bolts in base connections and splices for tightness.
- D. Adequate provisions for expansion and contraction shall be incorporated into the rail. Expansion joints shall be placed at 60-foot intervals and at all concrete expansion joints.
- E. Toeboards shall be shipped loose and attached to the handrail in the field. Attachment to the posts shall be made with clamps which will allow for expansion and contraction while maintaining a straight line.
- F. All defective, damaged or otherwise improperly installed handrail shall be removed and replaced with material which complies with this section at no additional cost to the Owner.
- G. Following installation, aluminum handrail shall be cleaned with a mild soap and clean water. Acid solutions, steel wool or harsh abrasives shall not be used.

END OF SECTION 05 40 00

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SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Miscellaneous Framing and Support
2. Shelf Angles
3. Metal Ladders
4. Ladder Safety Cages
5. Metal Ships' Ladders and Pipe Crossovers
6. Metal Floor Plate
7. Miscellaneous Steel Trim
8. Metal Bollards
9. Abrasive Metal Nosings Treads and Thresholds
10. Metal Downspout Boots
11. Loose Bearing and Leveling Plates
12. Loose Steel Lintels
13. Steel Weld Plates and Angles
14. Finishes (General)
15. Steel and Iron Finishes
16. Aluminum Finishes

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 03 30 00 – Cast-in-Place Concrete for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Nonslip aggregates and nonslip-aggregate surface finishes
 - 2. Prefabricated building columns
 - 3. Metal nosings and treads
 - 4. Paint products
 - 5. Grout
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Steel framing and supports for overhead doors
 - 2. Steel framing and supports for mechanical and electrical equipment.
 - 3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 4. Alternating tread devices
 - 5. Metal ships' ladders
 - 6. Metal floor plate and supports
 - 7. Miscellaneous steel trim
 - 8. Metal bollards
 - 9. Downspout guards
 - 10. Abrasive metal nosings treads and thresholds
 - 11. Metal downspout boots
 - 12. Loose steel lintels
- C. Samples for Verification: For each type and finish of extruded nosing and tread.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer
- B. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
- C. Welding Certificates

- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Research/Evaluation Reports: For post-installed anchors, from ICC-ES

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code - Steel."
 - 2. AWS D1.2, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 - Quality Requirements, to design ladders.
- B. Structural Performance of Aluminum Ladders: Aluminum ladders, including landings, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- C. Structural Performance of Alternating Tread Devices: Alternating tread devices shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 - 1. Uniform Load: 100 lbf/sq. ft.
 - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
 - 4. Alternating Tread Device Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 °F, ambient; 180 °F, material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36
- C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240 or ASTM A 666, Type 316L
- D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 316L
- E. Rolled-Steel Floor Plate: ASTM A 786, rolled from plate complying with ASTM A 36 or ASTM A 283, Grade C or D.
- F. Rolled-Stainless-Steel Floor Plate: ASTM A 793
- G. Steel Tubing: ASTM A 500, cold-formed steel tubing
- H. Steel Pipe: ASTM A 53, Standard Weight (Schedule 40) unless otherwise indicated.
- I. Zinc-Coated Steel Wire Rope: ASTM A 741
 - 1. Wire-Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- J. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: As indicated
 - 2. Material: Galvanized steel, ASTM A 653, structural steel, Grade 33, with G90 coating; 0.079-inch nominal thickness.
 - 3. Material: Cold-rolled steel, ASTM A 1008, structural steel, Grade 33; 0.0677-inch minimum thickness; hot-dip galvanized after fabrication.
- K. Cast Iron: Either gray iron, ASTM A 48, or malleable iron, ASTM A 47, unless otherwise indicated.
- L. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6
- M. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6
- N. Aluminum-Alloy Rolled Tread Plate: ASTM B 632, Alloy 6061-T6
- O. Aluminum Castings: ASTM B 26, Alloy 443.0-F
- P. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze)
- Q. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (lead red brass) or No. C84400 (lead semired brass)
- R. Nickel Silver Extrusions: ASTM B 151, Alloy UNS No. C74500

- S. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze)

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and use in wastewater treatment facilities. Use Zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
 - 3. Provide stainless-steel fasteners for fastening nickel silver.
 - 4. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 2.
- E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- H. Post-Installed Anchors: Torque-controlled expansion anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts,

complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with manufacturer's recommendations in Section 09 96 00 – High Performance Coatings.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Concrete: Comply with requirements in Section 03 30 00 - Cast-in-Place Concrete for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.

- 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
 - 1. Provide bearing plates welded to beams where indicated.
 - 2. Drill or punch girders and plates for field-bolted connections where indicated.
 - 3. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches o.c.
- E. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and

connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

1. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
2. Unless otherwise indicated, provide 1/2-inch baseplates with four 5/8-inch anchor bolts and 1/4-inch top plates.

F. Galvanize miscellaneous framing and supports where indicated.

G. Prime miscellaneous framing and supports with zinc-rich primer.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than six (6) inches from ends and 24 inches o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately two (2) inches larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize shelf angles located in exterior walls.

2.8 METAL LADDERS

A. General:

1. Comply with ANSI A14.3.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 18 inches apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 1-inch-diameter or 1-inch-square steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 3/4 inch in least dimension.
7. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
8. Galvanize exterior ladders, including brackets.

C. Aluminum Ladders:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Halliday Products
 - b. O'Keeffe's Inc.
 - c. Precision Ladders, LLC.
 - d. Thompson Fabricating, LLC.
 - e. Or approved equal
2. Space siderails 16 inches apart unless otherwise indicated.
3. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches deep, 3/4 inch wide, and 1/8 inch thick.
4. Rungs: Extruded-aluminum tubes, not less than 3/4 inch deep and not less than 1/8 inch thick, with ribbed tread surfaces.
5. Fit rungs in centerline of siderails; fasten by welding or with stainless-steel fasteners or brackets and aluminum rivets.
6. Provide platforms as indicated fabricated from pressure-locked aluminum bar grating or extruded-aluminum plank grating, supported by extruded-aluminum framing. Limit openings in gratings to no more than 3/4 inch in least dimension.
7. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted aluminum brackets.
8. Provide minimum 72-inch-high, hinged security door with padlock hasp at foot of ladder to prevent unauthorized ladder use.

2.9 LADDER SAFETY CAGES

A. General:

1. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless-steel fasteners.
2. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet o.c. Provide secondary intermediate hoops spaced not more than 48 inches o.c. between primary hoops.
3. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless-steel fasteners unless otherwise indicated.

B. Steel Ladder Safety Cages:

1. Primary Hoops: 1/4-by-4-inch flat bar hoops.
2. Secondary Intermediate Hoops: 1/4-by-2-inch flat bar hoops.
3. Vertical Bars: 3/16-by-1-1/2-inch flat bars secured to each hoop.
4. Galvanize ladder safety cages, including brackets and fasteners.

C. Aluminum Ladder Safety Cages:

1. Primary Hoops: 1/4-by-4-inch flat bar hoops.
2. Secondary Intermediate Hoops: 1/4-by-2-inch flat bar hoops.

3. Vertical Bars: 1/4-by-2-inch flat bars secured to each hoop.

2.10 METAL SHIPS' LADDERS AND PIPE CROSSEOVERS

- A. Provide metal ships' ladders and pipe crossovers where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.
 1. Treads shall be not less than five (5) inches exclusive of nosing or less than 8-1/2 inches including the nosing, and riser height shall be not more than 9-1/2 inches.
 2. Fabricate ships' ladders and pipe crossovers, including railings from aluminum.
 3. Fabricate treads and platforms from extruded-aluminum plank grating. Limit openings in gratings to no more than 3/4 inch in least dimension.
 4. Fabricate treads and platforms from rolled-aluminum-alloy tread plate.
 5. Comply with applicable railing requirements.
- B. Galvanize exterior steel ships' ladders and pipe crossovers, including treads, railings, brackets, and fasteners.

2.11 METAL FLOOR PLATE

- A. Fabricate from aluminum diamond floor plate of thickness indicated below:
 1. Thickness: As required for loadings indicated.
- B. Provide grating sections where indicated fabricated from extruded-aluminum plank grating. Limit openings in gratings to no more than 3/4 inch in least dimension.
- C. Provide stainless-steel angle supports as indicated.
- D. Include stainless-steel angle stiffeners, and fixed and removable sections as indicated.
- E. Provide flush stainless-steel bar drop handles for lifting removable sections, one at each end of each section.

2.12 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize exterior miscellaneous steel trim.

2.13 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
 - 1. Cap bollards with 1/4-inch-thick steel plate.
 - 2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 - 3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Fabricate bollards with 3/8-inch-thick steel baseplates for bolting to concrete slab. Drill baseplates at all four (4) corners for 3/4-inch anchor bolts.
 - 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch-thick steel plate welded to bottom of sleeve. Make sleeves not less than eight (8) inches deep and 3/4 inch larger than OD of bollard.
- D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch wall-thickness steel tubing with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4-inch steel machine bolt.
- E. Prime bollards with zinc-rich primer.

2.14 ABRASIVE METAL NOSINGS TREADS AND THRESHOLDS

- A. Provide abrasive metal nosing treads on all interior stair construction and thresholds for all interior/exterior doors.
- B. Cast-Metal Units: Cast aluminum, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Victory Treads
 - b. American Safety Tread Co., Inc.
 - c. Balco, Inc.
 - d. Safe-T-Metal Company, Inc.
 - e. Or approved equal
 - 2. Nosings: Cross-hatched units, 1-1/2 by 1-1/2 inches, for casting into concrete.
 - 3. Treads: Cross-hatched units, full depth of tread with 3/4-by-3/4-inch nosing, for application over bent plate treads or existing stairs.
 - 4. Thresholds: Fluted-saddle-type units, 5 inches wide by 1/2 inch high, with tapered edges.

- C. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. ACL Industries, Inc.
 - b. American Safety Tread Co., Inc.
 - c. Balco, Inc.
 - d. Or approved equal.
 - 2. Provide ribbed units, with abrasive filler strips projecting 1/16 inch above aluminum extrusion.
 - 3. Nosings: Square-back units, three (3) inches wide, for casting into concrete steps.
 - 4. Treads: Square-back units, full depth of tread with 1-3/8-inch lip, for application over existing stairs.
- D. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- E. Apply bituminous paint to concealed surfaces of cast-metal units.
- F. Apply clear lacquer to concealed surfaces of extruded units.

2.15 METAL DOWNSPOUT BOOTS

- A. Provide downspout boots made from aluminum in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
 - 1. Outlet: Vertical, to discharge into pipe OR at 35 degrees from horizontal, to discharge onto splash block or pavement.

2.16 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates
- C. Prime plates with zinc-rich primer.

2.17 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

- B. Galvanize and prime loose steel lintels located in exterior walls.
- C. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.18 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two (2) integrally welded steel strap anchors for embedding in concrete.

2.19 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.20 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153 for steel and iron hardware and with ASTM A 123 for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2.21 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with

edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two (2) coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for overhead doors securely to, and rigidly brace from, building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven (7) days before installing.
 1. Do not fill removable bollards with concrete.
- B. Anchor bollards to existing construction with anchor bolts. Provide four (4) 3/4-inch bolts at each bollard unless otherwise indicated.
 1. Embed anchor bolts at least four (4) inches in concrete.
- C. Anchor bollards in concrete in formed or core-drilled holes not less than eight (8) inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with non-shrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- D. Anchor internal sleeves for removable bollards in formed or core-drilled holes not less than eight (8) inches deep and 3/4 inch larger than OD of sleeve. Fill annular space around internal sleeves solidly with non-shrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward internal sleeve.
- E. Place removable bollards over internal sleeves and secure with 3/4-inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.
- F. Fill bollards solidly with concrete, mounding top surface to shed water.
 1. Do not fill removable bollards with concrete.

3.4 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

- A. Center nosings on tread widths unless otherwise indicated.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.
- C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 07 92 00 - Joint Sealants to provide a watertight installation.

3.5 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if

protruding, cut off flush with edge of bearing plate before packing with non-shrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

SECTION 05 51 19 - METAL GRATING STAIRS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes industrial-type, straight-run stairs with aluminum-grating treads and railings attached to aluminum grating stairs.
- B. Related Requirements
 - 1. Section 05 52 13 – Pipe and Tube Railings

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate pipes and other various mechanical devices that may conflict with the structural stairway. Modify stair structure to accommodate and approve modifications with the Engineer.

1.3 ACTION SUBMITTALS

- A. Product Data: For metal grating stairs and the following:
 - 1. Paint products
 - 2. Grout
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments.
- C. Delegated-Design Submittal: For stairs, including analysis data signed and sealed by the qualified professional Engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional Engineer, as defined in Section 01 40 00 - Quality Requirements, to design stairs and railings.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform Load: 100 lbf/sq. ft.
 - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
 - 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 - 5. Limit deflection of treads, platforms, and framing members to **L/360**.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Aluminum Plates, Shapes, and Bars: ASTM A 429, Alloy 6063-T5.
- C. Aluminum Bars for Grating Treads: Conform to Section 05 53 13 - Bar Gratings.
- D. Corrugated Nosings: Extruded aluminum, with an integral corrugated non-slip finish.

2.3 FASTENERS

- A. General: Provide type 316 stainless steel fasteners with coating complying with ASTM F 593. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers.
- C. Post-Installed Anchors: **Torque-controlled expansion anchors or chemical anchors** capable of sustaining, without failure, a load equal to six (6) times the load imposed when installed in unit masonry and four (4) times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Alloy **Group 1 (A1)** stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

- A. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D1187.
- B. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 1. Join components by welding unless otherwise indicated.
 2. Use connections that maintain structural value of joined pieces.
- B. Form exposed work with accurate angles and surfaces and straight edges.
- C. Weld connections to comply with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Weld exposed corners and seams continuously unless otherwise indicated.
 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for **Type 4** welds: good quality, uniform undressed weld with minimal splatter.
- D. Fabricate joints that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 ALUMINUM-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," Industrial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
 1. Fabricate stringers of structural aluminum channels.
 - a. Provide closures for exposed ends of channel stringers.
 2. Construct platforms of aluminum channel headers and miscellaneous framing members as needed to comply with performance requirements.
 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers.

- C. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."
 - 1. Fabricate treads and platforms from pressure-locked aluminum grating with 1-1/4-by-3/16-inch bearing bars at 15/16-inch o.c. and crossbars at four (4) inches o.c.
 - 2. Fabricate treads and platforms from pressure-locked steel grating with openings in gratings no more than 1/2 inch in least dimension.
 - 3. Surface: Serrated
 - 4. Finish: Mill finish
 - 5. Fabricate grating treads with non-slip nosing and with aluminum angle or aluminum plate carrier at each end for stringer connections. Secure treads to stringers with bolts.
 - 6. Fabricate grating platforms with nosing matching that on grating treads. Provide toeplates at open-sided edges of grating platforms. Mechanically attach grating to platform framing.

2.7 STAIR RAILINGS

- A. Comply with applicable requirements in Section 05 52 13 - Pipe and Tube Railings.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

3.2 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.
- B. Set steel-stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonmetallic, non-shrink grout unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

END OF SECTION 05 51 19

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum pipe and tube railings.

- B.** This section shall be used for areas where stairs and handrail are congruent. For all other handrail, refer to Section 05 40 00 - Aluminum Handrail.

1.2 RELATED DOCUMENTS

- A.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Requirements:

1. Section 05 40 00 - Aluminum Handrail
2. Section 05 50 00 - Metal Fabrications
3. Section 05 51 19 - Metal Grating Stairs

1.3 COORDINATION

- A.** Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B.** Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C.** Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.
- D.** Coordinate railings with gate and valve operators, as well as electrical components.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings
2. Railing brackets

- 3. Grout, anchoring cement, and paint products
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, and posts
 - 2. Fittings and brackets
- D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency
- B. Welding certificates
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- D. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code - Steel."
 - 2. AWS D1.2, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Aluminum Pipe and Tube Railings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. ATR Technologies, Inc.
 - b. Thompson Fabricating, LLC.
 - c. Tubular Specialties Manufacturing, Inc.
 - d. Approved Equal

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 - Quality Requirements, to design railings, including attachment to building or structural construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 1. Uniform horizontal load of 50 lbf/ft applied in any direction to the top rail
 2. Concentrated load of 200 lbf applied in any direction
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 1. Temperature Change: 120 °F, ambient; 180 °F.

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
 1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.4 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars and Tubing: ASTM B 221, Alloy 6063-T5/T52
- C. Extruded Structural Pipe and Round Tubing: ASTM B 429, Alloy 6063-T6
 - 1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832
- E. Plate and Sheet: ASTM B 209, Alloy 6061-T6
- F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6
- G. Castings: ASTM B 26, Alloy A356.0-T6

2.5 FASTENERS

- A. General: Provide the following:
 - 1. Aluminum Railings: Type 316 stainless-steel fasteners
 - 2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
 - 2. Provide Phillips OR square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six (6) times the load imposed when installed in unit masonry and four (4) times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 - 1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Non-shrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- C. Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop-assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.
- H. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

- I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- J. Form Changes in Direction as Follows:
 - 1. As detailed
 - 2. By flush bends or by inserting prefabricated flush-elbow fittings
- K. Close exposed ends of railing members with prefabricated end fittings.
- L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- O. For railing posts set in concrete, provide stainless-steel sleeves not less than six (6) inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- P. For removable railing posts, fabricate slip-fit sockets from stainless-steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than 1/40th of post height. Provide socket covers designed and fabricated to resist being dislodged.
 - 1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- Q. Toe Boards: Where indicated or required by OSHA, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.8 ALUMINUM FINISHES

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half (1/2) of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A31

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in three (3) feet.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in twelve (12) feet.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending two (2) inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within six (6) inches of post.

3.4 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Cover anchorage joint with flange of same metal as post, attached to post with set screws.
- C. Leave anchorage joint exposed with anchoring material flush with adjacent surface.
- D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
- E. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

- A. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 - 4. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

- A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 52 13

SECTION 05 53 13 - BAR GRATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes metal bar gratings and metal frames and supports for gratings.
- B. Related Requirements:
 - 1. Section 05 51 19 - Metal Grating Stairs
 - 2. Section 05 52 13 - Pipe and Tube Railings for metal pipe and tube handrails and railings

1.3 COORDINATION

- A. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Clips and anchorage devices for gratings
 - 2. Paint products
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For gratings, including manufacturers' published load tables.

1.5 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.
- B. Welding certificates

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
4. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Alabama Metal Industries Company; a Gibraltar Industries company
2. All American Grating
3. Harsco Industrial IKG, a division of Harsco Corporation
4. Ohio Gratings, Inc.
5. Or Approved Equivalent

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Floors: Uniform load of 150 lbf/sq. ft. or concentrated load of 2000 lbf, whichever produces the greater stress.
2. Walkways and Elevated Platforms Used as Exits: Uniform load of 125 lbf/sq. ft.
3. Heavy Equipment Room Floors: 300 lbf/sq. ft. or concentrated load of 3000 lbf, whichever produces the greater stress.
4. Electrical Room Floors: 250 lbf/sq. ft. or concentrated load of 2500 lbf, whichever produces the greater stress.
5. Limit deflection to L/360 or 1/4 inch, whichever is less.

B. Seismic Performance: Gratings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.5

2.3 METAL BAR GRATINGS

- A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual."
- B. Pressure-Locked, Rectangular-Bar Aluminum Grating: Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars or swaging crossbars between bearing bars.
 - 1. Bearing Bar Spacing: 1-3/16 inch o.c. (max)
 - 2. Bearing Bar Depth: As required to comply with structural performance requirements.
 - 3. Bearing Bar Thickness: As required to comply with structural performance requirements.
 - 4. Crossbar Spacing: 4 inches o.c.
 - 5. Traffic Surface: Plain
 - 6. Aluminum Finish: Mill Finish

2.4 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M
- B. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M
- C. Wire Rod for Bar Grating Crossbars: ASTM A 510
- D. Uncoated Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30
- E. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 33, with G90 coating
- F. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 240/A 240M, Type 316L
- G. Stainless-Steel Bars and Shapes: ASTM A 276, Type 316L

2.5 ALUMINUM

- A. General: Provide alloy and temper recommended by aluminum producer for type of use indicated, with not less than the strength and durability properties of alloy, and temper designated below for each aluminum form required.
- B. Extruded Bars and Shapes: ASTM B 221, alloys as follows:
 - 1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes
 - 2. 6061-T1, for grating crossbars
- C. Aluminum Sheet: ASTM B 209, Alloy 5052-H32

2.6 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
 2. Provide stainless-steel fasteners for fastening stainless steel.
- B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 2.
- C. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six (6) times the load imposed when installed in unit masonry and four (4) times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
1. Material for All Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.7 FABRICATION

- A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
1. Fabricate toeplates for attaching in the field.
 2. Toeplate Height: 4 inches unless otherwise indicated.
- F. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.
1. Provide no fewer than four (4) weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.
 2. Provide no fewer than four (4) saddle clips for each grating section containing rectangular bearing bars 3/16 inch or less in thickness and spaced 15/16 inch or more o.c., with each clip designed and fabricated to fit over two (2) bearing bars.
 3. Provide no fewer than four (4) weld lugs for each grating section containing rectangular bearing bars 3/16 inch or less in thickness and spaced less than 15/16 inch o.c., with each lug shop welded to three (3) or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.

4. Provide no fewer than four (4) flange blocks for each section of aluminum I-bar grating, with block designed to fit over lower flange of I-shaped bearing bars.
 5. Furnish stainless steel flange clamp with galvanized bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.
- G. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
1. Edge-band openings in grating that interrupt four (4) or more bearing bars with bars of same size and material as bearing bars.
- H. Do not notch bearing bars at supports to maintain elevation.

2.8 GRATING FRAMES AND SUPPORTS

- A. Aluminum or stainless-steel frames and supports in the following locations:
1. Exterior
 2. Interior

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I
- B. The portion of aluminum frames in contact with concrete shall have a bitumastic coating for protection.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Attach toeplates to gratings by welding at locations indicated.
- F. Field Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
- G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 INSTALLING METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 53 13

SECTION 05 60 00 – ALUMINUM HATCHES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Aluminum Roof Hatch

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related work specified elsewhere includes:

1. Section 05 50 00 – Metal Fabrications

1.3 SUBMITTALS

A. Contractor shall submit to the Engineer for approval:

1. Shop drawings
2. Product data including load information
3. Warranties

PART 2 - PRODUCTS

2.1 DRIP PROOF HATCH

A. Floor access doors shall be drip-proof type. Door leaf shall be ¼” aluminum checkered plate reinforced with structural aluminum channels and shall be capable of withstanding a 300 pound/sq. ft. uniform load with minimal deflection. (Calculations shall be provided to the Engineer upon request.) The following items shall be Type-316 stainless steel: slam locks, brackets, hinges and hardware. The door shall have a 316 stainless steel gas spring with integral hold open device which will assist in opening the door and shall lock automatically in the open position. The door shall open a minimum of 90°. The aluminum gutter frame shall be provided with a 1 ½” threaded drain fitting and shall have a thickness not less than ¼” and shall incorporate a neoprene gasket that will reduce air leakage to less than 1 CFM per linear foot of frame when the interior of the hatch is subjected to a 2-inch water column vacuum. All fasteners which penetrate into the “Dry” area of the hatch shall be sealed with “O” Ring Seals to prevent incidental water and gas leakage. The portion of the frame which is in contact with the concrete shall receive a protective bituminous coating.

- B. All double leaf access doors shall have two (2) interconnected slam locks which latch at both ends of the plate and can be un-latched from a single point. "Watertight" for standard single leaf doors shall be for a 1" - 2" head of water.
- C. Manufacturers
 - 1. Thompson Fabricating Company; Birmingham, AL
 - 2. Or Approved Equal

2.2 TRAFFIC LOAD HATCH

- A. Floor access doors shall be type "TH-H20" (gutterless) or "THG-H20" (gutter type) (WATERTIGHT, ODORTIGHT and GASTIGHT) as manufactured by Thompson Fabricating Company, Birmingham, AL. Door leaf shall be 1/4" aluminum checkered plate reinforced with structural aluminum channels and shall be capable of withstanding wheel loads up to AASHTO-H20 at OFF-STREET locations only. (Calculations will be provided to the engineer upon request.) The following items shall be Type-316 stainless steel: slam locks, brackets, hinges and hardware. The door shall have a 316 stainless steel gas spring with integral hold open device which will assist in opening the door and shall lock automatically in the open position. The door shall open a minimum of 90°. The aluminum extruded frame shall have a thickness not less than 1/4" and shall incorporate a neoprene gasket that will reduce air leakage to less than 1 CFM per lineal foot of frame when the interior of the hatch is subjected to a 2-inch water column vacuum. For type "THG" doors the gutter frames shall be provided with a 1 1/2" threaded drain coupling. All fasteners which penetrate into the "Dry" area of the hatch shall be sealed with "O" Ring Seals to prevent incidental water and gas leakage. The portion of the frame which is in contact with the concrete shall receive a protective bituminous coating.
- B. All double leaf access doors shall have two (2) interconnected slam locks with latch at both ends of the plate and can be un-latched from a single point. "Watertight" for single leaf H20 doors shall be for a 1" - 2" head of water.
- C. Manufacturers
 - 1. Thompson Fabricating Company; Birmingham, AL
 - 2. Or Approved Equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install where shown on the drawings according to manufactures recommendations.

END OF SECTION 05 60 00

SECTION 07 92 00 – JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work described in this section includes joint sealer systems.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
 - 1. Section 03 30 00 – Cast-in-Place Concrete
 - 2. Section 09 96 00 – High-Performance Coatings

1.3 SYSTEM PERFORMANCES

- A. Provide joint sealers that have been produced and installed to establish and maintain watertight and airtight continuous seals.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product specifications, handling, installation, curing instructions, color charts and performance tested data sheets for each product required.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an Installer who has successfully completed within the last three (3) years at least three (3) joint sealer applications similar in type and size to that of this project and who will assign mechanics from these earlier applications to this project, of which one will serve as lead mechanic.
- B. Single Source Responsibility for Joint Sealer Materials: Obtain joint sealer materials from a single manufacturer for each different product required.

1.6 DELIVER, STORAGE AND HANDLING

- A. Deliver materials to project site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multi-component materials.

- B. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with installation of joint sealers under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealer manufacturer or below 40 °F.
 - 2. When joint substrates are wet due to rain, frost, condensation or other causes.
- B. Joint Width Conditions: Do not proceed with installation of joint sealers when joint widths are less than allowed by joint sealer manufacturer for application indicated.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealers, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by testing and field experience.
- B. Colors: Provide color of exposed joint sealers indicated or, if not otherwise indicated, as selected by from manufacturer's standard colors.

2.2 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class and Uses.
- B. Multi-Part Non-Sag Urethane Sealant: Type M, Grade NS, Class 25, Uses NR, M, A and, as applicable to joint substrates indicated, O.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Dynatrol 11" Pecora Corp.
 - b. "Sonolastic NP-2"; Sonneborn
 - c. "Dymeric 511"; Tremco Inc.
 - d. "Vulkem 922"; Mameco International, Inc.
 - 2. Locations for Use: Exterior joints and penetrations in vertical surfaces of stucco, concrete, and between metal and concrete, mortar of stone; overhead or ceiling joints; perimeters of metal frames in exterior walls; vertical expansion and control joints in masonry and concrete; and at all miscellaneous locations requiring a joint sealant.
 - 3. Equivalent 1-part sealants will be acceptable, by one of the above-named manufacturers.

- C. Two-Part Pourable Urethane Sealant: Type M, Grade P, Class 25; Uses T, M, A and, as applicable to joint substrates indicated, O.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Chem-Calk 550"; Bostik Construction Product Div.
 - b. "Vulkem 245"; Mameco International, Inc.
 - c. "Pourthane"; W. R. Meadows, Inc.
 - d. "NR-200 Urexpan"; Pecora Corp.
 - e. "Sonolastic Paving Joint Sealant"; Sonneborn Building Products Div.,
 - f. "Rexnord Chem. Prod. Inc.
 - g. "THC-900/901"; Tremco Corp.
 2. Locations for Use: Exterior and interior expansion, control and construction joints in horizontal surfaces; and joints subject to pedestrian and light vehicular traffic.
 3. Equivalent 1-part sealants will be acceptable, by one of the above-named manufacturers.
- D. One-Part Mildew-Resistant Silicone Sealant: Type S, Grade NS; Class 25, Uses NT, G, A and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide for sealing interior joints with nonporous substrates around ceramic tile, showers, sinks and plumbing fixtures.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Dow-Corning 786"; Dow Corning Corp.
 - b. "SCS 1702"; General Electric.
 - c. "863 #345 White"; Pecora Corp.
 - d. "Proglaze White"; Tremco Corp.
 2. Locations for Use: Interior joints in vertical surfaces and terminal edges of tile; and joints at damp areas, such as around sinks and plumbing fixtures and pipe penetrations; and exposed terminal edges of vinyl flooring, such as around door frames and terminations at concrete.

2.3 LATEX JOINT SEALERS

- A. Acrylic-Emulsion Sealant: Manufacturer's standard, one-part non-sag, acrylic, mildew resistant, acrylic emulsion sealant complying with ASTM C 834, formulated to be paintable and recommended for exposed applications on interior and on protected exterior exposures involving joint movement of not more than + 7.5%.
1. Products: Subject to compliance with requirements, provide with one of the following:
 - a. "Chem-Calk 600"; Bostik Construction Products Div.
 - b. "AC-20"; Pecora Corp.
 - c. "Sonolac"; Sonneborn Building Products Div.; Rexnord Chemical Prod., Inc.
 - d. "Tremco Acrylic Latex Caulk"; Tremco Inc.
 2. Locations for Use: Interior joints in field-painted vertical and overhead surfaces at perimeter of metal door frames, gypsum drywall, plaster and concrete or concrete masonry; and all other interior locations not indicated otherwise.

2.4 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type which are non-staining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Plastic Foam Joint-Fillers:
 - 1. Preformed, compressible, resilient, non-waxing, non-extruding strips of plastic foam of material indicated below, and of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - 2. Backer Rod: Premium grade, closed cell polyethylene foam rod; Sealtight Backer Rod, as manufactured by W.R. Meadows, Inc., or approved equal.
 - 3. Joint Filler: "Ceramar" flexible foam expansion joint filler, as manufactured by W.R. Meadows, Inc., or approved equal.
- C. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing bond between sealant and joint filler or other materials at back (3rd) surface of joint. Provide self-adhesive tape where applicable.

2.5 MISCELLANEOUS MATERIALS

- A. Primer: Provide type recommended by joint sealer manufacturer where required for adhesion of sealant to joint substrates indicated.
- B. Cleaners for Nonporous Surfaces: Provide non-staining, chemical cleaner of type acceptable to manufacturer of sealant and sealant backing materials which are not harmful to substrates and adjacent nonporous materials.
- C. Masking Tape: Provide non-staining, non-absorbent type compatible with joint sealants and to surface adjacent to joints.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Require Installer to inspect joints indicated to receive joint sealers for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealer performance. Obtain Installer's written report listing any conditions detrimental to performance of joint sealer work. Do not allow joint sealer work to proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealers to comply with recommendations of joint sealer manufacturers and the following requirements:

1. Remove all foreign material from joint substrates which could interfere with adhesion of joint sealer, including dust; paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer; oil; grease; waterproofing; water repellents; water; surface dirt and frost.
 2. Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces, by brushing, grinding, blast cleaning, mechanical abrading, acid washing or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealers. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
 3. Remove laitance and form release agents from concrete.
 4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile and other non-porous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealers.
- B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealer manufacturer based on preconstruction joint sealer-substrate tests or prior experience. Apply primer to comply with joint sealer manufacturer's recommendations. Confine primers to areas of joint sealer bond, do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Elastomeric Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications and conditions indicated.
- C. Latex Sealant Installation Standard: Comply with requirements of ASTM C 790 for use of latex sealants.
- D. Installation of Sealant Backings:
1. Install sealant backings to comply with the following requirements:
 2. Install joint-fillers of type indicated or recommended by sealant manufacturer to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths which allow optimum sealant movement capability.
 - a. Do not leave gaps between ends of joint-fillers.
 - b. Do not stretch, twist, puncture or tear joint-fillers.
 - c. Remove absorbent joint-fillers which have become wet prior to sealant application and replace with dry material.
 3. Install bond breaker tape between sealants and joint-fillers, compression seals or back of joints where required to prevent third-side adhesion of sealant to back of joint.

- E. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration and providing uniform, cross-sectional shapes and depths relative to joint widths which allow optimum sealant movement capability.
- F. Tooling of Non-Sag Sealants:
 - 1. Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents which discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
 - 2. Concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 PROTECTION AND CLEANING

- A. Protect joint sealers during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of substantial completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealers immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work.
- B. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.
 - 1. Sound sealant shall not be visible on exposed surfaces.

END OF SECTION 07 92 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:
 - 1. Section 08 71 00 - Door Hardware for Hollow-Metal Doors.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

4. Locations of reinforcement and preparations for hardware.
 5. Details of each different wall opening condition.
 6. Details of anchorages, joints, field splices, and connections.
 7. Details of accessories.
 8. Details of moldings, removable stops, and glazing.
 9. Details of conduit and preparations for power, signal, and control systems.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification:
1. For each type of exposed finish required, prepared on Samples of not less than 3" x 5".
 2. For "Doors" and "Frames", prepare Samples approximately 8" x 10" to demonstrate compliance with requirements for quality of materials and construction:
 - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
 - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.
- E. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two (2) removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4"-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Republic Doors and Frames
 - 2. Steelcraft; an Allegion brand
 - 3. Or Approved Equal
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Standard-Duty Doors and Frames: SDI A250.8, Level 1. At locations indicated in the Door and Frame Schedule.
 - 1. Physical Performance: Level C according to SDI A250.4
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches
 - c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.032 inch.
 - d. Edge Construction: Model 2, Seamless
 - e. Core: Polyurethane with vertical steel stiffener
 - 3. Frames:

- a. Materials: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction:
 - 1) Knock down - for frames in gypsum board partitions, except fire rated frames
 - 2) Full profile welded - frames in masonry and concrete walls, fire rated frames over 7'-0" in gypsum board.
 - 4. Exposed Finish: Prime, Factory
- C. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.
 - 1. Physical Performance: Level B according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches
 - c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
 - d. Edge Construction: Model 2, Seamless
 - e. Core: Polyurethane with vertical steel stiffener
 - 3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction:
 - 1) Knock down - for frames in gypsum board partitions, except fire rated frames
 - 2) Full profile welded - frames in masonry and concrete walls, fire rated frames over 7'-0" in gypsum board.
 - 4. Exposed Finish: Prime, Factory
- D. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. At locations indicated in the Door and Frame Schedule.
 - 1. Physical Performance: Level A according to SDI A250.4
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches
 - c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.053 inch.
 - d. Edge Construction: Model 3, Stile and Rail
 - e. Core: Core: Polyurethane, vertical steel stiffener

3. Frames:
 - a. Materials: Metallic-coated, steel sheet, minimum thickness of 0.053 inch.
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction:
 - 1) Knock down - for frames in gypsum board partitions, except fire rated frames
 - 2) Full profile welded - frames in masonry and concrete walls, fire rated frames over 7'-0" in gypsum board.

4. Exposed Finish: Prime, Factory

E. Hollow-Metal Doors and Frames: NAAMM-HMMA 860. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level A according to SDI A250.4
2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches
 - c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.032 inch.
 - d. Edge Construction: Continuously welded with no visible seam
 - e. Core: Polyurethane, steel stiffened
3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch for frames that receive hollow-metal doors; minimum thickness of 0.042 inch for frames that receive hollow-core wood doors.
 - b. Materials: Metallic-coated steel sheet, minimum thickness of 0.042 inch - 0.053 inch.
 - c. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - d. Construction:
 - 1) Knock down - for frames in gypsum board partitions, except fire rated frames
 - 2) Full profile welded - frames in masonry and concrete walls, fire rated frames over 7'-0" in gypsum board.

4. Exposed Finish: Prime

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.
1. Physical Performance: Level B according to SDI A250.4
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule
 - b. Thickness: 1-3/4 inches
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum A40 coating.
 - d. Edge Construction: Model 2, Seamless
 - e. Core: Polyurethane with vertical steel stiffener
 - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 °F x h x sq. ft./Btu when tested according to ASTM C 1363.
 3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
 - b. Construction:
 - 1) Knock down - for frames in gypsum board partitions, except fire rated frames
 - 2) Full profile welded - frames in masonry and concrete walls, fire rated frames over 7'-0" in gypsum board.
 4. Exposed Finish: Prime Factory
- C. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. At locations indicated in the Door and Frame Schedule.
1. Physical Performance: Level A according to SDI A250.4
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
 - d. Edge Construction: Model 3, Stile and Rail
 - e. Core: Polyurethane with vertical steel stiffener
 - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 °F x h x sq. ft./Btu when tested according to ASTM C 1363.
 3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.

- b. Construction:
 - 1) Knock down - for frames in gypsum board partitions, except fire rated frames
 - 2) Full profile welded - frames in masonry and concrete walls, fire rated frames over 7'-0" in gypsum board.
- 4. Exposed Finish: Prime Factory
- D. Hollow-Metal Doors and Frames: NAAMM-HMMA 860. At locations indicated in the Door and Frame Schedule.
 - 1. Physical Performance: Level A according to SDI A250.4
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum G60A60 coating.
 - d. Edge Construction: Continuously welded with no visible seam.
 - e. Core: Steel stiffened.
 - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 °F x h x sq. ft./Btu when tested according to ASTM C 1363.
 - 3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum G60A60 coating.
 - b. Construction:
 - 1) Knock down - for frames in gypsum board partitions, except fire rated frames
 - 2) Full profile welded - frames in masonry and concrete walls, fire rated frames over 7'-0" in gypsum board.
 - 4. Exposed Finish: Prime
- 2.5 BORROWED LITES
 - A. Hollow-metal frames of metallic-coated steel sheet, minimum thickness of 0.053 inch.
 - B. Construction: Full profile welded
- 2.6 HOLLOW-METAL PANELS
 - A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.7 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2" wide x 10" long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Post-installed Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.8 MATERIALS

- A. Cold-Rolled Steel Sheet:** ASTM A 1008, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet:** ASTM A 1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet:** ASTM A 653, Commercial Steel (CS), Type B.
- D. Frame Anchors:** ASTM A 879, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008 or ASTM A 1011, hot-dip galvanized according to ASTM A 153, Class B.
- E. Inserts, Bolts, and Fasteners:** Hot-dip galvanized according to ASTM A 153.
- F. Power-Actuated Fasteners in Concrete:** Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Grout:** ASTM C 476, except with a maximum slump of 4", as measured according to ASTM C 143.
- H. Mineral-Fiber Insulation:** ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-

developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

- I. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.9 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than six (6) inches apart. Spot weld to face sheets no more than five (5) inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 2. Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated.
 3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
 4. Top Edge Closures: Close top edges of doors with inverted closures of same material as face sheets.
 5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
 6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four (4) spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 5. Jamb Anchors: Provide number and spacing of anchors as follows:

- a. Masonry Type: Locate anchors not more than 16" from top and bottom of frame. Space anchors not more than 32" o.c., to match coursing, and as follows:
 - 1) Two (2) anchors per jamb up to 60" high.
 - 2) Three (3) anchors per jamb from 60" – 90" high.
 - 3) Four (4) anchors per jamb from 90" – 120" high.
 - 4) Four (4) anchors per jamb plus one additional anchor per jamb for each 24" or fraction thereof above 120" high.
 - b. Stud-Wall Type: Locate anchors not more than 18" from top and bottom of frame. Space anchors not more than 32" o.c. and as follows:
 - 1) Three (3) anchors per jamb up to 60" high.
 - 2) Four (4) anchors per jamb from 60" – 90" high.
 - 3) Five (5) anchors per jamb from 90" – 96" high.
 - 4) Five (5) anchors per jamb plus one (1) additional anchor per jamb for each 24" or fraction thereof above 96" high.
 - c. Compression Type: Not less than two (2) anchors in each frame.
 - d. Post-Installed Expansion Type: Locate anchors not more than six (6) inches from top and bottom of frame. Space anchors not more than 26" o.c.
6. Head Anchors: Two (2) anchors per head for frames more than 42" wide and mounted in metal-stud partitions.
7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
- a. Single-Door Frames: Drill stop in strike jamb to receive three (3) door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two (2) door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
- 1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.
- 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 4. Provide loose stops and moldings on inside of hollow-metal work.

5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.10 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
- B. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with SDI A250.3.
 1. Color and Gloss: As selected by Engineer from manufacturer's full range.

2.11 ACCESSORIES

- A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch-thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.
 1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
 2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.
 3. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.
- B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field-apply bituminous coating to backs of frames that will be filled with grout containing anti-freezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 - 5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 - 6. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: $\pm 1/16$ inch, measured at door rabbet on a line 90° from jamb perpendicular to frame head.
 - b. Alignment: $\pm 1/16$ inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: $\pm 1/16$ inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: $\pm 1/16$ inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: $1/8$ inch $\pm 1/32$ inch.
 - b. Between Edges of Pairs of Doors: $1/8$ inch to $1/4$ inch $\pm 1/32$ inch.
 - c. At Bottom of Door: $5/8$ inch $\pm 1/32$ inch.
 - d. Between Door Face and Stop: $1/16$ inch to $1/8$ inch $\pm 1/32$ inch.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.
- D. Glazing: Comply with hollow-metal manufacturer's written instructions.
 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9" o.c. and not more than 2" o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

- F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 11 13

SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Service Doors
 - 2. Insulated Acoustical Service Doors
- B. Related Requirements:
 - 1. Section 02 41 19 – Selective Demolition
 - 2. Section 05 50 00 – Metal Fabrications
 - 3. Section 07 92 00 – Joint Sealants

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
 - 5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
 - 6. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 - 1. Include similar Samples of accessories involving color selection.

- D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
 - 1. Curtain Slats
 - 2. Bottom Bar
 - 3. Guides
 - 4. Brackets
 - 5. Hood
 - 6. Locking Device(s)
 - 7. Include similar Samples of accessories involving color selection.
- E. Certifications:
 - 1. Submit manufacturer's Underwriters Laboratories (UL), Warnock Hersey (WH) or Factory Mutual Research (FM) laboratory test report verifying product compliance in accordance with the required fire and smoke ratings.
 - 2. Provide certification from an accredited acoustical testing laboratory of product compliance noting a minimum 34 STC rating. Assembly shall have been tested in accordance with Laboratory Sound Transmission Loss (ASTM E-90) and STC determination (ASTM E-413).

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer
- B. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 and UL 10B.
 - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

2. Temperature-Rise Limit: At exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 °F above ambient after 30 minutes of standard fire-test exposure.
 3. Smoke Control: In corridors and smoke barriers, provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UL 1784; with maximum air-leakage rate of 3.0 cfm/sq. ft. of door opening at 0.10-inch for both ambient and elevated temperature tests.
- C. Sound-Control Doors: Assemblies tested in a laboratory for sound-transmission-loss performance according to ASTM E 90, calculated according to ASTM E 413, and rated for not less than the STC value indicated.
- D. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
1. Obtain operators and controls from overhead coiling door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
1. Design Wind Load: Uniform pressure (velocity pressure) per the IBC acting inward and outward.
 2. Testing: According to ASTM E 330 or DASMA 108 for garage doors and meeting the acceptance criteria of DASMA 108.
 3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
 4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.
- B. Windborne-Debris Impact Resistance: Provide glazed and impact-protective overhead coiling doors that pass missile-impact and cyclic-pressure tests according to ASTM E 1996 for Wind Zone 3 or DASMA 115.

2.3 DOOR ASSEMBLY

- A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McKeon Rolling Steel Door Company
 - b. Alpine Overhead Doors
 - c. Overhead Door Corporation
 - d. Cornell Iron Works, Inc.
 - e. Or Approved Equal
- B. Operation Cycles: Door components and operators capable of operating for not less than 10,000 cycles and for ten (10) cycles per day. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
 1. Include tamperproof cycle counter
- C. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E 283 or DASMA 105.
- D. STC Rating: Minimum of 34
- E. Curtain R-Value: 4.5 °F x h x sq. ft./Btu.
- F. Door Curtain Material: Aluminum: ASTM B 209 sheet or ASTM B 221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch; and as required.
- G. Door Curtain Slats: Curved or Flat profile slats of 1-7/8-inch - 3-1/4-inch center-to-center height.
 1. General: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated
 2. Perforated Slats: Approximately 1/16-inch - 3/32-inch pinholes, 7/8-inch wide x 3/8-inch high slots 25% of total door opening.
 - a. Perforated slats are only required if shown on the Drawings.
 3. Fenestrated Slats: Approximately 3- x 5/8-inch or 4- x 5/8-inch openings spaced approximately 1-1/2 inches apart and beginning 12" from jamb guides or 17% of total door opening.
 - a. Fenestrated slats are only required if shown on the Drawings.
 4. Vision Panels: Approximately 10- x 1-5/8-inch openings spaced approximately 2" apart and beginning 12" from end guides; in two (2) rows of slats at height indicated on Drawings; installed with insulated vision-panel glazing.
 - a. Vision panels are only required if shown on the Drawings.
 5. Insulated-Slat Interior Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch and minimum aluminum thickness of 0.032 inch.
 6. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

- H. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
- I. Bottom Bar: Two (2) angles, each not less than 1-1/2 x 1-1/2 x 1/8 inch thick; fabricated from hot-dip galvanized steel, stainless steel or aluminum extrusions and finished to match door.
- J. Curtain Jamb Guides: Galvanized steel, Stainless steel or Aluminum with exposed finish matching curtain slats.
 - 1. Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.
- K. Hood: Match curtain material and finish.
 - 1. Shape: Round
 - 2. Mounting: As shown on Drawings
 - 3. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - a. Galvanized Steel: Nominal 0.028-inch thick, hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 653.
 - b. Stainless Steel: 0.025-inch-thick stainless-steel sheet, Type 304, complying with ASTM A 666.
 - c. Aluminum: 0.040-inch-thick aluminum sheet complying with ASTM B 209, of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
 - 4. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.
- L. Locking Devices: Equip door with slide bolt for padlock.
 - 1. Locking Device Assembly: Locking by padlock, located on both left and right jamb sides, operable from coil side.
 - 2. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
 - 3. Chain Lock Keeper: Suitable for padlock.
- M. Manual Door Operator: Push-up operation.
 - 1. General: Equip door with manual door operator by door manufacturer.
 - 2. Provide manual chain hoist operators unless electric door operators are indicated.
 - 3. Required lifts or pull for door operation does not exceed 25 lbf.
 - 4. Provide operator with through-wall shaft operation.

5. Provide operator with manufacturer's standard removable operating arm.
6. Provide manual chain-hoist operator consisting of endless steel hand chain, chain pocket wheel and guard, and gear-reduction unit with a maximum 35-lbf force for door operation. Provide alloy steel hand chain with chain holder secured to operator guide.

N. Counterbalancing Mechanism

1. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
2. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
3. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
4. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
5. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

O. Curtain Accessories: Equip door with smoke seals, weatherseals, and push/pull handles.

1. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.
2. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
 - a. At door head, use 1/8-inch-thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
 - b. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.
3. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

P. Door Finish:

1. General:
 - a. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
 - b. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

Q. Baked-Enamel or Powder-Coat Finish:

1. AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.
2. Baked-Enamel or Powder-Coated Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
3. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness
4. Stainless-Steel Finish: No. 2B (bright, cold rolled) or No. 4 (polished directional satin).
 - a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1) Run grain of directional finishes with long dimension of each piece.
 - 2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3) Directional Satin Finish: No. 4.
 - c. Bright, Cold-Rolled, Unpolished Finish: No. 2B
5. Interior Curtain-Slat Facing: Finish as indicated by manufacturer's designations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Fire-Rated Doors: Install according to NFPA 80.

- E. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
 - 3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather-resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.
 - 2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 08 33 23

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Mechanical door hardware for the following:
 - a. Swinging Doors
 - b. Sliding Doors
 - c. Folding Doors
- 2. Cylinders for door hardware specified in other Sections.
- 3. Electrified door hardware.

B. Related Requirements:

- 1. Coordinate products specified in Part 2 with Division 08 Sections in subparagraphs below. Astragals, silencers, and cylinders can be specified in this Section or with doors and frames.
- 2. Division 8 – Openings
- 3. Division 13 – Special Construction

1.3 COORDINATION

- A. Floor-Recessed Door Hardware: Coordinate layout and installation with floor construction.
 - 1. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation and Keying Conference: Conduct conference at Project site.
 - 1. Conference participants shall include Installer's Architectural Hardware Consultant.
 - 2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - a. Flow of traffic and degree of security required
 - b. Preliminary key system schematic diagram
 - c. Requirements for key control system
 - d. Requirements for access control
 - e. Address for delivery of keys

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For electrified door hardware
 - 1. Include diagrams for power, signal, and control wiring.
 - 2. Include details of interface of electrified door hardware and building safety and security systems.
- C. Samples: For each exposed product in each finish specified, in manufacturer's standard size.
 - 1. Tag Samples with full product description to coordinate Samples with door hardware schedule.
- D. Samples for Initial Selection: For each type of exposed finish
- E. Samples for Verification: For each type of exposed product, in each finish specified.
 - 1. Sample Size: Full-size units or minimum 2" x 4" Samples for sheet and 4-inch-long Samples for other products.
 - a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

2. Tag Samples with full product description to coordinate Samples with door hardware schedule.
- F. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Submittal Sequence: Submit door hardware schedule after or concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
 3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - e. Fastenings and other installation information.
 - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - g. Mounting locations for door hardware.
 - h. List of related door devices specified in other Sections for each door and frame.
- G. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Architectural Hardware Consultant.
- B. Product Certificates: For each type of electrified door hardware.
 1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final door hardware and keying schedule.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
2. Warranty Period: Three (3) years from date of Substantial Completion unless otherwise indicated below:
 - a. Exit Devices: Two (2) years from date of Substantial Completion.
 - b. Manual Closers: Ten (10) years from date of Substantial Completion.
 - c. Concealed Floor Closers: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of door hardware from single manufacturer.
 1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

- A. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- B. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the ABA standards of the Federal agency having jurisdiction.
 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
 4. Adjust door closer sweep periods so that, from an open position of 90°, the door will take at least five (5) seconds to move to a position of 12° from the latch.
 5. Adjust spring hinges so that, from an open position of 70°, the door will take at least 1.5 seconds to move to the closed position.

2.3 SCHEDULED DOOR HARDWARE

- A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.
 - 1. Door hardware is scheduled in Part 3.

2.4 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies
 - b. Stanley Commercial Hardware; a division of Stanley Security Solutions
 - c. Or approved equal

2.5 SELF-CLOSING HINGES AND PIVOTS

- A. Self-Closing Hinges and Pivots: BHMA A156.17
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies
 - b. Stanley Commercial Hardware; a division of Stanley Security Solutions
 - c. Or approved equal

2.6 CENTER-HUNG AND OFFSET PIVOTS

- A. Center-Hung and Offset Pivots: BHMA A156.4
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Hager Companies
 - b. Stanley Commercial Hardware; a division of Stanley Security Solutions
 - c. Or approved equal

2.7 CONTINUOUS HINGES

- A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch-thick, hinge leaves with minimum overall width of 4"; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
- B. Pin-and-Barrel-Type Hinges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies
 - b. Select Products Limited
 - c. Stanley Commercial Hardware; a division of Stanley Security Solutions
 - d. Or approved equal

2.8 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 1. Bored Locks: Minimum 1/2-inch latch bolt throw.
 2. Mortise Locks: Minimum 3/4-inch latch bolt throw.
 3. Deadbolts: Minimum 1-inch bolt throw.
- C. Lock Backset: 2-3/4 inches unless otherwise indicated.
- D. Strikes: Provide manufacturer's standard strike for each lock bolt or latch bolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
- E. Locks and Latches: BHMA A156.2, BHMA A156.12, BHMA A156.13, BHMA A156.16
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best Access Systems; Stanley Security Solutions, Inc.
 - b. Corbin Russwin, Inc.; an ASSA ABLOY Group company
 - c. Stanley Commercial Hardware; a division of Stanley Security Solutions
 - d. Yale Security Inc; an ASSA ABLOY Group company
 - e. Or approved equal

2.9 EXIT LOCKS AND EXIT ALARMS

- A. Exit Locks and Alarms: BHMA A156.29, Grade 1
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Precision Hardware, Inc.; a Stanley company
 - b. SARGENT Manufacturing Company; ASSA ABLOY
 - c. Or approved equal

2.10 SURFACE BOLTS

A. Surface Bolts: BHMA A156.16

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc
 - b. Trimco
 - c. Or approved equal

2.11 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc
 - b. Trimco
 - c. Or approved equal

2.12 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Precision Hardware, Inc.; a Stanley company
 - b. SARGENT Manufacturing Company; ASSA ABLOY
 - c. Yale Security Inc; an ASSA ABLOY Group company
 - d. Or approved equal

2.13 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best Access Systems; Stanley Security Solutions, Inc.
 - b. Corbin Russwin, Inc.; an ASSA ABLOY Group company
 - c. Hager Companies
 - d. SARGENT Manufacturing Company; ASSA ABLOY
 - e. Stanley Commercial Hardware; a division of Stanley Security Solutions
 - f. Yale Security Inc; an ASSA ABLOY Group company

g. Or approved equal

- B. Standard Lock Cylinders: BHMA A156.5; Grade 2 permanent cores; face finished to match lockset.
 - 1. Core Type: Interchangeable
- C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide ten (10) construction master keys.
- D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide ten (10) construction master keys.

2.14 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one (1) extra key blank for each lock. Supplier is to closely coordinate with owner and architect all keying requirements. All lock cylinders shall be construction master keyed using split key method. Incorporate decisions made in keying conference.
 - 1. Master Key System: Change keys and a master key operate cylinders.
 - a. Provide three (3) cylinder change keys and five (5) master keys.
 - 2. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
 - b. Re-key Owner's existing master key system into new keying system.
 - 3. Keyed Alike: Key all cylinders to same change key.
- B. Keys: Nickel silver.
 - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "DO NOT DUPLICATE."

2.15 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; aluminum or stainless steel unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc
 - b. Hager Companies
 - c. Trimco
 - d. Or approved equal

2.16 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release.
- B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.
- C. Astragals: BHMA A156.22

2.17 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. SARGENT Manufacturing Company; ASSA ABLOY
 - b. Stanley Commercial Hardware; a division of Stanley Security Solutions
 - c. Yale Security Inc; an ASSA ABLOY Group company
 - d. Or approved equal

2.18 CONCEALED CLOSERS

- A. Concealed Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. SARGENT Manufacturing Company; ASSA ABLOY
 - b. Or approved equal

2.19 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Hager Companies
- b. Rockwood Manufacturing Company; an ASSA ABLOY Group company
- c. Trimco
- d. Or approved equal

2.20 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Allegion plc
 - b. Or approved equal

2.21 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies
 - b. Reese Enterprises, Inc.
 - c. Zero International, Inc.
 - d. Or approved equal

B. Maximum Air Leakage: When tested according to ASTM E 283 with tested pressure differential of 0.3-inch, as follows:

- 1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. of door opening
- 2. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening
- 3. Gasketing on Double Doors: 0.50 cfm per foot of door opening

2.22 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies
 - b. National Guard Products, Inc.
 - c. Reese Enterprises, Inc.
 - d. Zero International, Inc.
 - e. Or approved equal

2.23 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Allegion plc
 - b. Or approved equal

2.24 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
3. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.25 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within 1/2 of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if

they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated on Drawings unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8
 - 2. Custom Steel Doors and Frames: HMMA 831
 - 3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one (1) hinge for every 30" of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one (1) intermediate offset pivot per door and one (1) additional intermediate offset pivot for every 30" of door height greater than.
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by Owner.
 - 2. Furnish permanent cores to Owner for installation.
- F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 07 92 00 "Joint Sealants."
- G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
 - 2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70° and so that closing time complies with accessibility requirements of authorities having jurisdiction.
 - 3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

- B. Occupancy Adjustment: Approximately three (3) months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include six (6) months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.8 DOOR HARDWARE SCHEDULE

- A. Hardware Set #1

1. Door #: 101A, 101B

2. Doors: Typical exterior double door

Qty	Unit	Product	Description	Color	Manufacturer
1	ea	push/pull handle	by door manufacturer	-	-
1	ea	cylinder	20-013 x 118 x MK x 50-217	626	SCH
1	ea	surface bolt	by door manufacturer	-	-
1	ea	weather strip	by door manufacturer	-	-

END OF SECTION 08 71 00

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SECTION 09 96 00 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: High-performance coatings and special preparation of surfaces.
1. Use high performance coating systems specified in this section to finish components, unless otherwise indicated. Without restricting volume or generality, work to be performed under this section may include, but is not limited to:
 - a. Exterior steel
 - b. Interior steel
 - c. Exterior concrete
 - d. Interior concrete
 - e. Piping, hangers, and supports
 - f. Exposed bare pipes (including color coding)
 2. Painting or finishing is not needed for following:
 - a. Surfaces or materials specifically scheduled or shown on Drawings to remain unfinished
 - b. Items provided with factory finish.
 - c. Equipment nameplates, fire rating labels, and operating parts of equipment
 3. Materials and products having factory-applied primer shall not be considered factory finished.

1.2 REFERENCE STANDARDS

- A. American Society for Testing and Materials:
1. ASTM D16 - Terminology Relating to Paint, Varnish, Lacquer, and Related Products
 2. ASTM D522 – Test Methods for Mandrel Bend Test of Attached Organic Coatings
 3. ASTM D6386 – Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product
 4. ASTM D3359 – Test Methods for Rating Adhesion by Tape Test
- B. SSPC: The Society for Protective Coatings:
1. SSPC - Painting Manual, Volume 2: Systems and Specifications.
 2. SSPC-Paint 16 - Coal Tar Epoxy-Polyamide Black (or Dark Red).
 3. SSPC-SP 2 - Hand Tool Cleaning.
 4. SSPC-SP 3 - Power Tool Cleaning.
 5. SSPC-SP 5 - White Metal Blast Cleaning.
 6. SSPC-SP 6/NACE 3 - Commercial Blast Cleaning.
 7. SSPC-SP 7/NACE 4 - Brush-Off Blast Cleaning.

8. SSPC-SP 10/NACE 2 - Near-White Metal Blast Cleaning.
9. SSPC-SP 11 - Power Tool Cleaning to Bare Metal.
10. SSPC-SP13/NACE 6 – Surface Preparation of Concrete

C. National Association of Pipe Fabricators

1. NAPF 500-03-01 Solvent Cleaning
2. NAPF 500-03-02 Hand Tool Cleaning
3. NAPF 500-03-03 Power Tool Cleaning
4. NAPF 500-03-04 Abrasive Blast Cleaning of Ductile Iron Pipe
5. NAPF 500-03-05 Abrasive Blast Cleaning of Cast Ductile Iron Fittings

D. International Concrete Repair Institute

1. ICRI-CSP 2 – Grinding
2. ICRI-CSP 3 – Light Shotblast
3. ICRI-CSP 4 – Light Scarification
4. ICRI-CSP 5 – Medium Shotblast
5. ICRI-CSP 6 – Medium Scarification

1.3 PREINSTALLATION MEETINGS

- A. Section 01 31 00 – Project Management and Coordination.
- B. Convene minimum two weeks prior to commencing Work of this Section.
- C. Schedule a conference and inspection to be held on-site before field application of coating systems begins.
- D. Conference shall be attended by Contractor, Owner's Representative, Engineer, coating applicators, and a representative of coating material manufacturer.
- E. Topics to be discussed at meeting shall include:
 1. A review of Contract Documents and accepted shop drawings shall be made and deviations or differences shall be resolved.
 2. Review items such as environmental conditions, surface conditions, surface preparation, application procedures, and protection following application.
 3. Establish which areas on-site will be available for use as storage areas and working area
- F. Pre-construction conference and inspection shall serve to clarify Contract Documents, application requirements and what work should be completed before coating application can begin.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:

1. Submit manufacturer information indicating coating materials, manufacturer's name, product name, product number, performance ratings, curing times, mixing, thinning and application requirements.
 - a. Provide material analysis, including vehicle type and percentage by weight and by volume of vehicle, resin and pigment.
 - b. Submit manufacturer's Material Safety Data Sheets (MSDS) and other safety requirements.
 - C. Samples: Submit one color chart/color samples, illustrating colors for selection.
 - D. Schedule: Contractor shall submit a schedule of items that will receive high-performance coatings per Specification 09 96 00.
 - E. Color: Contractor shall submit a schedule of colors based on Color System Material Identification.
 - F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - G. Manufacturer Instructions: Submit special procedures, perimeter conditions requiring special attention.
 - H. Quality Assurance Submittals:
 1. Certificates:
 - a. Coatings manufacturer shall certify that coating materials utilized are "non-lead" (less than 0.06% lead by weight in dried film) as defined in Part 1303 of Consumer Product Safety Act.
 - b. Provide certification that specialized equipment as may be required by manufacturer for proper application of coating materials shall be utilized for work of this Section.
 - c. Provide manufacturer's certification that products to be used comply with specified requirements and are suitable for intended application.
 2. Manufacturer's Instructions:
 - a. Submit manufacturer's installation procedures which shall be basis for accepting or rejecting actual installation procedures.
 - I. Qualifications Statements:
 1. Submit qualifications for manufacturer and applicator.
 2. Submit manufacturer's approval of applicator.
- 1.5 CLOSEOUT SUBMITTALS
- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
 - B. Operation and Maintenance Data: Submit maintenance and cleaning requirements for coatings, repair and patching techniques.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Extra Stock Materials:
 - 1. Furnish 1 gal of each color of each type of coating specified, for Owner's maintenance use.
 - 2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.7 QUALITY ASSURANCE

- A. Conform to applicable codes and ordinances for flame, fuel, smoke, and volatile organic compound (VOC) ratings requirements for finishes at time of application.

1.8 QUALIFICATIONS

- A. Provide products from a company specializing in manufacture of high-performance coatings with a minimum of 10 years experience.
- B. Applicator shall be trained in application techniques and procedures of coating materials and shall demonstrate a minimum of 2 years successful experience in such application.
 - 1. Maintain, throughout duration of application, a crew of painters who are fully qualified to satisfy specified qualifications.
- C. Single Source Responsibility:
 - 1. Materials shall be products of a single manufacturer or items standard with manufacturer of specified coating materials.
 - 2. Provide secondary materials which are produced or are specifically recommended by coating system manufacturer to ensure compatibility of system.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Container Labeling: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Inspection:
 - 1. Accept materials on Site in manufacturer's sealed and labeled containers.
 - 2. Inspect for damage and to verify acceptability.

- D. Store materials in ventilated area and otherwise according to manufacturer instructions.
- E. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.10 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Minimum Conditions: Do not install materials when temperature is below 35°F or above 110°F.
- C. Refer to specific product information sheets for minimum surface temperature requirements. Surface temperatures shall be at least 5°F (3°C) above dew point and in a rising mode.
- D. Subsequent Conditions: Maintain above temperature range, 24 hours before, during, and 72 hours after installation of coating.
- E. Relative humidity shall be no higher than 85%.
- F. For exterior spray application, wind velocity shall be less than 15 mph (25 kph).
- G. Atmosphere shall be relatively free of airborne dust.
- H. Restrict traffic from area where coating is being applied or is curing.

1.11 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Include coverage for bond to substrate, and degradation of chemical resistance.

PART 2 - PRODUCTS

2.1 HIGH-PERFORMANCE COATINGS

- A. Manufacturers:
 - 1. Tnemec Company, Inc.
 - 2. Sherwin Williams Company
 - 3. Or Approved Equal.

2.2 COMPONENTS

A. General:

1. Coating Description:
 - a. Complete multicoat systems formulated and recommended by manufacturer for intended applications and in indicated thicknesses.
 - b. Specified number of coats does not include primer or filler coat.
2. Chromium Content as Zinc Chromate or Strontium Chromate: None.
3. Colors: Selected from manufacturer's standard colors based on Color System Material Identification
4. Minimum Dry Film Thickness Per Coat: See schedule.
5. Primer: Per manufacturer's recommendation.

B. Epoxy Coating:

1. Modified Polyamine Epoxy
 - a. Finish: Gloss.
 - b. Minimum Solids Content: 100% (mixed).
 - c. Vendor Reference
 - 1) **Tnemec:** Series 435 Perma-Glaze
 - 2) **Sherwin Williams:** DuraPlate 5900
2. Modified Polyamine Epoxy Mortar
 - a. Finish: Gloss.
 - b. Minimum Solids Content: 100% (mixed).
 - c. Vendor Reference
 - 1) **Tnemec:** Series 434 Perma-Shield H2S
 - 2) **Sherwin Williams:** DuraPlate 5900 Mortar
3. Glass Flake Modified Polyamine Epoxy
 - a. Finish: N/A
 - b. Minimum Solids Content: 82.0 ± 2.0%
 - c. Vendor Reference
 - 1) **Tnemec:** Series 142 Epoxoline
 - 2) **Sherwin Williams:** Macropoxy 5500 LT
4. Modified Polyamine Epoxy
 - a. Finish: N/A
 - b. Minimum Solids Content: 82.0 ± 2.0%
 - c. Vendor Reference
 - 1) **Tnemec:** Series 141 Epoxoline
 - 2) **Sherwin Williams:** Macropoxy 5500 LT

5. Surface Tolerant Modified Polyamidoamine Epoxy
 - a. Finish: Semi-gloss.
 - b. Minimum Solids Content: $84.0 \pm 2.0\%$ (mixed).
 - c. Vendor Reference
 - 1) **Tnemec:** Series 135 Chembuild
 - 2) **Sherwin Williams:** Macropoxy 5500 LT
6. NSF Approved Pure Polyamide Epoxy
 - a. Finish: N/A
 - b. Minimum Solids Content: $56.0 \pm 2.0\%$
 - c. Vendor Reference
 - 1) **Tnemec:** Series 20 or 20HS Pota-Pox
 - 2) **Sherwin Williams:** Macropoxy 646 PW
7. Polyamidoamine Epoxy
 - a. Finish: N/A
 - b. Minimum Solids Content: $67.0 \pm 2.0\%$ (mixed).
 - c. Vendor Reference
 - 1) **Tnemec:** Series N140 Pota-Pox Plus
 - 2) **Sherwin Williams:** Macropoxy 5500 LT
8. High-Build Epoxy Coating – Pure Polyamide Epoxy
 - a. Finish: Satin.
 - b. Minimum Solids Content: $56.0\% \pm 2.0\%$ (mixed).
 - c. Vendor Reference
 - 1) **Tnemec:** Series 66 or 66HS Hi-Build Epoxoline
 - 2) **Sherwin Williams:** Macropoxy 646 Fast Cure
9. Waterborne Acrylic Epoxy
 - a. Finish: Satin.
 - b. Minimum Solids Content: $44.0 \pm 2.0\%$ (mixed)
 - c. Vendor Reference
 - 1) **Tnemec:** Series 113 H.B. Tneme-Tufcoat
 - 2) **Sherwin Williams:** Pro Industrial Water Based Epoxy
10. Modified Polyamine Epoxy
 - a. Finish: N/A
 - b. Minimum Solids Content: 100% (mixed).
 - c. Vendor Reference
 - 1) **Tnemec:** Series 201 Epoxoprime
 - 2) **Sherwin Williams:** General Polymers 3746
11. Modified Polyamine Epoxy

- a. Finish: N/A
 - b. Minimum Solids Content: 100% (mixed).
 - c. Vendor Reference
 - 1) **Tnemec:** Series 237 Power-Tread
 - 2) **Sherwin Williams:** General Polymers 4080 (FasTop 12S)
12. Modified Novolac Epoxy
- a. Finish: N/A
 - b. Minimum Solids Content: 100% (mixed)
 - c. Vendor Reference
 - 1) **Tnemec:** Series 239SC Chembloc
 - 2) **Sherwin Williams:** Cor-Cote HCR
- C. Polyurethane Coating:
1. Modified Aromatic Polyurethane Primer
- a. Finish: N/A
 - b. Minimum Solids Content: $61.0 \pm 2.0\%$ (mixed).
 - c. Vendor Reference
 - 1) **Tnemec:** Series 1 Omnithane
 - 2) **Sherwin Williams:** Corothane 1 GalvaPac 1K or 2K Zinc Primer
2. Aromatic Urethane, Zinc-Rich Primer
- a. Finish: N/A
 - b. Minimum Solids Content: $63.0 \pm 2.0\%$ (mixed); Metallic Zinc Content: 83% minimum in dried film. ASTM D 522 Type III Zinc dust.
 - c. Vendor Reference
 - 1) **Tnemec:** Series 91-H2O Hydro-Zinc
 - 2) **Sherwin Williams:** Corothane 1 GalvaPac 1K or 2K Zinc Primer
3. Aliphatic Acrylic Polyurethane
- a. Finish: Gloss.
 - b. Minimum Solids Content: $66.0 \pm 2.0\%$ (mixed).
 - c. Vendor Reference
 - 1) **Tnemec:** Series 1095 Endura-Shield
 - 2) **Sherwin Williams:** Acolon 218 HS
4. Aliphatic Moisture Cured Urethane
- a. Finish: Semi-gloss.
 - b. Minimum Solids Content: $92.0 \pm 2.0\%$ (clear mixed).
 - c. Vendor Reference
 - 1) **Tnemec:** Series 248 Everthane
 - 2) **Sherwin Williams:** Amor Seal Rexthane 1
5. Polyurethane Modified Concrete

- a. Finish: Matte.
- b. Minimum Solids Content: 100%.
- c. Vendor Reference
 - 1) **Tnemec:** Series 241 MVT Everthane
 - 2) **Sherwin Williams:** General Polymers FasTop 12S

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application examination.
- B. Examine areas and conditions under which application of coating systems shall be performed for conditions that will adversely affect execution, permanence, or quality of coating system application.
- C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes until moisture content of surface is below following limits:
 - 1. Masonry Surfaces: 12% maximum
 - 2. Vertical Concrete Surfaces: 12% maximum
 - 3. Horizontal Concrete Surfaces: 8% maximum
- D. Correct conditions detrimental to timely and proper execution of Work.
- E. Do not proceed until unsatisfactory conditions have been corrected.
- F. Commencement of installation constitutes acceptance of conditions and responsibility for satisfactory performance.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application preparation.
- B. Protection:
 - 1. Take precautionary measures to prevent fire hazards and spontaneous combustion. Remove empty containers from Site.
 - 2. Place cotton waste, cloths and hazardous materials in containers, and remove from Site daily.
 - 3. Provide drop cloths, shields, and other protective equipment.
 - 4. Protect elements surrounding work of this section from damage or disfiguration.
 - 5. As Work proceeds, promptly remove spilled, splashed, or splattered materials from surfaces.
 - 6. During application of coating materials, post Wet Paint signs.
 - 7. During application of solvent-based materials, post No Smoking signs.

- C. Clean surfaces of loose foreign matter.
- D. Remove substances that would bleed through finished coatings; if removal is not possible, seal surface with shellac.
- E. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- F. Existing Painted and Sealed Surfaces:
 - 1. Remove loose, flaking, and peeling paint, and feather edge and sand smooth edges of chipped paint.
 - 2. Clean with mixture of trisodium phosphate and water to remove surface grease and foreign matter.
- G. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Surfaces shall be mechanically cleaned to remove passivation and to provide a uniform 1.0 mil anchor profile.
- H. Ferrous Metal:
 - 1. Surfaces shall be free of residual deposits of grease, rust, scale, dirt, dust, and oil.
 - a. Immersion Service: SSPC-SP 10 Near White Blast Cleaning
 - b. Non-Immersion Service: SSPC-SP 6 Commercial Blast Cleaning.
 - 2. Field Repair of Shop Primed Surfaces:
 - a. Non-Immersion Service: Remove all dirt, dust, chalk, oil, grease, as well as any other foreign matter by solvent cleaning (SSPC-SP 1) and/or power washing. All areas damaged during transportation, construction or installation shall be cleaned in accordance with SSPC-SP 11 Power Tool Cleaning to Bare Metal or SSPC-SP 6 Commercial Blast Cleaning. All edges shall be feathered. All surfaces shall be clean and dry prior to coating
 - b. Immersion Service: Remove all dirt, dust, chalk, oil, grease, as well as any other foreign matter by solvent cleaning (SSPC-SP 1) and/or power washing. All areas damaged during transportation, construction or installation shall be cleaned in accordance with SSPC-SP 10 Near White Blast Cleaning. All edges shall be feathered. The remainder of the intact shop primer shall be cleaned in accordance with SSPC-SP 7 Brush-Off Blast Cleaning to provide a minimum, uniform, anchor profile of at least 1.0 mil. In order to prevent injury to surrounding painted areas, blast cleaning may necessitate use of lower air pressure, small nozzle and abrasive particle sizes, short blast nozzle distance from surface, shielding and masking. If damage is too extensive to touch-up, item shall be re-cleaned and coated or painted. All surfaces shall be clean and dry prior to receiving the specified finish coat(s).

3. For surfaces not shop primed, surfaces shall be cleaned in compliance with specifications of Steel Structures Painting Council as indicated in Schedule of Coating Systems below.

3.3 APPLICATION

- A. Comply with MPI - Architectural Painting Manual.
- B. Apply primer to each surface, unless specifically not required by coating manufacturer.
- C. Apply coating systems in compliance with manufacturer's instructions and using application method best suited for obtaining full, uniform coverage of surfaces to be coated.
- D. Apply primer, intermediate, and finish coats to comply with wet and dry film thickness and spreading rates for each type of material as recommended by manufacturer.
 1. Application rates in excess of those recommended and fewer numbers of coats than specified shall not be accepted.
- E. Number of coats specified shall be minimum number acceptable. Apply additional coats as needed to provide a smooth, even application.
 1. Closely adhere to re-coat times recommended by manufacturer. Allow each coat to dry thoroughly before applying next coat. Provide adequate ventilation for tank interior to carry off solvents during drying phase.
- F. Employ only application equipment that is clean, properly adjusted, and in good working order, and of type recommended by coating manufacturer.
- G. After surface preparation, interior weld seams shall receive a stripe coat applied by brush.
- H. Make edges of paint adjoining other materials or colors sharp and clean, without overlapping.
- I. Apply coatings to specified thicknesses.
- J. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish.
- K. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Inspecting and Testing: Comply with MPI - Architectural Painting Manual.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Collect waste material that may constitute fire hazard, place in closed metal containers, and remove daily from Site.
- C. Clean surfaces immediately of overspray, splatter, and excess material.
- D. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.6 COLOR SYSTEM MATERIAL IDENTIFICATION

- 1. A schedule, approved by Engineer and Owner, shall be submitted prior to any material receiving color coatings.
- 2. The high-performance coating manufacturer shall submit their color selection along with manufacturer's color numbers.

3.7 SCHEDULE

- 1. See Drawings.

END OF SECTION 09 96 00

SECTION 13 10 00 – BYPASS PUMPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Under this item, the Contractor is required to furnish all materials, labor, equipment, power, maintenance, fuel, etc. to implement a temporary pumping system for the purpose of diverting flow around the work area throughout the required duration.
- B. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
 - 1. Division 2 – Existing Conditions
 - 2. Division 40 – Process Interconnections

1.3 QUALITY ASSURANCE

- A. Follow national standards and as specified herein.
- B. Perform leakage and pressure tests on discharge piping using clean water, before operation.
- C. Keep and maintain spare parts for piping on site, as required.
- D. Maintain adequate hoisting equipment and accessories for the pump on-site.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. The Contractor shall prepare a detailed description of the proposed pumping system and submit. Bid proposals without an acceptable detailed plan for the temporary bypass pumping system shall be rejected.
- C. The Contractor shall submit to the Engineer a detailed plan and description outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing wastewater flows in all locations requiring bypass pumping. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment,

materials and all other incidental items necessary and/or required to insure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Contract Documents. No construction shall begin until all provisions and requirements have been reviewed by the Engineer.

D. The plan shall include but not be limited to details of the following:

1. Staging areas for pumps;
2. Sewer plugging method and types of plugs;
3. Number, size, material, location and method of installation of suction piping;
4. Number, size, material, location and method of installation of discharge piping;
5. Bypass pump sizes, capacity, number of each size to be on site and power requirements;
6. Calculations of static lift, friction losses, flow velocity (pump curves showing pump operating range shall be submitted), and bypass pump pipe size;
7. Downstream discharge plan;
8. Thrust and restraint block sizes and locations;
9. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill;
10. Method of noise control for each pump and/or generator;
11. Any temporary pipe supports and anchoring required;
12. Design plans and computation for access to bypass pumping locations indicated on the drawings;
13. Schedule for installation of and maintenance of bypass pumping lines; and
14. Plan indicating selection location of bypass pumping line locations.

1.5 COORDINATION AND SCHEDULING

- A. Section 01 31 00 – Project Management and Coordination: Requirements for coordination.
- B. Coordinate Work of this Section with plant operations.

1.6 CONTRACTORS RESPONSIBILITY FOR OVERFLOWS AND SPILLS

- A. Schedule and perform work in manner that does not cause or contribute to incidence of overflows, releases or spills of sewage from sanitary sewer system or bypass operation.

1.7 DELIVERY AND STORAGE

- A. Transport, deliver, handle, and store pipe, fittings, pumps, ancillary equipment and materials to prevent damage and following manufacturer's recommendations.
 1. Inspect all material and equipment for proper operation before initiating work.
- B. Material found to be defective or damaged due to manufacturer or shipment shall be repair as recommended by the manufacturer.

1.8 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All bypass pumping for the duration of this project shall occur during low flow periods and as directed by the Owner.

2.2 DESIGN REQUIREMENTS

A. Bypass Schedule:

Process Areas	Service	Pump From	Pump To	Maximum Flow (MGD)
Influent pump station	RWW	IPS Wetwell	Anoxic Selector	5.6
Sludge pump station	WAS	Sludge suction at bottom of secondary clarifiers	Digester No.1	0.3
Sludge buffer tank	WAS	Bottom of sludge buffer tank	Digester No.1	0.3
Sludge buffer tank	SN	Top of sludge buffer tank	Level correction tank	0.1

B. Bypass Pumping System

1. The Contractor shall provide all temporary bulk heads, pipeline plugs, and temporary discharge piping as required
2. The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each size pump utilized shall be installed at the bypassing locations, ready for use in the event of primary pump failure.
3. Bypass pumping system shall be capable of bypassing the flow around the work area and of releasing any amount of flow up to full available flow into the work area as necessary for satisfactory performances of work.

C. Performance Requirements

1. It is essential to the operation of the existing sewerage system that there be no interruption in the flow of sewage throughout the duration of the project. To this end, the Contractor shall provide, maintain and operate all temporary facilities such as dams,

plugs, pumping equipment (back-up units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with his work, carry it past his work and return it to the existing sewer downstream of his work.

2. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
3. The Contractor shall provide all necessary means to safely convey the secondary effluent flow past the work area. The Contractor will not be permitted to stop or impede the main flows under any circumstances.
4. The Contractor shall maintain flow around the work area in a manner that will not cause surcharging or overflows of the upstream processes.
5. The Contractor shall protect water resources, wetlands and other natural resources.

2.3 MATERIALS

A. Discharge and Suction Pipes

1. To prevent the accidental spillage of flows, all suction/discharge systems shall be temporarily constructed of rigid pipe with positive, restrained joints. Under no circumstances will aluminum "irrigation" type piping or glued PVC pipe be allowed. Discharge hose will only be allowed in short sections and by specific permission from the Engineer.

B. Polyethylene Plastic Pipe

1. High density solid wall and following ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-DR) based on Outside Diameter, ASTM D1248 and ASTM D3550.
2. Homogenous throughout, free of visible crack, discoloration, pitting, varying wall thickness, holes, foreign materials, blisters, or other deleterious faults.

C. High-Density Polyethylene (HDPE)

1. Homogenous throughout, free of visible crack, discoloration, pitting, varying wall thickness, holes, foreign materials, blisters, or other deleterious faults.
2. Assembled and joined at site using couplings, flanges or butt-fusion method to provide leak proof joint. Following manufacturer's instructions and ASTM D 2657.
 - a. Threaded or solvent joints and connections are not permitted.
3. Fusing shall be conducted by personnel certified as fusion technicians by manufacturer of HDPE pipe and/or fusing equipment.
4. Butt-fused joint shall be truly aligned and contain uniform roll-back beads resulting from use of proper temperature and pressure.
 - a. Allow adequate cooling before removal of pressure.
 - b. Watertight and have tensile strength equal to that of pipe.

D. Flexible Hoses and Associated Couplings and Connectors

1. Abrasion resistant.
2. Suitable for intended service.
3. Rated for external and internal loads anticipated, including test pressure.
 - a. External loading shall incorporate anticipated traffic loadings if required.
4. When subjected to traffic loading, compose system, such as traffic ramps or covers.
 - a. Install system and maintain H-20 loading requirements while in use.

E. Valves and Fittings

1. Determined according to flow calculations, pump sizes previously determined, and system operating pressures.

F. Plugs

1. Plugs shall be selected and installed according to size of line to be plugged, pipe, and manhole configurations, and based on specific site.

2.4 EQUIPMENT

A. Pumps

1. All pumps used shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. The pumps may be electric or diesel powered. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows.

B. Controls

1. The Contractor shall provide the necessary stop/start controls for each pump.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify layout, type, and orientation of piping connections.
- C. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 PREPARATION

- A. Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipelines. The Contractor shall locate his bypass pipelines to minimize any

disturbance to existing utilities and shall obtain approval of the pipeline locations from the Owner and the Engineer. All costs associated with relocating utilities and obtaining all approvals shall be paid by the Contractor.

- B. During all bypass pumping operation, the Contractor shall protect any existing processes and equipment next to or in near proximity. The Contractor shall be responsible for all physical damage caused by human or mechanical failure.

3.3 INSTALLATION AND REMOVAL

- A. The Contractor shall be responsible for all coordination, installation, operation, and removal of the temporary bypass pumping.
- B. When working confined space entry areas, the Contractor shall exercise caution and comply with OSHA requirements.

END OF SECTION 13 10 00

SECTION 13 31 22 – PRE-ENGINEERED METAL CANOPY SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Complete single-story, rigid-frame-type, clear span, pre-engineered metal canopy systems of the nominal length, width, eave height, and roof pitch, with straight columns, and as indicated on the Drawings.
 - a. Roof System consists of the manufacturer's standard standing seam, machine-seamed roof and related work.
 - b. Manufacturer's standard building components and accessories may be used, provided components, accessories, and complete structure conform to design indicated and specified requirements.

B. Metal siding, perforated soffits, and additional and related items and work shall be provided at locations where indicated on the Drawings.

C. Related Requirements:

1. Related work specified elsewhere includes:
 - a. Section 03 30 00 - Cast In Place Concrete
 - b. Section 05 50 00 - Metals Fabrication
 - c. Section 07 41 13 - Standing-Seam Metal Roof Panels
 - d. Section 07 92 00 - Joint Sealants
 - e. Section 09 96 00 - High Performance Coatings

1.2 SYSTEM PERFORMANCE REQUIREMENTS

A. General: Engineer, design, fabricate and erect the pre-engineered metal canopy system to withstand loads from winds, gravity, structural movement including movement thermally induced, and to resist in-service use conditions that the building will experience, including exposure to the weather, without failure.

1. Design each member to withstand stresses resulting from combinations of loads that produce the maximum allowable stresses in that member as prescribed in MBMA's "Design Practices Manual."
2. Provide grounding system for lightning protection; Comply with building manufacturer's recommendations.

B. Design Loads: Basic design loads, as well as auxiliary and collateral loads, are indicated on the drawings, and shall in addition be as required by project conditions.

1. Basic design loads include live load, and wind load, in addition to the dead load.

2. Collateral loads shall include additional dead loads over and above the weight of the metal canopy system, such as roof-mounted and suspended mechanical systems, finished ceilings, light fixtures, conduits, ductwork, piping, equipment, etc.
 3. All frames shall be designed to limit lateral drift per Drawings
- C. Structural Framing and Roof Panels: Design primary and secondary structural members and exterior covering materials for applicable loads and combinations of loads in accordance with the Metal Building Manufacturers Association's (MBMA) "Design Practices Manual," in accordance with notes and requirements on Structural Drawings, and the following. Where a conflict in requirements may occur, the more stringent requirements shall apply. Comply with requirements for U.L. Class 90 wind uplift rating.
1. AISC "Code of Standard Practice for Steel Buildings and Bridges":
 - a. Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence: "This approval constitutes the Owner's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings."
 2. Structural Steel: Comply with the American Institute of Steel Construction's (AISC) "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" for design requirements and allowable stresses, including the "Commentary" and Supplements thereto, as issued.
 3. Light Gage Steel: Comply with the American Iron and Steel Institute's (AISI) "Specification for the Design of Cold Formed Steel Structural Members" and "Design of Light Gage Steel Diaphragms" for design requirements and allowable stresses.
 4. Welded Connections: Comply with the American Welding Society's (AWS) "Standard Code for Arc and Gas Welding in Building Construction" for welding procedures, and AWS D1.1 "Structural Welding Code."
 5. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
 6. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Product data consisting of metal canopy system manufacturer's product information for building components and accessories.
- C. Shop drawings prepared by or under the supervision of a registered Professional Engineer, for metal canopy structural framing system, roofing panels, and other metal canopy system components and accessories that are not fully detailed or dimensioned in manufacturer's product data. The responsible design engineer shall place his stamp on all Shop Drawings.
 1. Structural Framing: Furnish complete erection drawings prepared by or under the supervision of a professional engineer legally authorized to practice in the jurisdiction where the Project is located and where the system components are manufactured. Include

details showing fabrication and assembly of the metal canopy system. Show anchor bolts settings and roof framing. Include transverse cross-sections. Design analysis shall be included, to show all design loads, load combinations, foundation reactions and lateral deflections.

2. Roofing Panels: Provide layouts of panels on roofs, details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashings, closures, and special details. Include transverse cross-sections.
3. Building Accessory Components: Provide details of metal canopy accessory components to clearly indicate methods of installation.

- D. Professional engineer's certificate prepared and signed by the responsible design Engineer, legally authorized to practice in the jurisdiction where Project is located and where the system components are manufactured, verifying that the structural framing and covering panels meet indicated loading requirements and codes of authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer to erect the pre-engineered metal canopy who has specialized in the erection and installation of types of metal canopy systems similar to that required for this project for at least 5 verifiable years, and who is certified in writing by the metal canopy system manufacturer as qualified for erection of the manufacturer's products.
- B. Manufacturer's Qualifications: Provide pre-engineered metal canopies manufactured by a firm with no less than 5-years verifiable experience in manufacturing metal canopy systems that are similar to those indicated for this project and have a record of successful in-service performance.
- C. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedures". Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests within previous 12-months. If recertification of welders is required, retesting will be Contractor's responsibility.
- D. Single-Source Responsibility: Obtain the metal canopy system components, including structural framing, roof covering, and accessory components, from one source from a single manufacturer.
- E. Design Criteria: The drawings indicate size, profiles, and dimensional requirements of the pre-engineered metal canopies and are based on the specific type and model indicated. Metal canopy systems having equal characteristics by other manufacturers may be considered provided that deviations in dimensions and profiles are minor and do not change the design concept or intended performance as judged by the Engineer. The burden of proof of equality is on the proposer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver prefabricated components, sheets, panels, and other manufactured items so they will not be damaged or deformed. Package roof panels for protection against transportation damage.

- B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to not delay that work.
- C. Handling: Exercise care in unloading, storing, and erecting roof covering panels to prevent bending, warping, twisting, and surface damage.
- D. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weather tight ventilated covering. Store metal wall and roof panels so that water accumulations will drain freely. Do not store panels in contact with other materials that might cause staining, denting or other surface damage.
- E. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.6 WARRANTY AND GUARANTEE

- A. Roofing Panel Warranty: Furnish the roofing panel manufacturer's written warranty, covering failure of the metal roof panels within the warranty period.
 - 1. Warranty Periods (from date of Substantial Completion)
 - a. Weather-tightness: 20-years.
 - b. Finishes: 20-years.
 - c. Materials and Workmanship: 3-years.
- B. This warranty and guarantee shall be in addition to and not a limitation of other rights the Owner may have under the Contract Documents, and shall run concurrently with other project warranties and guarantees.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specified requirements, provide metal canopy systems provided by one of the following:
 - 1. American Buildings Co.
 - 2. Atlantic Building Systems.
 - 3. Butler Manufacturing Co.
 - 4. Ceko Buildings Division.
 - 5. Gulf States Manufacturers, Inc.
 - 6. Metal Building Components, Inc.
 - 7. O.S.I., Inc.
 - 8. Star Buildings Division, H. H. Robertson Co.
 - 9. Varco-Pruden Buildings.
 - 10. Or Pre-Approved Equal.

2.2 MATERIALS

- A. Hot-Rolled Structural Steel Shapes: Comply with ASTM A 572 or A 529.
- B. Steel Tubing or Pipe: Comply with ASTM A 500, Grade B, ASTM A 501, or ASTM A 53.
- C. Steel Members Fabricated from Plate or Bar Stock: Provide 42,000 psi minimum yield strength. Comply with ASTM A 529, ASTM A 570, or ASTM A 572.
- D. Steel Members Fabricated by Cold Forming: Comply with ASTM A 607, Grade 50.
- E. Cold-Rolled Carbon Steel Sheet: Comply with requirements of ASTM A 366 or ASTM A 568.
- F. Hot-Rolled Carbon Steel Sheet: Comply with requirements of ASTM A 568 or ASTM A 569.
- G. Structural Quality Zinc-Coated (Galvanized) Steel Sheet: Comply with ASTM A 446 with G90 coating complying with ASTM A 525. Grade to suit manufacturer's standards.
- H. Aluminum-Zinc Alloy Coated Steel Sheets ("Galvalume"): Comply with ASTM A 428, latest edition.
- I. Bolts for Structural Framing: Comply with ASTM A 307 or ASTM A 325 as necessary for design loads and connection details.
- J. Anchor Bolts: ASTM A 307, non-headed type unless otherwise indicated.
- K. Non-Metallic Shrinkage-Resistant Grout: Pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CRD-C621.
 - 1. Products offered by manufacturers to comply with requirements for non-metallic, non-shrink grout include the following:
 - a. Euco N.S.; Euclid Chemical Company
 - b. Crystex; L&M Construction Chemicals
 - c. Masterflow 713; Master Builders
 - d. Five Star Grout; U.S. Grout Corp.
 - e. Upcon; Upco Chemical Division, USM Crop.
 - f. Propak; Protex Industries, Inc.
- L. Paint and Coating Materials: Comply with performance requirements of the federal specifications indicated. Unless specifically indicated otherwise, compliance with compositional requirements of federal specifications indicated is not required.
 - 1. Shop Primer for Ferrous Metal: Fast-curing, lead-free, abrasion- resistant, rust-inhibitive primer selected by the manufacturer for compatibility with substrates with types of alkyd finish paint systems indicated and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure. Comply with FS TT-P-86, Types I, II, or III.
 - 2. Shop Primer for Galvanized Metal Surfaces: Zinc dust-zinc oxide primer selected by the manufacturer for compatibility with substrate. Comply with FS TT-P-641.

2.3 STRUCTURAL FRAMING

- A. Rigid Frames: Fabricate from hot-rolled structural steel shapes. Provide factory-welded, shop-painted, built-up “I-beam”-shape or open-web-type frames consisting of tapered or parallel flange beams and straight columns. Furnish frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly.
1. Provide length of span and spacing of frames indicated. Slight variations in length of span and frame spacing may be acceptable if necessary to meet manufacturer’s standards, and proposed in writing by manufacturer and accepted in writing by Engineer prior to Bid Date.
 2. Building eave height: As indicated on Drawings
 3. Roof Pitch: 1/12
- B. Primary Endwall Framing: Provide the following primary endwall framing members fabricated for field-bolted assembly:
1. Endwall Columns: Manufacturer’s standard shop-painted, built-up factory-welded “I”-shape or cold-formed “C” sections, fabricated from 14-gage (0.0747-inch) steel.
 2. Endwall Beams: Manufacturer’s standard shop-painted “C”-shape roll-formed sections fabricated from 16-gage (0.0598-inch) steel.
- C. Secondary Framing: Provide the following secondary framing members:
1. Roof Purlins, Sidewall and Endwall Girts: “C”-or “Z”-shaped sections fabricated from 16-gage (0.0598-inch) shop-painted roll-formed steel. Purlin spacers shall be fabricated from 14-gage (0.0747-inch) cold-formed galvanized steel sections.
 2. Eave Struts: Unequal flange “C”-shaped sections formed to provide adequate backup for both wall and roof panels. Fabricate from 16-gage (0.0598-inch) shop-painted roll-formed steel.
 3. Flange and Sag Bracing: 1-5/8-inches by 1-5/8-inch angles fabricated from 16-gage (0.0598-inch) shop-painted roll-formed steel, unless indicated otherwise on Structural Drawings.
 4. Base or Sill Channels: Fabricate from 14-gage (0.0747-inch) cold-formed galvanized steel sections.
- D. Wind Bracing: All bays and end walls are to remain open. If wind bracing is required, the manufacturer may use either heavier structural members or portal frames.
- E. Bolts: Provide shop-painted bolts except when structural framing components are in direct contact with roofing and siding panels. Provide zinc-plated or cadmium-plated bolts when structural framing components are in direct contact with roofing and siding panels.

2.4 SHOP PAINTING

- A. General: Clean surfaces to be primed of loose mill scale, rust, dirt, oil, grease, and other matter precluding paint bond. Follow procedures of SSPC-SP3 for power-tool cleaning, SSPC-SP7 for brush-off blast cleaning, and SSPC-SP1 for solvent cleaning, unless specific procedures are indicated otherwise. Shop paint structural steel, except those members or portions of members

to be embedded in concrete or mortar. Paint embedded steel which is partially exposed on portions and initial 2-inch of embedded areas only.

1. Do not paint surface which are to be welded or high-strength bolted with friction-type connections.
 2. Prime structural steel primary and secondary framing members with the manufacturer's standard rust-inhibitive primer.
 3. Prime galvanized members, after phosphoric acid pretreatment, with manufacturer's standard zinc dust-zinc oxide primer.
 4. Apply 2-coats of paint to surfaces which are inaccessible after assembly or erection. Change color of second coat to distinguish it from the first coat.
- B. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:
1. SP-1 "Solvent Cleaning," followed by SP-3 "Power Tool Cleaning."
- C. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions. Use painting methods which result in full coverage of joints, corners, edges and exposed surfaces.

2.5 PRE-FINISHED ROOFING PANELS

- A. Face Sheets: Fabricate roof panel face sheets to the profile or configuration indicated from minimum 24-gage (0.00179-inch), aluminum-zinc alloy coated steel sheets ("Galvalume") with at least 50,000 p.s.i. yield. Finish shall be manufacturer's standard 3-coat (i.e.: primer, color coat, and clear top coat) "Kynar 500" 70% resin coating.
- B. Standing Seam Roof Panels: Manufacturer's standard factory formed roof panel system and accessories designed for mechanical attachment of panels to roof purlins and framing, and machine seaming. Form panels of minimum 24 gage, aluminum-zinc alloy coated steel sheets ("Galvalume") with 50,000 p.s.i. yield.
1. Roof Panels: Butler "MR-24", or approved equivalent by one of the above named manufacturers, with concealed anchorage and sealant systems; Machine seamed.
 2. Finish: Manufacturer's standard 3-coat "Kynar 500" 70% resin coating.
 3. Colors: As selected by Owner and Engineer from manufacturer's full line of standard non-metallic color selections.
- C. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets, self-locking bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
1. Provide metal-backed neoprene washers under heads of fasteners bearing on weather side of panels.
 2. Use aluminum or stainless steel fasteners for exterior application and galvanized or cadmium-plated fasteners for interior applications.
 3. Locate and space fastenings in true vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of neoprene washer.

4. Provide fasteners with heads matching color of roofing or siding sheets by means of factory-applied coating.
- D. Accessories: Provide the following sheet metal accessories factory-formed of the same material (except 50,000 p.s.i. yield) in the same finish as roof and wall panels:
 1. Flashings
 2. Closures
 3. Fillers
 4. Metal expansion joints
 5. Fascias and trim
- E. Flexible Closure Strips: Closed-cell, expanded cellular rubber, self-extinguishing flexible closure strips. Cut or premolded to match configuration of roofing sheets. Provide closure strips where indicated or necessary to ensure weather tight construction.
- F. Sealing Tape: Pressure-sensitive 100-percent solids gray polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, non-sag, nontoxic, nonstaining tape 2-inch wide and 1/8-inch thick.
- G. Joint Sealant: One-part elastomeric polyurethane, polysulfide, or silicone rubber sealant as recommended by the building manufacturer.
- H. Insulation: None

2.6 FABRICATION

- A. General: Design prefabricated components and necessary field connections required for erection to permit easy assembly and disassembly.
 1. Fabricate components in such a manner that once assembled, they may be disassembled, repackaged, and reassembled with a minimum amount of labor.
 2. Clearly and legibly mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
- B. Structural Framing: Shop-fabricate framing components to indicated size and section with base plates, bearing plates, and other plates required for erection, welded in place. Provide holes for anchoring or connections shop-drilled or punched to template dimensions.
 1. Shop Connections: Provide power riveted, bolted, or welded shop connections.
 2. Field Connections: Provide bolted field connections.

PART 3 - EXECUTION

3.1 ERECTION

- A. Surveys: Employ a registered professional engineer or and surveyor, experienced in survey work, to establish permanent bench marks as shown and as necessary for accurate erection of pre-engineered steel structures. Check elevations of concrete bearing surfaces, and locations of

anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Engineer. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been agreed upon with Engineer.

- B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.
- C. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete work.
- D. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place work.
 - 1. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate location.
 - 2. Refer to Division 3 of these specifications for anchor bolt installation requirements in concrete.
- E. Setting Bases and Bearing Plates: Clean concrete bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
 - 1. Set loose and attached base plates and bearing plates for structural members on steel wedges or shims or other adjusting devices.
 - 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove steel wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
 - 3. Pack grout solidly between bearing surfaces and bases of plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials and allow to cure. For proprietary grout materials, comply with manufacturer's instructions.
 - a. Moist cure grout for not less than 7-days after placement.
- F. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure within specified AISC tolerances.
 - 2. Set base plates with double-nutted anchor bolts, and as otherwise required.
 - 3. Splice members only where indicated and accepted on shop drawings.
 - 4. Purlins and Girts: Provide rake or gable purlins with tight-fitting closure channels and fascias. Secure purlins and girts to structural framing and hold rigidly to a straight line by sag rods.
 - 5. Bracing: All sides and end walls to remain open.
 - a. Movement-resisting frames may be used in lieu of sidewall rod bracing, to suit manufacturer's standards.

- b. Where diaphragm strength of roof or wall covering is adequate to resist wind forces, rod or angle bracing will not be required, except when indicated on Structural Drawings.

G. Roofing:

- 1. General: Arrange and nest sidelap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weather tight enclosure. Avoid “panel creep” or application not true to line. Protect factory finishes from damage.
 - a. Field cutting of exterior panels by torch is not permitted.
 - b. Provide weather seal under ridge cap. Flash and seal roof panels at eave, rake, ventilators, and similar locations with rubber, or neoprene, or other acceptable closures to exclude weather and in compliance with warranty requirements.
- 2. Roof Sheets: Provide sealant tape at lapped joints of ribbed or fluted roof sheets and between roof sheets and skylights, protruding equipment, roof ventilators, vents, and accessories. Machine seam joints in roof panels in accordance with roof manufacturer’s current written recommendations and requirements.
 - a. Apply a continuous ribbon of sealant tape to clean, dry surface of the weather side of fastenings on end laps, and on side laps of corrugated nesting-type, ribbed, or fluted panels and elsewhere as needed to make roof sheets weatherproof to driving rains.

H. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.

- 1. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
- 2. Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

I. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to Engineer. Finish gas-cut sections equal to a sheared appearance when permitted.

J. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint. Apply paint to exposed areas with same material as used for shop painting.

- 1. Apply by brush or spray to provide a minimum dry fill thickness of 2.0-mils.

3.2 FIELD QUALITY CONTROL

A. Shop Bolted Connections: Inspect in accordance with AISC specifications.

B. Shop Welding: Inspect during fabrication of structural steel assemblies, as follows:

- 1. Certify welders and conduct inspections as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.

2. Perform visual inspection of all welds.
- C. Field Bolted Connections: Inspect in accordance with AISC specifications.
- D. Field Welding: Inspect during erection of structural steel as follows:
 1. Certify welders and conduct inspections as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
 2. Perform visual inspection of all welds.

3.3 REQUIRED PROCESS AREAS

- A. Pre-engineered metal canopy shall be provided for the process areas referenced below as indicated on construction drawings.
 1. Biological nutrient removal basin blowers
 2. Tertiary filters and UV units
 3. Digester No.2 and No.3 blowers
 4. Digested sludge transfer pump

END OF SECTION 13 31 22

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PART 1 - SECTION 26 00 00 - ELECTRICAL

PART 2 - GENERAL

2.1 Scope of Work

- A. Work under this item of the Contract shall include the furnishing of all labor, material, equipment, supplies, and services necessary to construct and install the complete electrical systems, including exterior and interior of buildings as shown on the drawings and specified herein.
- B. The Contractor shall base his proposal on the materials specified herein and on the drawings. Reference to a particular product by the manufacturer, trade name, or catalog number establishes the quality standards of materials and equipment required for this installation and is not intended to exclude products equal in quality and similar in design. Where two or more designations are listed, choice shall be optional with the Contractor. The Engineer reserves the sole right to decide the equality of materials proposed for use in lieu of those specified.

2.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2.3 CODES, PERMITS, AND INSPECTIONS

- A. Comply with applicable laws of the community, with latest edition of NEC where not in conflict with those laws, and with the service rules of the local utility company. Obtain and pay for all permits required. After completion of the work, submit certificate of final inspection and approval from the local electrical inspector, certifying that the installation complies with all regulations governing same.

2.4 DRAWINGS AND SPECIFICATIONS

- A. Consider as complementary each to the other. What is called for by one shall be as binding as if called for by both. Where conflicts occur, secure clarification from Engineer in advance of bidding; otherwise provide the more expensive quality or quantity. Follow figures in preference to scale dimensions; verify all dimensions and existing conditions.

2.5 CONFLICTS, COORDINATION AND CHANGES

- A. In the event that interferences or conflicts develop, the Engineer shall decide which equipment shall be relocated regardless of which was first installed. In the interest of avoiding such conflicts, the electrical sub-contractor who is using common space such as mechanical rooms, chases, ceiling space, etc., shall coordinate his work with all other trades and other parts of his own work.

If, during this coordination, it is discovered that necessary or desirable changes should be made, advise the Engineer and secure his decision in writing.

2.6 SUBMITTALS

- A. The Electrical Contractor shall submit five copies of a list of items proposed for use. The Electrical Contractor shall also submit five copies of catalog data and shop drawings on proposed substitutions and on panelboards, exhaust fans, transformers, motor control centers, switchboards, light fixtures, electric heaters, safety switches, surge suppressors, lightning arrestors, etc. Where substitutions alter the design or space requirements, the Electrical Contractor shall defray all items of cost for the revised design and construction including costs of all allied trades involved.
- B. The Electrical Contractor shall include in his submittals, layout drawings of all electrical rooms, layout drawings of all common space rooms, and/or layout drawings of all backboards or any other space where electrical equipment is mounted showing that he has taken into account other trades that may share this space.
- C. Record Drawings: Provide, and in such detail as required.
- D. Operations and Maintenance Manuals: Provide, and in such detail as required.

2.7 WARRANTY

- A. Warrant the entire electrical system in proper working order. Replace, without additional charge, all work or material which may develop defects (ordinary wear and tear or damage resulting from improper handling excepted) within a period of one year from date of final acceptance.

PART 3 - PRODUCTS

3.1 GENERAL

- A. All materials shall be new and shall be listed as approved by the Underwriter's Laboratories, Inc. in every case where a standard has been established for the particular type of material in question. All work shall be executed in workmanlike manner and shall present a neat and mechanical appearance when completed.

3.2 ELECTRICAL SERVICE

- A. General: Coordinate with Duke Energy. Provide all material and labor not supplied by Duke Energy to produce a complete installation meeting the Utility regulations. The Electrical Contractor shall be responsible for including all costs and fees associated with bringing power to this site in their original bid per the allowance noted in the front-end documents of these specifications. The Contractor shall pay all costs for removing the existing electric service facilities. A copy of the bill showing the cost to provide the electrical service shall be given to the Owner for verification of the cost.

- B. Characteristics of Service:
 - 1. New 277/480 volt, 60 cycle, 3 phase, 4 wire.
- C. Metering: Obtain from details from Duke Energy. The electrical contractor shall provide all miscellaneous electrical components such as conduit, wiring, metering enclosures, etc for a complete metering installation.
- D. Main Service Equipment: Install as per the Single-Line Diagram(s) and per Duke Energy's regulations. Coordinate any increase or decrease in transformer size with Duke Energy.
- E. Service Feeder: Install as per the Single-Line Diagram(s) and per Duke Energy's regulations. Coordinate any increase or decrease in transformer size with Duke Energy.
- F. Transformer: The Contractor shall coordinate with Duke Energy for correct size of service transformer prior to installation connection. Coordinate any increase or decrease in transformer size with Duke Energy.

PART 4 - EXECUTION

4.1 Visit to Site

- A. Before submitting a bid, visit the site and ascertain all existing conditions. Make such adjustments in work as are required by the actual conditions encountered.

4.2 Cutting and Chasing

- A. Where possible all work shall be built in as the job progresses. Where this is not possible, secure approval and do necessary cutting, chasing, etc. required. Do not cut through any structural members without securing approval in advance; such holes shall be neatly cut or drilled – not chipped.

4.3 Trenching and Backfilling

- A. Do all excavating necessary for installation of work; backfill trenches and excavations after work has been installed and inspected. Backfill within the building and under paved areas shall meet compaction requirements and fill material shall be pit run gravel or similar granular material.

4.4 ELECTRICAL SERVICE INSTALLATION

- A. Project Conditions: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated.
- B. Notify Project Manager and Owner no fewer than seven days in advance of proposed interruption of electrical service.

- C. Indicate method of providing temporary electrical service.
- D. Do not proceed with interruption of electrical service without Project Manager's written permission.

4.5 SALVAGE MATERIAL

- A. All metals and devices removed from the project that can be returned for scrap shall be the property of the owner. Owner shall have first right of refusal on all items that are to be demolished, removed or scrapped from the project. Contractor shall provide a list of such items in written form to the owner. Prior to the contractor salvaging any material for his own gain, the contractor shall obtain written approval from the owner.

END OF SECTION 26 00 00

PART 1 - SECTION 25 05 13 – MEDIUM VOLTAGE CABLES

PART 2 - GENERAL

A. SUMMARY

1. Section Includes:
2. Cables.
3. Connectors.
4. Solid terminations.
5. Separable insulated connectors.
6. Splice kits.
7. Medium-voltage tapes.
8. Arc-proofing materials.
9. Fault indicators.

B. Related Requirements:

1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 26 00 11 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

2.2 ACTION SUBMITTALS

- A. Product Data: For each type of cable, include splices and terminations for cables and cable accessories.
- B. Samples: 16-inch (400 mm) lengths for each type of cable specified.

2.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 3 - PRODUCTS

3.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with IEEE C2 and NFPA 70.

- C. Source Limitations: Obtain cables and accessories from single source from single manufacturer.

3.2 CABLES

- A. Manufacturer – Southwire, General or approved equal
- B. Cable Type: Type MV 105
- C. Conductor Insulation: Crosslinked polyethylene or Ethylene-propylene rubber.
 - 1. Voltage Rating: 5, 8, 15 kV.
 - 2. Insulation Thickness: 133 percent insulation level.
- D. Conductor: Copper.
- E. Comply with UL 1072, AEIC CS8, ICEA S-93-639/NEMA WC 74, and ICEA S-97-682, and ICEA S-94-649.
- F. Conductor Stranding: Compact round, concentric lay, Class B or Concentric lay, Class B.
- G. Strand Filling: Conductor interstices are filled with impermeable compound.
- H. Shielding: Copper tape or Solid copper wires, helically applied over semiconducting insulation shield.
- I. Shielding and Jacket: Corrugated copper drain wires embedded in extruded, chlorinated, polyethylene jacket.
- J. Cable Jacket: Sunlight-resistant PVC.

3.3 CONNECTORS

- A. Manufacturer – Elasti-Mold, G&W, 3M or approved equal
- B. Comply with ANSI C119.4 for connectors between aluminum conductors or for connections between aluminum to copper conductors.
- C. Copper-Conductor Connectors: Copper barrel crimped connectors.

3.4 SOLID TERMINATIONS

- A. Manufacturer – Elasti-Mold, G&W, 3M or approved equal
- B. Multiconductor Cable Sheath Seals: Type recommended by seal manufacturer for type of cable and installation conditions, including orientation.
 - 1. Cold-shrink sheath seal kit with preformed sleeve openings sized for cable and insulated conductors.

2. Heat-shrink sheath seal kit with phase- and ground-conductor re-jacketing tubes, cable- end sealing boot, and sealing plugs for unused ground-wire openings in boot.
- C. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class shall be equivalent to that of cable. Include shield ground strap for shielded cable terminations.
 1. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone-rubber, insulator modules; shield ground strap; and compression-type connector.
 2. Class 2 Terminations, Indoors: Kit with stress-relief tube, non-tracking insulator tube, shield ground strap, and compression-type connector. Include cold-shrink-rubber sleeve moisture seal for end of insulation whether or not supplied with kits.

3.5 SEPARABLE INSULATED CONNECTORS

- A. Description: Modular system with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.
- B. Manufacturer – Elasti-Mold, G&W, 3M or approved equal
- C. Standard: Comply with IEEE 386.
- D. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.
- E. Load-Break Cable Terminators: Elbow-type units with 200 A load make/break and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.
- F. Dead-Break Cable Terminators: Elbow-type unit with 200 A or 600 A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.
- G. Dead-Front Terminal Junctions: Modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals and complete with grounding lug, manufacturer's standard accessory stands, stainless steel mounting brackets, and attaching hardware.
 1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.
 2. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.
 3. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.
 4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable-elbow terminator.

- H. Test-Point Fault Indicators: Applicable current-trip ratings and arranged for installation in test points of load-break separable connectors, and complete with self-resetting indicators capable of being installed with shotgun hot stick and tested with test tool.
- I. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

3.6 SPLICE KITS

- A. Description: For splicing medium voltage cables; type as recommended by cable or splicing kit manufacturer for the application.
- B. Manufacturer – Elasti-Mold, G&W, 3M or approved equal
- C. Standard: Comply with IEEE 404.
- D. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, materials, ratings, and configurations of cable conductors. Include all components required for complete splice, with detailed instructions.

3.7 MEDIUM-VOLTAGE TAPE

- A. Description: Electrical grade, insulating tape for medium voltage application.
- B. Manufacturer – Elasti-Mold, G&W, 3M or approved equal
- C. Ethylene/propylene rubber-based, 30 mil (0.76 mm) splicing tape, rated for 130 deg C operation. Minimum 3/4 inch (20 mm) wide.
- D. Silicone rubber-based, 12 mil (0.30 mm) self-fusing tape, rated for 130 deg C operation. Minimum 1-1/2 inch (38 mm) wide.
- E. Insulating-putty, 125 mil (3.175 mm) elastic filler tape. Minimum 1-1/2 inches (38 mm) wide.

3.8 ARC-PROOFING MATERIAL

- A. Manufacturer – Elasti-Mold, G&W, 3M or approved equal
- B. Tape for First Course on Metal Objects: 10 mil (250 micrometer) thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.
- C. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3 inch (8 mm) thick, and compatible with cable jacket.
- D. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1 inch (25 mm) wide.

3.9 SOURCE QUALITY CONTROL

- A. Test and inspect cables according to ICEA S-97-682 or ICEA S-94-649 before shipping.
- B. Test strand-filled cables for water-penetration resistance according to ICEA T-31-610, using a test pressure of 5 psig (35 kPa).

PART 4 - EXECUTION

4.1 INSTALLATION

- A. Install cables according to IEEE 576.
- B. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab through the conduit. Separate the wire brush and the rubber swab by 48 to 72 inch (1200 to 1800 mm) on the pull rope.
 - 1. Wire Brush Mandrel: Consists of a length of brush approximately the size of the conduit inner diameter with stiff steel bristles and an eye on each end for attaching the pull ropes. If an obstruction is felt, pull the brush back and forth repeatedly to break up the obstruction.
 - 2. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching the pull ropes. Pull the rubber duct swab through the duct to extract loose debris from the duct.
- C. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
 - 1. Where necessary, use manufacturer-approved pulling compound or lubricant that does not deteriorate conductor or insulation.
 - 2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips, that do not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
 - 3. Use pull-in guides, cable feeders, and draw-in protectors as required to protect cables during installation.
 - 4. Do not pull cables with ends unsealed. Seal cable ends with rubber tape.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- E. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."
- F. Install direct-buried cables on leveled and tamped bed of 3 inch (75 mm) thick, clean sand. Separate cables crossing other cables or piping by a minimum of 2 inch (50 mm) of tamped earth, plus an additional 2 inch (50 mm) of sand. Install permanent markers at ends of cable runs, changes in direction, and buried splices.
- G. Install "buried-cable" warning tape 12 inch (305 mm) above cables.
- H. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit; support cables at intervals adequate to prevent sag.

- I. Install sufficient cable length to remove cable ends under pulling grips. Remove length of conductor damaged during pulling.
- J. Install cable splices at pull points and elsewhere as indicated; Use dead-front separable watertight connectors in manholes and other locations subject to water infiltration.
- K. Install terminations at ends of conductors, and seal multiconductor cable ends with standard kits.
- L. Install separable insulated-connector components as follows:
 - 1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
 - 2. Portable Feed-Through Accessory: At each terminal junction, with one on each terminal.
 - 3. Standoff Insulator: At each terminal junction, with one on each terminal.
- M. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:
 - 1. Clean cable sheath.
 - 2. Wrap metallic cable components with 10 mil (250 micrometer) pipe-wrapping tape.
 - 3. Smooth surface contours with electrical insulation putty.
 - 4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.
 - 5. Band arc-proofing tape with two layers of 1 inch (25 mm) wide half-lapped, adhesive, glass-cloth tape at each end of the arc-proof tape.
- N. Seal around cables passing through fire-rated elements according to Section 07 84 13 "Penetration Firestopping."
- O. Install fault indicators on each phase where indicated.
- P. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.
- Q. Ground shields of shielded cable at one point only. Maintain shield continuity and connections to metal connection hardware at all connection points.
- R. Identify cables according to Section 26 05 53 "Identification for Electrical Systems." Identify phase and circuit number of each conductor at each splice, termination, pull point, and junction box. Arrange identification so that it is unnecessary to move the cable or conductor to read the identification.

4.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.

2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
 3. Perform Partial Discharge test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.
 4. Perform Dissipation Factor test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.
- B. Prepare test and inspection reports.

END OF SECTION 26 05 13

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SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.
2. Section 26 05 23 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
3. Section 27 13 13 "Communications Copper Backbone Cabling" for twisted pair cabling used for data circuits.
4. Section 27 15 13 "Communications Copper Horizontal Cabling" for twisted pair cabling used for data circuits.

1.3 DEFINITIONS

- A. PV: Photovoltaic.
- B. RoHS: Restriction of Hazardous Substances.
- C. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer's authorized service representative.

- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Belden Inc.
 - 2. Okonite Company (The).
 - 3. Southwire Company.
 - 4. Or Engineer approved equal.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation:
 - 1. Type NM: Comply with UL 83 and UL 719.
 - 2. Type RHW-2: Comply with UL 44.
 - 3. Type SE: Comply with UL 854.
 - 4. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
 - 5. Type THHN and Type THWN-2: Comply with UL 83.
 - 6. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
 - 7. Type UF: Comply with UL 83 and UL 493.
 - 8. Type XHHW-2: Comply with UL 44.
- F. Shield:

1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, dual spirally wrapped copper tape shields and three bare symmetrically applied ground wires, and sunlight- and oil-resistant outer PVC jacket.

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. 3M Electrical Products.
 2. Hubbell Power Systems, Inc.
 3. O-Z/Gedney; a brand of Emerson Industrial Automation.
 4. TE Connectivity Ltd.
 5. Thomas & Betts Corporation; A Member of the ABB Group.
 6. Engineer Approved Equal.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Feeders: Copper for feeders smaller than No. 2 AWG; aluminum for feeders No. 2 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- D. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- E. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- F. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.
- G. PV Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- F. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway.
- G. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- J. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- K. Branch Circuits in Cable Tray: Type THHN/THWN-2, single conductors in raceway.
- L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- M. VFC Output Circuits: Type XHHW-2 in metal conduit.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

- G. Complete cable tray systems installation according to Section 26 05 36 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors feeding the following critical equipment and services for compliance with requirements:
 3. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
 4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 5. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- E. Cables will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports to record the following:
1. Procedures used.
 2. Results that comply with requirements.
 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 05 19

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SECTION 26 05 23 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Backboards.
 - 2. Category 6 twisted pair cable.
 - 3. Twisted pair cabling hardware.
 - 4. RS-485 cabling.
 - 5. Low-voltage control cabling.
 - 6. Control-circuit conductors.
 - 7. Identification products.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- D. RCDD: Registered Communications Distribution Designer.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency, RCDD, layout technician, installation supervisor, and field inspector, certified cabling agent and installer.
- B. Source quality-control reports.

- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - 1. Flame Travel Distance: 60 inches or less.
 - 2. Peak Optical Smoke Density: 0.5 or less.
 - 3. Average Optical Smoke Density: 0.15 or less.
- C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.
- E. RoHS compliant.

2.2 BACKBOARDS

- A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches.
- B. Painting: Paint plywood on all sides and edges with black alkyd paint. Comply with requirements in Section 09 96 00 – High-Performance Coatings.

2.3 CATEGORY 6 TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden CDT Networking Division/NORDX.
 2. General Cable; General Cable Corporation.
 3. Mohawk; a division of Belden Networking, Inc.
 4. Or Approved Equal.
- C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables. All network cabling shall be certified and installed by a certified installer.
- D. Conductors: 100-ohm, 23 AWG solid copper.
- E. Shielding/Screening: Shielded twisted pairs (FTP).
- F. Cable Rating: Plenum.
- G. Jacket: Blue thermoplastic.

2.4 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Belden CDT Networking Division/NORDX.
 2. General Cable; General Cable Corporation.
 3. Hubbell Premise Wiring.
 4. Leviton Manufacturing Co., Inc.
 5. Mohawk; a division of Belden Networking, Inc.
 6. Or Approved Equal.
- C. General Requirements for Twisted Pair Cable Hardware:
1. Comply with the performance requirements of Category 6.
 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 3. Cables shall be terminated with connecting hardware of same category or higher.
- D. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.
- E. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- F. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.

- G. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
 - 1. Features:
 - a. Universal T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 - c. Replaceable connectors.
 - d. 24 or 48 ports.
 - 2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
 - 3. Number of Jacks per Field: One for each four-pair cable indicated.
- H. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with an eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.
- I. Plugs and Plug Assemblies:
 - 1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded twisted pair cable.
 - 2. Comply with IEC 60603-7-1, IEC 60603-7-2, IEC 60603-7-3, IEC 60603-7-4, and IEC 60603-7.5.
 - 3. Marked to indicate transmission performance.
- J. Jacks and Jack Assemblies:
 - 1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded twisted pair cable.
 - 2. Designed to snap-in to a patch panel or faceplate.
 - 3. Standards:
 - a. Category 5e, unshielded twisted pair cable shall comply with IEC 60603-7-2.
 - b. Category 5e, shielded twisted pair cable shall comply with IEC 60603-7-3.
 - c. Category 6, unshielded twisted pair cable shall comply with IEC 60603-7-4.
 - d. Category 6, shielded twisted pair cable shall comply with IEC 60603-7.5.
 - e. Category 6a, unshielded twisted pair cable shall comply with IEC 60603-7-41.
 - f. Category 6a, shielded twisted pair cable shall comply with IEC 60603-7.51.
 - 4. Marked to indicate transmission performance.
- K. Faceplate:
 - 1. Two port, vertical single-gang faceplates designed to mount to single-gang wall boxes.
 - 2. Eight port, vertical double-gang faceplates designed to mount to double-gang wall boxes.
 - 3. Plastic Faceplate: High-impact plastic. Coordinate color with Section 26 27 26 "Wiring Devices."

4. Metal Faceplate: Stainless steel, complying with requirements in Section 26 27 26 "Wiring Devices."
5. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.

L. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CMG.

1. Paired, one pair, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, one pair, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262.

2.6 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. Multi-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. Multi-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.7 CONTROL-CIRCUIT CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Cable; General Cable Corporation.
 - 2. Southwire Company.
 - 3. Or Approved Equal.
- B. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- C. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- E. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.
 - 1. Smoke control signaling and control circuits.

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test twisted pair cables according to TIA-568-C.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test cables on receipt at Project site.
 - 1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2. Outlet boxes for cables shall be no smaller than 4 inches square by 1-1/2 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
 3. Flexible metal conduit shall not be used.
- B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Raceway Installation in Equipment Rooms:
1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
 2. Install cable trays to route cables if conduits cannot be located in these positions.
 3. Secure conduits to backboard if entering the room from overhead.
 4. Extend conduits 3 inches above finished floor.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
1. Comply with TIA-568-C Series of standards.
 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 4. Cables may not be spliced.
 5. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
 9. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
 10. Support: Do not allow cables to lie on removable ceiling tiles.
 11. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
 12. All terminations shall be made with ring or fork type terminals.

C. Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Install termination hardware as specified in Section 27 15 13 "Communications Copper Horizontal Cabling" unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Below each feed point, neatly coil a minimum of 72 inches of cable in a coil not less than 12 inches in diameter.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.5 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
 1. Class 1 remote-control and signal circuits; No 14 AWG.
 2. Class 2 low-energy, remote-control, and signal circuits; No. 14 AWG.
 3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.6 FIRESTOPPING

- A. Comply with TIA-569-D, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 GROUNDING

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For low-voltage control wiring and cabling, comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

- B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. Tests and Inspections:
 - 1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- F. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- G. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- H. Prepare test and inspection reports.

END OF SECTION 26 05 23

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Lightning Protection Institute Installation Standard, LPI 175
- C. National Fire Protection Association Lightning Protection Standard, NFPA 780
- D. Underwriters Laboratories, Inc. Installation Requirements, UL96A

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Ground bonding common with lightning protection system.
 - 3. Foundation steel electrodes.
 - 4. Lightning Protection System.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 - a. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1) Test wells.
 - 2) Ground rods.
 - 3) Ground rings.
 - 4) Grounding arrangements and connections for separately derived systems.
 - b. Instructions for periodic testing and inspection of grounding features at ground rings and test well based on NFPA 70B.
 - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. ERICO International Corporation.
 - 3. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 4. Thomas & Betts Corporation; A Member of the ABB Group.
 - 5. Or Approved Equal.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- G. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- H. Conduit Hubs: Mechanical type, terminal with threaded hub.
- I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with socket set screw.
- J. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- K. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

- L. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- M. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- N. Straps: Solid copper, copper lugs. Rated for 600 A.
- O. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one-piece clamp.
- P. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- Q. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with stainless-steel bolts.
 - a. Material: Die-cast zinc alloy.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet.
- B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

2.6 LIGHTNING PROTECTION SYSTEM

- 1. The system to be furnished under this specification shall be the standard product of manufacturers regularly engaged in the production of lightning protection equipment and shall be the manufacturer's latest approved design. The equipment shall be UL listed and properly UL labeled. All equipment shall be new and of a design and construction to suit the application where it is used in accordance with accepted industry standards and LPI, UL, and NFPA code requirements.
- 2. All materials shall be copper and bronze and of the size, weight, and construction to suit the application and used in accordance with LPI, UL, and NFPA code requirements. Class I sized components may be utilized on roof levels 75 feet and below in height. Class II sized components are required for roof levels over 75 feet in height. Bolt type connectors and splicers shall be utilized on Class I and Class II structures. Pressure squeeze clamps are not acceptable. All mounting hardware shall be stainless steel to prevent corrosion.
- 3. Aluminum materials may not be used except on roofs that utilize aluminum, galvalume or galvanized metal roofing components. On aluminum, galvalume or galvanized metal roofs or where aluminum, galvalume or galvanized metal parapet caps exist, the entire roof lightning protection equipment shall utilize aluminum components to insure compatibility. However, the down leads and grounding are to utilize copper with the bimetal transition occurring at the through roof assembly with an approved bimetal through roof assembly.
- 4. A surge arrester at the main electrical service entrance is required by Underwriters Laboratories UL96A lightning protection codes and in order to obtain the UL Master Label

certification. It shall be the responsibility of the electrical contractor to install or verify that a surge arrester is installed on the main electrical service.

5. The installation shall be accomplished by an experienced installation company that is UL listed, a member of the Lightning Protection Institute and an employer of Certified Master Installers of lightning protection systems. A Certified Master Installer shall directly supervise the work. All equipment shall be installed in a neat, workmanlike manner. The system shall consist of a complete conductor network at the roof and include air terminals, connectors, splicers, bonds, copper down leads, and proper ground terminals. Copper down lead conductors shall be utilized even when aluminum is required on the roof. Down lead conductors in conduit shall not be brought directly through the roof. Through roof assemblies with solid brass or stainless steel rods shall be utilized for this purpose. Structural steel may be utilized in the installation as outlined by UL, NFPA, and LPI.
6. The lightning protection installer will work with other trades to insure a correct, neat and unobtrusive installation. The roofing contractor will be responsible for sealing and flashing all lightning protection roof penetrations as per the roof manufacturer's recommendations. However, the lightning protection contractor will be required to coordinate locations of through roofs and submit details of through roof penetrations as required. The lightning protection contractor shall use a compatible adhesive to adhere lightning protection components to the roof when required. The lightning protection contractor shall furnish and install the adhesive and obtain an approval of the compatible adhesive from the roof manufacturer/contractor prior to the installation. Should the roofing contractor/manufacture require any special walk pads, membrane patches, pavers, etc. under the components of the lightning protection system, it shall be the responsibility of the roofing contractor to furnish and install such items. The lightning protection installer shall be responsible for marking the roof with all conductor and/or pad locations. It shall be the responsibility of the lightning protection installer to assure a sound bond to the main water service and to assure interconnection with other ground systems.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG minimum.
 1. Bury at least 24 inches below grade.
 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, non-shrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
 - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - 9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- H. Metallic Fences: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

- H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
 - 1. Install tinned-copper conductor not less than No. 3/0 AWG for ground ring and for taps to building steel.
 - 2. Bury ground ring not less than 24 inches from building's foundation.
- I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
 - 1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level shall be no more than ten (10) OHMS at all locations covered by these specifications, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- F. Grounding system will be considered defective if resistance is more than ten (10) OHMS and it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Report measured ground resistances that exceed values as listed on the plans.
- I. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Steel slotted support systems.
2. Aluminum slotted support systems.
3. Nonmetallic slotted support systems.
4. Conduit and cable support devices.
5. Support for conductors in vertical conduit.
6. Structural steel for fabricated supports and restraints.
7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
8. Fabricated metal equipment support assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.
2. Include rated capacities and furnished specialties and accessories.

- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.

3. Equipment supports.
 4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For hangers and supports for electrical systems.
1. Include design calculations and details of hangers.
 2. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
 2. Ductwork, piping, fittings, and supports.
 3. Structural members to which hangers and supports will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Projectors.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M.
 2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design hanger and support system.

- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the supported equipment and systems will be fully operational after the seismic event."
 - 2. Component Importance Factor: 1.5.
- C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- B. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- C. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti, Inc.
 - 2) MKT Fastening, LLC.
 - 3) Or Approved Equal.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) B-line, an Eaton business.
 - 2) Hilti, Inc.

- 3) MKT Fastening, LLC.
- 4) Or Approved Equal.

- 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
- 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
- 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
- 6. Toggle Bolts: Stainless-steel springhead type.
- 7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 05 50 00 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. NECA 101
 - 3. NECA 102.
 - 4. NECA 105.
 - 5. NECA 111.
- B. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 05 50 00 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Section 09 91 13 "Exterior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. CGRC: PVC Coated Galvanized Rigid Conduit.
- C. PVC: Schedule 40 Poly Vinyl Chloride Conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 1. Structural members in paths of conduit groups with common supports.
 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allied Tube & Conduit; a part of Atkore International.
 - 2. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 3. Perma-Cote.
 - 4. Plasti-Bond.
 - 5. Southwire Company.
 - 6. Thomas & Betts Corporation; A Member of the ABB Group.
 - 7. Wheatland Tube Company.
 - 8. Or Approved Equal.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch, minimum.
- E. FMC: Comply with UL 1; zinc-coated steel.
- F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- H. Joint Compound for GRC or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CANTEX INC.
 2. RACO; Hubbell.
 3. Thomas & Betts Corporation; A Member of the ABB Group.
 4. Or Approved Equal.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fiberglass:
1. Comply with NEMA TC 14.
 2. Comply with UL 2515 for aboveground raceways.
 3. Comply with UL 2420 for belowground raceways.
- D. ENT: Comply with NEMA TC 13 and UL 1653.
- E. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- F. LFNC: Comply with UL 1660.
- G. Rigid HDPE: Comply with UL 651A.
- H. Continuous HDPE: Comply with UL 651A.
- I. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- J. RTRC: Comply with UL 2515A and NEMA TC 14.
- K. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- L. Fittings for LFNC: Comply with UL 514B.

- M. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hoffman; a brand of Pentair Equipment Protection.
 - 2. Square D.
 - 3. Rittal
 - 4. Or Approved Equal.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 12 unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allied Moulded Products, Inc.
 - 2. Hoffman; a brand of Pentair Equipment Protection.
 - 3. Or Approved Equal.
- B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

- E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- F. Solvents and Adhesives: As recommended by conduit manufacturer.

2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.
 - d. Or Approved Equal.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.
 - d. Or Approved Equal.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Crouse-Hinds, an Eaton business.
 - 2. Hoffman; a brand of Pentair Equipment Protection.
 - 3. Hubbell Incorporated; Wiring Device-Kellems.
 - 4. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 5. Plasti-Bond.
 - 6. Thomas & Betts Corporation; A Member of the ABB Group.
 - 7. Wiremold / Legrand.
 - 8. Or Approved Equal.

- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes:
 - 1. Material: Cast metal or sheet metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Nonadjustable, rectangular.
 - 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
 - 1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- M. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.
- N. Gangable boxes are allowed.
- O. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Fiberglass.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

P. Cabinets:

1. NEMA 250, Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Oldcastle Precast, Inc.
 - b. Quazite: Hubbell Power Systems, Inc.
 - c. Or Approved Equal.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.

2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC,.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R, unless otherwise noted.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: GRC.
2. Exposed, Not Subject to Severe Physical Damage: GRC.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
4. Concealed in Ceilings and Interior Walls and Partitions: GRC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use setscrew, cast-metal fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. All vertical turnups from underground raceways shall utilize GRC sweep 90-degree radius bends and GRC vertical conduit. The Vertical portion of the conduit shall be coated or wrapped in a bitumastic coating system from below grade to 6 inches above grade.
- J. Stub-ups to Above Recessed Ceilings:
 1. Use GRC for raceways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- S. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.

- V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- W. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.
- Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- BB. Locate boxes so that cover or plate will not span different building finishes.
- CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

- DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- EE. Set metal floor boxes level and flush with finished floor surface.
- FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 20 00 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 31 20 00 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 20 00 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

- D. Install handholes with bottom below frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

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SECTION 26 05 36 – CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Ladder cable tray.
- 2. Solid-bottom cable tray.
- 3. Cable tray accessories.
- 4. Warning signs.

B. Related Requirements:

- 1. Section 27 05 36 "Cable Trays for Communications Systems" for cable trays and accessories serving communications systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.

- 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
- 2. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to sides of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

C. Delegated-Design Submittal: For seismic restraints.

1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer who is licensed in the state where Project is located and who is responsible for their preparation.
2. Design Calculations: Calculate requirements for selecting seismic restraints.
3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
 2. Vertical and horizontal offsets and transitions.
 3. Clearances for access above and to side of cable trays.
 4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
- B. Seismic Qualification Certificates: For cable trays, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cable tray supports and seismic bracing.
- B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
 2. Component Importance Factor: 1.5.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.

1. Temperature Change: 120 deg F, ambient.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAY

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
- C. Structural Performance: See articles on individual cable tray types for specific values for the following parameters:
 1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
 3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.3 LADDER CABLE TRAY

- A. Manufactures: Snake Tray; Husky; or US Tray.
- B. Description:
 1. Configuration: Two longitudinal side rails with transverse rungs swaged or welded to side rails, complying with NEMA VE 1.
 2. Width: 36 inches unless otherwise indicated on Drawings.
 3. Minimum Usable Load Depth: 5 inches.
 4. Straight Section Lengths: 10 feet, except where shorter lengths are required to facilitate tray assembly.
 5. Rung Spacing: 6 inches o.c.
 6. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
 7. Minimum Cable-Bearing Surface for Rungs: 7/8-inch width with radius edges.
 8. No portion of the rungs shall protrude below the bottom plane of side rails.
 9. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
 10. Fitting Minimum Radius: 24 inches.
 11. Class Designation: Comply with NEMA VE 1, Class 5A
 12. Splicing Assemblies: Bolted type using serrated flange locknuts.
 13. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
 14. Covers: Ventilated-hat type made of same materials and with same finishes as cable tray.

A. Materials and Finishes:

1. Steel (not applicable for this project)
 - a. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1011/A 1011M, SS, Grade 33.
 - b. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
 - c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
 - e. Finish: Hot-dipped galvanized after fabrication, complying with ASTM A123/A123 M, Class B2.
 - 1) Hardware: Stainless steel, Type 316.
 - f. Finish: Hot-dipped galvanized after fabrication, complying with ASTM A 653/A 653M, G90.
 - 1) Hardware: Galvanized, ASTM B 633.
 - g. Finish: Electrogalvanized after fabrication, complying with ASTM B 633.
 - h. Hardware: Galvanized, ASTM B 633.
 - i. Finish: Powder-coat enamel paint.
 - 1) Powder-Coat Enamel: Cable tray manufacturer's recommended primer and corrosion-inhibiting treatment, with factory-applied powder-coat paint.
 - 2) Epoxy-Resin Prime Coat: Cold-curing epoxy primer, MPI# 101.
 - 3) Epoxy-Resin Topcoat: Epoxy, cold-cured gloss, MPI# 77.
 - 5) Hardware: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.
 - j. Finish: Factory-standard primer, ready for field painting, with chromium-zinc-plated hardware according to ASTM F 1136.
 - k. Finish: Black oxide finish for support accessories and miscellaneous hardware according to ASTM D 769.
2. Aluminum
 - a. Materials: Alloy 6063-T6 according to ANSI H35.1/H 35.1M for extruded components, and Alloy 6061-T6 according to ANSI H35.1/H 35.1M for fabricated parts.
 - b. Hardware: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.
 - c. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.
3. Stainless Steel:
 - a. Materials: Low-carbon, passivated stainless steel, Type 316L, ASTM F 593 and ASTM F 594.
 - b. Hardware for Stainless-Steel Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

6.1 SOLID-BOTTOM CABLE TRAY (use only as specially directed by the Engineer)

A. Manufactures: Snake Tray; Husky; or US Tray.

B. Description:

1. Configuration: Two longitudinal side rails with a nonventilated continuous bottom.
2. Width: 36 inches unless otherwise indicated on Drawings.
3. Minimum Usable Load Depth: 5 inches.
4. Straight Section Lengths: 10 feet, except where shorter lengths are required to facilitate tray assembly.
5. No portion of the continuous bottom shall protrude below the bottom plane of side rails.
6. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
7. Fitting Minimum Radius: 24 inches.
8. Class Designation: Comply with NEMA VE 1, Class 5A.
9. Splicing Assemblies: Bolted type using serrated flange locknuts.
10. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
11. Covers: Louvered 2-in-3 pitch type made of same materials and with same finishes as cable tray.

B. Materials and Finishes:

1. Steel (not applicable for this project)

- a. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1011/A 1011M, SS, Grade 33.
- b. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
- c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
- e. Finish: Hot-dipped galvanized after fabrication, complying with ASTM A123/A123 M, Class B2.
 - 1) Hardware: Stainless steel, Type 316.
- f. Finish: Hot-dipped galvanized after fabrication, complying with ASTM A 653/A 653M, G90.
 - 1) Hardware: Galvanized, ASTM B 633.
- g. Finish: Electrogalvanized after fabrication, complying with ASTM B 633.
- h. Hardware: Galvanized, ASTM B 633.
- i. Finish: Powder-coat enamel paint.
 - 1) Powder-Coat Enamel: Cable tray manufacturer's recommended primer and corrosion-inhibiting treatment, with factory-applied powder-coat paint.
 - 2) Epoxy-Resin Prime Coat: Cold-curing epoxy primer, MPI# 101.
 - 3) Epoxy-Resin Topcoat: Epoxy, cold-cured gloss, MPI# 77.
 - 5) Hardware: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

- j. Finish: Factory-standard primer, ready for field painting, with chromium-zinc-plated hardware according to ASTM F 1136.
 - k. Finish: Black oxide finish for support accessories and miscellaneous hardware according to ASTM D 769.
2. Aluminum
- a. Materials: Alloy 6063-T6 according to ANSI H35.1/H 35.1M for extruded components, and Alloy 6061-T6 according to ANSI H35.1/H 35.1M for fabricated parts.
 - b. Hardware: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.
 - c. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.
3. Stainless Steel:
- a. Materials: Low-carbon, passivated stainless steel, Type 316L, ASTM F 593 and ASTM F 594.
 - b. Hardware for Stainless-Steel Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

10.1 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Barrier Strips: Same materials and finishes as for cable tray.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

10.2 WARNING SIGNS

- A. Lettering: 1-1/2-inch high, black letters on yellow background, with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."
- B. Comply with Section 26 05 53 "Identification for Electrical Systems."

10.3 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect cable trays according to NEMA FG 1.

PART 11 - EXECUTION

11.1 CABLE TRAY INSTALLATION

- A. Install cable tray and support systems according to NEMA FG 1.
- B. Install cable tray as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable tray, so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square-neck carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure.
- G. Design fasteners and supports to carry cable tray, cables, and a concentrated load of 200 lb. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems." Comply with seismic-restraint details according to Section 26 05 48.16 "Seismic Controls for Electrical Systems".
- H. Place supports, so that spans do not exceed maximum spans on schedules, and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of tray rungs.
- I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- J. Support assembly to prevent twisting from eccentric loading.
- K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
- L. Do not install more than one cable tray splice between supports.
- M. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- N. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed recommended dimensions. Space connectors and set gaps according to applicable standard.
- O. Make changes in direction and elevation using manufacturer's recommended fittings.
- P. Make cable tray connections using manufacturer's recommended fittings.

- Q. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
- R. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- S. Install cable trays with enough workspace to permit access for installing cables.
- T. Install barriers to separate cables of different systems, such as power, communications, and data processing, or of different insulation levels, such as 600, 5000, and 15 000 V.
- U. Install permanent covers and cover clamps, if used, after installing cable.
- V. Clamp covers on cable trays installed outdoors with heavy-duty clamps.
- W. Install warning signs in visible locations on or near cable trays after cable tray installation.

11.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Cable trays with electrical power conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72-inch intervals. The grounding conductor shall be sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."
- D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding-bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
- E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

11.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18 inches.

- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.
- E. Tie mineral-insulated cables down every 36 inches where required to provide a two-hour fire rating and every 72 inches elsewhere.
- F. In existing construction, remove inactive or dead cables from cable trays.

11.4 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect raceways to cable trays according to requirements in NEMA FG 1.

11.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
 - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
 - 4. Verify that there are no intruding items, such as pipes, hangers, or other equipment, in the cable tray.
 - 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
 - 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
 - 7. Check for improperly sized or installed bonding jumpers.
 - 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 - 9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.
- B. Prepare test and inspection reports.

11.6 PROTECTION

- A. Protect installed cable trays and cables.
 - 1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
 - 2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
 - 3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 26 05 36

SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
- 2. Sleeve-seal systems.
- 3. Sleeve-seal fittings.
- 4. Grout.
- 5. Silicone sealants.

B. Related Requirements:

- 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

- 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
- 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40 used for underground horizontal runs.
- D. Aluminum Rigid Conduit: ARC turn up elbows; ARC to 18" above finished grade or floor.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Metraflex Company (The).
 - c. Engineer Approved Equal.
 - 2. Sealing Elements: Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. HOLDRITE
 - b. Engineer Approved Equal.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
 - 2. Labels.
 - 3. Bands and tubes.
 - 4. Tapes and stencils.
 - 5. Tags.
 - 6. Signs.
 - 7. Cable ties.
 - 8. Paint for identification.
 - 9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.

- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E and Section 26 05 74 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on a white field.
 - 2. Legend: Indicate voltage.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 240-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - 4. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 5. Color for Neutral: White or gray.
 - 6. Color for Equipment Grounds: Green.
 - 7. Colors for Isolated Grounds: Green with white stripe.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:

1. Identify system voltage with black letters on a white background.

E. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.3 LABELS

A. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Brother International Corporation.
 - c. Panduit Corp.
 - d. Or Approved Equal.
2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
3. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

2.4 BANDS AND TUBES

A. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Panduit Corp.
 - c. Or Approved Equal.
 - d. All wires and cables shall have heat-shrink identification at all terminations and splices.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlton Industries, LP.
 - b. Panduit Corp.
 - c. Or Approved Equal.
- B. Underground-Line Warning Tape:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Seton Identification Products.
 - c. Or Approved Equal.
 2. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 3. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
 4. Tag: Type I:
 - a. Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - b. Width: 3 inches.
 - c. Thickness: 4 mils.
 - d. Weight: 18.5 lb/1000 sq. ft..
 - e. Tensile according to ASTM D 882: 30 lbf and 2500 psi.
 5. Tag: Type II:
 - a. Multilayer laminate, consisting of high-density polyethylene scrim coated with pigmented polyolefin; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.

- b. Width: 3 inches.
 - c. Thickness: 12 mils.
 - d. Weight: 36.1 lb/1000 sq. ft.
 - e. Tensile according to ASTM D 882: 400 lbf and 11,500 psi.
- 6. Tag: Type ID:
 - a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - b. Width: 3 inches.
 - c. Overall Thickness: 5 mils.
 - d. Foil Core Thickness: 0.35 mil.
 - e. Weight: 28 lb/1000 sq. ft..
 - f. Tensile according to ASTM D 882: 70 lbf and 4600 psi.
- 7. Tag: Type IID:
 - a. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - b. Width: 3 inches.
 - c. Overall Thickness: 8 mils.
 - d. Foil Core Thickness: 0.35 mil.
 - e. Weight: 34 lb/1000 sq. ft.
 - f. Tensile according to ASTM D 882: 300 lbf and 12,500 psi.
- C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Seton Identification Products.
 - d. Or Approved Equal.

2.7 SIGNS

- A. Metal-Backed Butyrate Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Marking Services, Inc.
 - c. Or Approved Equal.
2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 10 by 14 inches.

2.8 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Marking Services, Inc.
 2. Panduit Corp.
 3. Or Approved Equal.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "UPS."
- M. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- P. Self-Adhesive Labels:
1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
- Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- W. Underground Line Warning Tape:
1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
 2. Limit use of underground-line warning tape to direct-buried cables.
 3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- X. Metal Tags:
1. Place in a location with high visibility and accessibility.
 2. Secure using UV-stabilized cable ties.

Y. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized cable ties.

Z. Write-on Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized cable ties.

AA. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

BB. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

CC. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

DD. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch-high, black letters on 20-inch centers.

1. Locate identification at changes in direction, at penetrations of walls and floors, and at 30-foot maximum intervals.
- D. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- E. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
 1. "EMERGENCY POWER."
 2. "POWER."
 3. "UPS."
- F. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify the phase.
 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.
- H. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- I. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.
- J. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- K. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- L. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- M. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
 1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to raceways concealed within wall.

3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- N. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- O. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- P. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Metal-backed, butyrate warning signs.
 1. Apply to exterior of door, cover, or other access.
 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- Q. Arc Flash Warning Labeling: Self-adhesive labels.
- R. Operating Instruction Signs: Metal-backed, butyrate warning signs.
- S. Emergency Operating Instruction Signs: Metal-backed, butyrate warning signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- T. Equipment Identification Labels:
 1. Indoor Equipment: Metal-backed butyrate signs.
 2. Outdoor Equipment: Laminated acrylic or melamine sign.
 3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - g. Substations.
 - h. Emergency system boxes and enclosures.
 - i. Motor-control centers.
 - j. Enclosed switches.
 - k. Enclosed circuit breakers.
 - l. Enclosed controllers.
 - m. Variable-speed controllers.

- n. Push-button stations.
- o. Power-transfer equipment.
- p. Contactors.
- q. Remote-controlled switches, dimmer modules, and control devices.
- r. Battery-inverter units.
- s. Battery racks.
- t. Power-generating units.
- u. Monitoring and control equipment.
- v. UPS equipment.

END OF SECTION 26 05 53

SECTION 26 05 73 – ELECTRICAL SYSTEM STUDY

PART 1 - GENERAL

1.01 SCOPE

- A. The Contractor shall provide an engineering analysis including an electrical coordination study and arc flash assessment for the entire electrical system at the wastewater treatment plant commencing at the utility pad-mount transformer (including all proposed new systems as well as all existing systems denoted to remain in service). Obtain the short circuit data at the primary of the utility pad-mount transformer from the local electric utility. Obtain all fault contribution information for the proposed new generator(s). The analysis shall include a short-circuit analysis and protective device evaluation. In addition, the analysis shall include an Arc Flash study.
- B. After the completion of the Electrical System Analysis, the Contractor shall coordinate between the calculated fault current and the published integrated withstand ratings shown in switchboard and panel schedules. The Contractor shall provide over current protection devices (OCPD) with withstand ratings greater than calculated fault currents. The Contractor shall be responsible for all OCPD's to coordinate properly. This effort may include changing OCPD technology as required (ie thermal trip to solid state trip).
- C. The project shall begin at the point of utility service for the facility and continue down through the system, to all downstream distribution switchgear; branch panelboards; motor control centers; variable frequency motor controllers; local safety switches; as well as motors; and all motors larger than 5HP.
- D. The study shall include any new generators and any associated emergency power distribution equipment, including automatic transfer switches and generator ground fault protection.

1.02 RELATED DOCUMENTS

- A. Single line diagrams
- B. Specifications

1.03 SUBMITTALS

- A. General. Submit the following according to Conditions of the Contract Documents:
- B. Submit for review six copies of the protection coordination study.

- C. Shop drawings for equipment effected by the coordination study will not be reviewed until the coordination study has been submitted and approved.
- D. Qualification data for firms and persons specified in the “Quality Assurance” Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Engineer and Owner, and other information specified.
- E. A one-line diagram of the system shall be included.
- F. The final report shall be bound in a three-ring binder.
- G. The final report shall contain individual, tabbed sections for each section. Each tabbed section shall contain the information as outlined in Part 2 of this document. Tab 1 shall list the manufacturer’s name, address, general business phone number, after hours service phone number, spare parts phone number, distributor’s name, address, general business phone number, after hours service phone number and spare parts phone number. Tab 2 shall contain Section 2.2’s short-circuit analysis with protective device evaluation. Tab 3 shall contain Section 2.3’s protective device coordination study. Tab 4 contains Section 2.4’s information and so on.

1.04 RELATED STANDARDS

- A. All studies shall be performed in accordance with the latest applicable IEEE and ANSI standards.

1.05 QUALITY ASSURANCE

- A. Preparer Qualifications: Firm experienced in the analysis, evaluation, and coordination of electrical distribution systems and similar to the system for this project. Firm must have at a minimum a 5-year record of successful in-service performance.
- B. The study shall be prepared in accordance with the latest edition of NETA Std. ATS, NFPA 70B, the “National Electrical Code”, ANSI C2” National Electrical Safety Code”, and ANSI/IEEE Guidelines, as well as manufacturer’s recommendations.
- C. Short-Circuit Analysis and Coordination Study shall be performed by a registered Professional Engineer registered in the state where the project site is located. Study shall be signed and sealed by the Engineer. The Engineer shall have a minimum of eight years experience in the analysis, evaluation, and coordination of electrical distribution systems.
- D. The firm conducting the study shall have Professional Liability Insurance in addition to standard general insurance.

1.06 DELIVERY, STORAGE AND HANDLING

- A. The six sets of submittals shall be submitted for review and approval to release.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Engineering analysis and coordination study shall be performed by the switchgear manufacture.

2.02 SHORT-CIRCUIT ANALYSIS WITH PROTECTIVE DEVICE EVALUATION

- A. Systematically calculate fault currents based on the available fault current at the facility service entrance. Study preparer shall obtain the available fault current from the local utility.
- B. Short-circuit calculations shall be prepared by means of a digital computer utilizing a commercially available software package. Motor contribution shall be incorporated in determining fault levels. Results of short-circuit calculations shall be presented in tabular form and shall include momentary and interrupting fault values for three-phase and phase-to-ground faults.
- C. Analyze the short-circuit currents by preparing a tabulation comparing the fault levels to the device interrupting ratings. Indicate areas in which integrated/series ratings are utilized. The following information shall be included in the tabulation:
1. Bus identification number.
 2. Location identification.
 3. Voltage
 4. Manufacturer and type of equipment.
 5. Device rating.
 6. Calculated short-circuit current.

2.03 PROTECTIVE DEVICE COORDINATION STUDY

- A. Prepare coordination time-current characteristic curves to determine the required settings/sizes of the protective devices to maximize selectivity. The utility upstream protective device feeding the facility shall be maintained as the upper limit for coordination. These settings shall be obtained by the preparer, along with any other protective device setting requirements. The coordination curves shall be prepared on log-log paper and illustrate adequate clearing times between series devices. The curves shall be created through the use of the study software package, but must reflect actual protective devices to be installed. Adequate time-current curves shall be generated to depict coordination. In addition, protective device characteristics shall

be suitably determined to reflect calculated short-circuit levels at the location.

- B. A narrative analysis shall accompany each coordination curve sheet and describe the coordination and protection in explicit detail. All curve sheets shall be multi-color for improved clarity. Areas lacking complete coordination shall be highlighted and reasons provided for allowing condition to remain or provide solution to resolve situation. System coordination, recommended ratings, and setting of protective devices shall be accomplished by a registered professional electrical engineer with a minimum of eight years of current experience in the coordination of electrical power systems.
- C. The following information shall be provided on all curve sheets.
 - 1. Device identification and associated settings/size.
 - 2. Voltage at which curves are plotted.
 - 3. Current multiplier.
 - 4. ANSI frequent fault damage curve.
 - 5. Cable insulation damage curves.
 - 6. Transformer inrush point.
 - 7. Single-line for the portion of the system.
 - 8. Motor starting profiles (where applicable).

2.04 ARC FLASH ANALYSIS

- A. An arc flash analysis will be performed based on existing short circuit values provided by the customer or in conjunction with a short circuit study. The results from the short circuit study will be used to determine arc energy levels at each defined location in the facility for a specified working distance. Based on the arc energy at each defined point, the proper PPE will be determined and if the arc energy level exceeds available PPE ratings, the locations will be noted. Labels will be provided for each evaluated location that lists the hazard levels along with the required PPE while working in that area. Analysis will be provided to determine if any changes can be made in protection system to reduce arc energy levels.

2.05 SINGLE-LINE DIAGRAM

- A. The final report shall include a multi-color single-line diagram of the electrical distribution system within the scope of the project. The single-line shall include:
 - 1. Transformer rating, voltage ratio, impedance, and winding connection.
 - 2. Feeder cable phase, neutral and ground sizes, length of cable, conductor material, and conduit size and type.

3. Switchgear, switchboards, panelboards, MCC's, fuses, circuit breakers, ATS's and switches continuous current ratings.
4. Protective relays with appropriate device numbers and CT's and PT's with associated ratios.
5. Detailed legend indicating device type identification and other significant details.

PART 3 - EXECUTION

3.01 SUMMARY

- A. The results of the system studies shall be summarized in a final report.
- B. Where required, copies of the final report shall be submitted to the power company for their review and approval. Approved copies or the report shall be submitted to the Design Engineer.

3.02 FIELD SETTINGS

- A. The contractor shall engage the manufacturer's service group or alternately a qualified independent testing firm to perform field adjustments of the protective devices as required for placing the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study and protective device evaluation/coordination study.
- B. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short-circuit and protective device coordination study, shall be carried out by manufacturer's service group.

END OF SECTION 26 05 73

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SECTION 26 12 16 - DRY-TYPE MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dry-type, medium-voltage transformers, with primary and secondary bushings within or without air-terminal enclosures.
2. Control network.
3. Warning labels and signs.

B. Related Requirements:

1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. VPI: Vacuum Pressure Impregnation.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference:** Conduct conference at Project Site.
- B. Preinstallation Coordination Meeting(s):** Conduct meeting(s) at Project Site before construction activity.

1.4 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
 - a. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. For dry-type, medium-voltage transformers.
 - a. Include plans and elevations showing major components and features.
 - 1) Include plan view and cross section of equipment base, showing clearances, manufacturer's recommended workspace, and locations of penetrations for grounding and conduits.
 - b. Include details of equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of field connections.
 - c. Include single-line diagram.
 - d. Include list of materials.
 - e. Include nameplate legends.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For transformers, signed by product manufacturer.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Cooper, Siemens, or Engineer Approved Equal.

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- B. Comply with IEEE C2.
- C. Comply with IEEE C57.12.01.

2.3 PERFORMANCE REQUIREMENTS

- A. Windings Material: Aluminum.
- B. Surge Arresters: Comply with IEEE C62.11, Distribution Class; metal-oxide-varistor type, connected in each phase of incoming circuit and ahead of disconnecting device.
- C. Cooling Systems: Comply with IEEE C57.12.01 for cooling class.
 - 1. Self-Cooled Rating, Class AA.
 - 2. Future Forced-Air-Cooled Rating, Class AA/FA:
 - 3. Make provision for future addition of forced-air-cooling equipment. Transformer bushings, leads, and related components must be sized for future equipment. Provide fan mounts, conduit supports, and terminal boxes.
- D. Coils Insulation Systems:
 - 1. Primary and secondary coil assemblies must be manufactured using polyester VPI system.
- E. Winding Connections: Connection of windings and terminal markings must comply with IEEE C57.12.70.
- F. Bushings must comply with IEEE C57.19.01 requirements for impulse and low-frequency insulation levels.
- G. Tap Changer: External, for de-energized operation.
 - 1. Taps: Two 2-1/2 percent, full-capacity taps above and two 2-1/2 percent, full-capacity taps below rated voltage. Comply with IEEE C57.12.36 requirements.
- H. Enclosure:
 - 1. Provide with provisions for lifting and anchoring frame to concrete pad.
 - 2. With integral skid-mounting frame, suitable to allow skidding or rolling of transformer in any direction.
 - 3. Transformer Enclosure Finish: Factory-applied finish in manufacturer's standard gray over rust-inhibiting primer on treated metal surface.
- I. Sound level must comply with requirements of NEMA TR 1.
- J. Capacities and Characteristics:
 - 1. Enclosure: Ventilated power transformer, NEMA 250 Type 1 enclosure.
 - 2. Additional IEEE Standards: Comply with IEEE C57.12.50, IEEE C57.12.51 and IEEE C57.12.55.
 - 3. Comply with UL 1562 listing requirements.
 - 4. Connections:
 - a. Primary: Air-filled terminal cabinet for cable connection Terminals for close connection to primary switch.
 - b. Secondary: Throat for busway connection.

5. Transformer Ratings.
 - a. Impedance: Not less than 5.75 percent.
 - b. Temperature Rise: 150 deg C.
 - c. Coils Connection:
 - 1) Line-Side Winding: Delta.
 - 2) Load-Side Winding: Wye.
 - d. Voltage and BIL Ratings:
 - 1) Nominal primary phase-to-phase voltage and BIL: 4160 V, 30 kV, 13 800 V, 60 kV.
 - 2) Nominal secondary voltage and BIL: 208Y/120 V, 10 kV or 480Y/277 V, 10 kV.
6. Taps: Two 2-1/2 percent, full-capacity taps above and two 2-1/2 percent, full-capacity taps below rated voltage. Comply with IEEE C57.12.51 requirements.
7. Transformer Accessories:
 - a. Dial-type analog thermometer with alarm contacts.
 - b. At least four stainless steel ground connection pads.
 - c. Provisions for jacking, lifting, and towing.
 - d. Machine-engraved nameplate made of anodized aluminum or stainless steel.

2.4 CONTROL NETWORK

- A. Controllers: Support serial MS/TP and Ethernet IP communications, and able to communicate directly via RS-485 serial networks and Ethernet 10Base-T networks as native device.

2.5 WARNING LABELS AND SIGNS

- A. Comply with requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."
 1. Warning signs must be made of baked enamel.
 2. Equipment Identification Labels: Engraved, laminated-acrylic or -melamine label, legend 4 inch (100 mm) high.

2.6 SOURCE QUALITY CONTROL

- A. Testing Administrant: Engage qualified electrical testing agency to evaluate transformer.
- B. Testing: Test and inspect transformer in accordance with IEEE C57.12.91.
- C. Factory Tests and Inspections: Perform the following factory-certified routine tests by, or

under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, before delivering to site. Affix label with name and date of manufacturer's certification of system compliance on control units.

1. Tests for transformers 500 kVA and smaller:
 - a. Turns ratio, polarity, and phase relation on rated voltage connection.
 - b. Transformer no-load losses and excitation current at 100 percent of ratings. This test may be based on a statistical sample.
 - c. Applied voltage and induced voltage.
 - d. Partial discharge.
2. Tests for transformers 501 kVA and larger:
 - a. Resistance measurements of windings on rated voltage tap and at tap extremes.
 - b. Turns ratio, polarity, and phase relation on rated voltage connection.
 - c. Transformer no-load losses and excitation current at 100 percent of ratings.
 - d. Impedance voltage and load loss at rated current and rated frequency on rated voltage connection and at tap extremes.
 - e. Applied voltage and induced voltage.
 - f. Partial discharge.

D. Nonconforming Work:

1. Equipment that does not pass tests and inspections will be considered defective.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Pre-Installation Checks:

1. Verify removal of shipping bracing after placement.

B. Verify that ground connections are in place and that requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Ground resistance at transformer location may not be greater than 5 Ω .

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install transformers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."**

- B. Transformer must be installed level and plumb and must tilt less than 1.5 degrees while energized.
- C. Comply with requirements for vibration isolation and seismic control devices specified in Section 26 05 29 "Hangers and Supports for Electrical Systems" and Section 26 05 48.16 "Seismic Controls for Electrical Systems."
- D. Maintain minimum clearances and workspace at equipment in accordance with manufacturer's published instructions and NFPA 70.

3.3 CONNECTIONS

- A. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
 - 1. For grounding to grounding electrodes, provide bare copper cable not smaller than 4/0 AWG. Bond surge arrester and neutrals directly to transformer enclosure and then to grounding electrode system with bare copper conductors. Keep leads as short as practicable, with no kinks or sharp bends. Make joints in grounding conductors and loops by exothermic weld or compression connector.
 - 2. Terminate grounding and bonding conductors on common equipment grounding terminal on transformer enclosure. Install supplemental terminal bars, lugs, and bonding jumpers as required to accommodate number of conductors for termination.
 - 3. Complete transformer tank grounding and lightning arrester connections prior to making other electrical connections.
- B. Terminate medium-voltage cables in incoming section of substations in accordance with Section 26 05 13 "Medium-Voltage Cables."

3.4 SIGNS AND LABELS

- A. Comply with installation requirements for labels and signs specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Install warning signs as required to comply with 29 CFR 1910.269.

3.5 FIELD QUALITY CONTROL

- A. Testing Preparation:
- B. Field tests and inspections must be witnessed by authorities having jurisdiction.
- C. Tests and Inspections:
 - 1. General Field-Testing Requirements:
 - a. Comply with provisions of "Testing and Test Methods" Chapter in NFPA 70B.
 - b. After installing transformer but before primary is energized, verify that

grounding system at substation is tested at specified value or less.

D. Nonconforming Work:

1. Equipment and devices will be considered defective if they do not pass tests and inspections.
2. Remove and replace malfunctioning units and retest.

E. Assemble and submit test and inspection reports. Record as-left set points of adjustable devices.

F. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

END OF SECTION 26 12 16

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SECTION 26 23 00 – SMART LOW VOLTAGE DRAWOUT SWITCHGEAR

PART 1 - GENERAL

1.1 SCOPE

- A. This section defines low voltage metal-enclosed switchgear assemblies with drawout circuit breaker elements for use in AC systems, rated 600 V or less.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 SUBMITTALS

- A. Submit shop drawings and product data for approval and final documentation in the quantities listed according to the Conditions of the Contract. Customer name, customer location and customer order number shall identify all transmittals.
- B. Documents for Approval: General arrangement drawings showing dimensioned elevation, floor plan, side view and foundation details, one-line diagram showing major features, nameplate legends, schematic diagrams and bill of material.
- C. Final Documents: Record documentation to include those in 1.3.B and wiring diagrams, list of recommended spare parts, instruction and installation manuals and certified test reports.
- D. Product Data: Include features, characteristics and ratings of individual circuit breakers and other components. Also, time-current characteristic curves for over current protective devices, including circuit-breaker trip devices and fusible devices.

1.4 RELATED STANDARDS

- A. Comply with requirements of latest revisions of applicable industry standards, specifically including the following:
 - 1. ANSI/IEEE C37.20.1 – Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear
 - 2. ANSI/IEEE C37.50 – Test Procedure for Low Voltage AC Power Circuit Breakers Used in Enclosures
 - 3. ANSI/IEEE C37.51 – Conformance Testing of Metal-Enclosed Low Voltage AC Power Circuit Breaker Switchgear Assemblies
 - 4. ANSI/IEEE C37.13 – Low Voltage AC Power Circuit Breakers Used in Enclosures
 - 5. ANSI C37.16 – Preferred Ratings, Related Requirements and Application for Low Voltage Power Circuit Breakers and AC Power Circuit Protectors
 - 6. ANSI/IEEE C37.17 - Trip Devices for AC and General Purpose DC Low Voltage Power Circuit Breakers
 - 7. UL 1558 – Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear
 - 8. UL 1066 – Low Voltage AC and DC Power Circuit Breakers Used in Enclosures

9. NEMA SG5 – Power Switchgear Assemblies
10. NEMA SG3 – Low Voltage Power Circuit Breakers
- B. Manufacturer Seismic Qualification: The low voltage switchgear shall meet and be certified to seismic requirements specified in the IBC 2009 International Building Code, ASCE American Society of Civil Engineers 7-10.
 1. The low voltage switchgear shall be compliant with IBC 2009 parameters:
 - a. Building Occupancy Category (as defined in Table 1.1 from ASCE 2010): II
 - b. Seismic Design Category: C
 - c. Site Class: D as defined in IBC 2006 Table 1613.5.2 Site Class Definitions
 - d. Ip – Importance Factor: 1.25 - Buildings and structures that represent a substantial hazard to human life in the event of failure or that can cause substantial economic impact or mass disruption of day-to-day civilian life (Building Occupancy Code III)
 - e. SS – Mapped Spectral Accelerations for Short Periods at 0.2 seconds – 180%g
 - f. Sds – 5% Damped Design Spectral Response Accelerations for Short Periods at 0.2 seconds – 1.2.
 2. Equipment shall be designed to be located in a concrete and steel, moment-resisting frame building not exceeding 12 stories in height with a minimum story height of 10 feet.]

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of this equipment shall have a minimum of 20 years of experience producing similar electrical equipment. The manufacturer of the switchgear assembly shall be the same manufacturer as the breakers. The manufacturer shall be ISO 9001 or 9002 certified.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in factory labeled packages. Shipping groups shall not exceed 15 ft. in length.
- B. Circuit breakers shall be shipped inside their respective cells in which they were factory acceptance tested.
- C. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from potential damage from weather and construction operations. Store so condensation will not form on or in switchgear and if necessary, apply temporary heat where required to obtain suitable service conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The low-voltage switchgear shall be manufactured by SIEMENS or EATON.

- B. Manufacturers considered unacceptable for this project are ABB and Square D.

2.2 RATINGS

- A. System Configuration: Switchgear suitable for application in three-phase, 60 Hz, 4 wire grounded-neutral system.
- B. Electrical Ratings:
1. Nominal System Voltage: 480 Volts.
 2. Maximum Design Voltage: 635 volts with non-fused breakers
 3. Minimum Integrated Short-Circuit Current: 100kA
 4. Main-Buss Continuous Current: Minimum Rating Of 3000A or as scheduled on the contract drawings.
 5. Neutral Bus Continuous Current: 100 percent of main phase buss.

2.3 GENERAL REQUIREMENTS

- A. Smart-Gear Low Voltage Switchgear. Each low voltage switchgear lineup shall be supplied with the following functionality:
1. CPU with factory programmed software that supports remote monitoring, configuration and control of embedded intelligent devices and structural monitoring devices.
 2. Communication backbone linking embedded intelligent devices, CPU and HMI.
 3. Remote mounted 22" touch screen HMI pre-configured and programmed with application specific graphical user interface (application specific elevation and one-line drawings) that act as user home page. Provide integral DC-UPS to power the industrial PC at the remote HMI console.
 4. The HMI must communicate with the pre-programmed CPU and act as the local master. Using the touch screen HMI, the user must be able to navigate back and forth between the elevation and one-line views of the LVS lineup. Utilizing the elevation or one-line screens, the user must be able to select (touch) an embedded intelligent device (breaker, meter, relay, etc) and drill down to access screens that support monitoring, configuring and control of the intelligent devices.
 5. Utilizing the touch screen HMI, the user must be able to access the following information and functions:
 - a. LVS one-line view
 - 1) Breaker status – open/closed/tripped
 - 2) Breaker position – connect/test/disconnect
 - 3) Dynamic Arc Flash Sentry (DAS) status – activated/deactivated
 - 4) Bus status – dead/healthy/unhealthy
 - 5) System alarm warning (when applicable)
 - b. LVS elevation view
 - 1) Breaker status – open/closed
 - 2) Breaker position – connect/test/disconnect

- 3) Dynamic Arc Flash Sentry (DAS) status – activated/deactivated
- 4) Buss status – dead/healthy/unhealthy
- 5) System alarm warning (when applicable)
- c. Breaker control (Password or hardware enabled/disabled)
 - 1) Open selected breaker
 - 2) Close selected breaker
 - 3) Activate DAS (arc flash maintenance mode)
 - 4) De-activate DAS (arc flash maintenance mode)
 - 5) Breaker status – open/closed (Info only)
 - 6) Ready to close indication – OK/No (Info only)
 - 7) Spring charge status – charged/discharged (Info only)
- d. Breaker monitoring
 - 1) Breaker temperature (current temperature, time stamped minimum temperature and time stamped maximum temperature)
 - 2) Cradle temperature (current temperature, time stamped minimum temperature and time stamped maximum temperature)
 - 3) Number of switching operations under load
 - 4) Number of switching operations caused by trips
 - 5) Number of short circuit trips
 - 6) Number of overload trips
 - 7) Number of ground fault trips
 - 8) Time until presumed overload trip
 - 9) Runtime meter
 - 10) Contact wear status
 - 11) Operation counter reading
 - 12) Rating plug (amperage)
 - 13) Voltage
 - a) L-N A phase
 - b) L-N B phase
 - c) L-N C phase
 - d) L-N Average
 - e) L-L A-B phases
 - f) L-L B-C phases
 - g) L-L C-A phases
 - h) L-L Average
 - i) Phase unbalance
 - j) Form factor
 - k) Peak factor
 - l) THD
 - 14) Amperage
 - a) A phase
 - b) B phase

- c) C phase
- d) Average
- e) Neutral (if applicable)
- f) Ground
- g) Phase unbalance
- h) THD

15) Power

- a) KW A
- b) KVAR A
- c) KVA A
- d) KW B
- e) KVAR B
- f) KVA B
- g) KW C
- h) KVAR C
- i) KVA C
- j) KW total
- k) KVAR total
- l) KVA total
- m) PF A phase
- n) PF B phase
- o) PF C phase
- p) PF total
- q) Frequency

16) Energy

- a) Active normal KWH
- b) Active reverse KWH
- c) Reactive normal KWH
- d) Reactive reverse KWH

17) Harmonic analysis (bar graph)

- a) Voltage (1st – 29th harmonic)
- b) Current (1st – 29th harmonic)

18) Logs

- a) Event logs (1st – 10th events)

- 19) Event time
- 20) Event source
- 21) Event reason

- a) Trip logs (1st – 5th events)

- 22) Event time
- 23) Event source
- 24) Event reason
- 25) Waveform capture
- 26) 30 day load study

e. Breaker configuration (Password and/or hardware enabled/disabled)

- 1) Trip unit active parameter set – A (normal mode) / B (maintenance mode)
- 2) Long-time pickup
- 3) Long-time delay
- 4) I4T Curve for LT
- 5) Phase loss sensitivity
- 6) Thermal memory
- 7) Short-time pickup
- 8) Short-time delay
- 9) Short-time – Off/Trip
- 10) I²t curve for ST
- 11) Instantaneous pickup
- 12) Instantaneous – Off/Trip
- 13) Ground fault pickup
- 14) Ground fault delay
- 15) Grand fault alarm pickup
- 16) Grand fault alarm delay
- 17) Ground fault alarm – Off/Trip
- 18) I²t curve for GF
- 19) Neutral protection (amperage)
- 20) Neutral protection – Off/Trip
- 21) Arc flash hazard calculation
 - a) 3 phase bolted fault current (user input)
 - b) System voltage (user input)
 - c) System grounding – Grounded System/Ungrounded System/High Resistance (user in-put)
 - d) Arc flash arcing current (displays calculated value)
 - e) Arc flash incident energy (displays calculated value)
 - f) Arc flash hazard category (displays calculated value)
 - g) Arc flash hazard boundary (displays calculated value)
 - h) Box configuration value (displays default/assumed value)
 - i) Conductor gap (displays default/assumed value)
 - j) Working distance (displays default/assumed value)
 - k) Distance x factor (displays default/assumed value)
- 22) Waveform capture trigger settings
- 23) 30-day load study activation settings

f. Documentation

- 1) LVS as-built lineup drawings
 - a) Bill of material
 - b) General arrangement
 - c) General information
 - d) One-line
 - e) Physical arrangement
 - f) Schematics
 - g) LVS installation manual
 - h) Breaker operator manual
 - i) Spare parts list
- g. Digital meter monitoring
 - 1) Voltage Va-n
 - 2) Voltage Vb-n
 - 3) Voltage Vc-n
 - 4) Voltage Va-b
 - 5) Voltage Vb-c
 - 6) Voltage Vc-a
 - 7) Current a phase
 - 8) Current b phase
 - 9) Current c phase
 - 10) Apparent Power a phase (KVA)
 - 11) Apparent Power b phase (KVA)
 - 12) Apparent Power c phase (KVA)
 - 13) Active Power a phase (KW)
 - 14) Active Power b phase (KW)
 - 15) Active Power c phase (KW)
 - 16) Reactive Power a phase (KVAR)
 - 17) Reactive Power b phase (KVAR)
 - 18) Reactive Power c phase (KVAR)
 - 19) Power Factor a phase
 - 20) Power Factor b phase
 - 21) Power Factor c phase
 - 22) Frequency
 - 23) Average Voltage Vph-n
 - 24) Average Voltage Vph-ph
 - 25) Average Current
 - 26) Total Apparent Power (KVA)
 - 27) Total Active Power (KW)
 - 28) Total Reactive Power (KVAR)
 - 29) Total Power Factor
- h. LOAD SHED functionality
 - 1) Load Shed feature shall be provided for all power feeder circuit breakers.
 - 2) Each power feeder circuit breaker shall be customer selectable to open while the connected Standby Sources are providing power to the facility.
 - 3) The Load Shed feature shall be a selectable function during manual generator startup and generator exercise.

- B. The switchgear shall be factory assembled and tested and comply with applicable industry standards. It shall be a coordinated design so that shipping groups are easily connected together at the site into a continuous line-up. Necessary connecting materials shall be furnished. All power circuit breakers and assemblies shall be produced by a single manufacturer.
- C. The switchgear assembly shall consist of one or more metal-enclosed sections in an indoor NEMA 1 enclosure.
 - 1. End sections shall include provisions for main bus extension and installation of future vertical sections.
 - 2. The design shall incorporate preformed steel channels, angles and structural components bolted together and reinforced to form a rigid, self-supporting assembly.
 - 3. Fabricate enclosure with removable, rear cover panels, secured by captive screws, to allow access to rear interior of switchgear.
- D. Front breaker doors and covers must be free of any ventilation openings.
- E. Provide mimic buss diagram.
- F. Horizontal barriers are to be provided to form individual circuit breaker or metering compartments. Circuit breaker compartments are to be barriered from the bus compartment through a primary disconnect assembly. Each circuit breaker or metering compartment shall be provided with a hinged front door secured with hand-operated key-lockable rotary latches.
- G. Circuit breaker compartments shall include stationary primary contact disconnects that shall be silver-plated copper at the connection points and of one-piece construction.
 - 1. The upper set of disconnects shall bolt directly to the main bus and, for feeder circuit breakers, the lower set shall extend to the rear cable area and shall be insulated where they pass through the main bus compartment.
 - 2. Primary disconnects shall be sized for the maximum continuous current for the frame size of the circuit breaker which is located in the compartment.
 - 3. Interlocks shall be provided to prevent a circuit breaker element of the incorrect frame size or interrupting rating from being inserted into the compartment.
 - 4. Secondary control and communication connections, when required, shall be accessible from the front of the switchgear without exposing any power cables or bussing. The secondary control contacts shall be of the sliding contact design, silver plated and engage the draw out circuit breaker element in the “connected” and “test” positions.
- H. All control wiring within the assembly shall be continuous and shall terminate on each end at a suitable terminal block. Control wiring shall be 14-gauge minimum, stranded type SIS and shall be laser printed every six inches with the wire origin and destination information. Wire markers shall be machine imprinted with the wire name as indicated on the wiring diagrams.
 - 1. Wire markings shall be laser imprinted with wire name as indicated on the wiring diagrams.

- I. Finish: Steel parts shall be prepared for painting by a five-stage wash system consisting of an alkaline cleaner, fresh water rise, iron phosphate treatment, fresh water rise and non-chromate sealer. After cleaning and stabilization, the steel parts shall be coated with a thermosetting polyester powder applied with electrostatic equipment at a nominal 2 mils dry film thickness and then cured properly. The paint finish shall have a pencil hardness of 2H, a salt spray rating as defined in ASTM B-117-73 of 600 hours. Paint color shall be ANSI 61 light gray.
- J. Bus isolation barriers shall be arranged to isolate the busses on either side of each main and tie circuit breaker from each other.
- K. Incoming line isolation barriers shall be arranged to isolate the incoming line connections from the main horizontal and vertical buss.
- L. Main buss shall connect vertical sections and shall be uniform capacity the entire length of assembly. Vertical and horizontal buss bar shall utilize a channel shape design to maximize short circuit withstand capability and minimize heat rise. The main horizontal bus shall be run in a vertical, edge-to-edge arrangement for high short circuit strength. Access to the rear cable termination area shall be possible without reaching over the main and vertical bus.
 - 1. Buss shall be 98% conductivity tinned aluminum over entire length of the buss bar.
 - 2. Feeder Circuit-Breaker Load Terminals: Tinned aluminum extensions equipped with mechanical cable connectors for outgoing circuit conductors.
 - 3. Ground Buss shall be tin plated copper of 98% minimum conductivity, minimum size 1/4 by 3 inches.
 - 4. Bus bracing shall be equal to the short circuit interrupting rating of the lowest rated circuit breaker applied in the assembly or 100kA minimum.
 - 5. Provide for future extensions from either end of main phase, neutral and ground bus by means of predrilled bolt holes and connecting links.
- M. Bus/Cable compartment barriers: Barriers shall be supplied to isolate the rear cable area from the main buss area.

2.4 COMPONENTS

- A. Instrument Transformers: Comply with IEEE C57.13.
 - 1. Potential Transformers: Secondary-voltage rating of 120 V and NEMA accuracy class of 0.6 with burdens of W, X and Y.
 - 2. Current Transformers: Ratios as indicated; burden and accuracy class suitable for connected relays, meters and instruments.
- B. Multifunction Digital-Metering Monitors shall be UL-listed or recognized, microprocessor-based unit suitable for three or four wire systems. Units shall be mounted in the instrument compartment door and as follows:
 - 1. Incoming monitoring or main breakers:
 - a. All main(s) shall be monitored with Siemens 9810 equipped with IP communications.

- 1) The metering shall be accomplished with a Siemens Model 9810 digital meter.
2. Feeder breakers:
 - a. Each feeder circuit breaker shall be monitored.
 - 1) Each trip unit shall provide an LCD display for metering.
- C. Provision for Future Devices: Equip future circuit breaker compartments with rails, mounting brackets, supports, necessary appurtenances and buss connections as scheduled on the Contract Drawings.
- D. Control Power Supply: Control power transformer supplying 120-V control circuits through secondary disconnect devices are to be dry-type transformers with primary and secondary fuses.
 1. Transformers shall be mounted in auxiliary compartments.
 2. Multiple-source control power transfer. **Provide control power transformers for each incoming power source to the switchgear. Located the control power transformers in separate compartments with necessary interlocking relays shall be provided.**
 - a. Each transformer shall be connected to line side of associated main circuit breaker.
 - b. Secondary windings connected through a relay or relays to control buss to affect an automatic control power transfer scheme.
 3. Provide **redundant** self-contained **DC-UPS power supplies** for all 120VAC control circuits within the switchgear. Each DC-UPS shall employ hot swappable lithium batteries. The batteries shall customer serviceable and easily accessed.
 4. All hard relays provided for system control shall be field-adjustable time-delay relays. Provide relay logic (timed to open; timed to close; etc) as required for the associated process.
- E. Programmable Logic Controllers:
 1. Provide Programmable Logic Controllers with features equal to or exceeding the Siemens S7-1500 processor.
 2. Provide redundant Programable Logic Controllers to process the operation of all circuit breakers within the packaged switchgear.

2.5 PLC AUTOMATIC TRANSFER SCHEME

- A. Main – Generator transfer system shall consist of:
 1. Run concurrently on the Sm@rt platform.
 2. Controllable on the 22” HMI used for Arc Flash Reduction
 3. IPC 47D Controller capable of Main – Gen control and expandable to Main – Gen – Gen in the future.
- B. Normal Operation
 1. The normal main breaker is closed and emergency breaker is open. Open / Closed Mode Switch is located on control page of HMI. Select which mode is preferred.

C. Loss of Normal Source

1. When the normal source drops below the threshold settings of the source monitoring relays, the system will delay transfer to emergency for (5 sec) adjustable (TDVF) in order to override any momentary source outages. **Parallel the two standby generators when the connected load requires the second standby generator to run.** If after (5sec) adjustable, the normal source is still not available then the system will initiate a generator start request. Once the emergency system becomes available (at 90% rated voltage and frequency as indicated by the emergency source available light). The normal main breaker will open and after timer TDOX (3sec) expires the emergency breaker will close.

D. Return of Normal Source –

1. Closed Transition Mode (Retransfer from Emergency to Normal) Upon return of normal source 1, the system will monitor the source to ensure stability for (5 min) adjustable (TDVA). After time has expired the system will initiate a closed transition retransfer, (if, the phase, voltage and frequency at generator are in synchronization with that of utility) the normal main breaker will close after timer TDOL (100msec) expires the emergency breaker will open. Once retransfer has occurred, the generator start request will be removed and cool down timer will begin timing (15 minutes).

E. No Load Test

1. Push no load test pushbutton on HMI screen. The system will initiate a generator start request. To stop test, push the no load test pushbutton on HMI screen.

F. Load Test – Closed Transition Mode

- G. Push load test pushbutton on HMI screen. The system will initiate a closed transition retransfer, (if, the phase, voltage and frequency at generator are in synchronization with that of utility) the emergency breaker will close after timer TDOL (100msec) expires the normal main breaker will open.

H. Return from Load Test – Closed Transition Mode (Retransfer from Emergency to Normal)

1. Push load test off pushbutton on the HMI screen. The system will initiate a closed transition retransfer, (if, the phase, voltage and frequency at generator are in synchronization with that of utility) the normal main breaker will close after timer TDOL (100msec) expires the emergency breaker will open. Once retransfer has occurred, the generator start request will be removed and cool down timer will begin timing (5 minutes). **

I. Load Test – Open Transition Mode

1. Push load test pushbutton on HMI screen. The system will initiate a generator start request. Once the emergency system becomes available (at 90% rated voltage and frequency as

indicated by the emergency source available light). The normal main breaker will open after timer TDOX (3sec) expires the emergency breaker will close.

J. Return from Load Test – Open Transition Mode (Retransfer from Emergency to Normal)

1. Push load test off pushbutton on the HMI screen. The system will initiate an open transition retransfer, the emergency main breaker will open and after timer TDOX(3sec) expires the normal main breaker will close. Once retransfer has occurred, the generator start request will be removed and cool down timer will begin timing (5 minutes).

K. Load Test (Exerciser On) – Closed Transition Mode

1. Per the time and day set points on the HMI touch screen. The Exerciser will turn on and be on for the duration set point on the HMI screen. The system will initiate a closed transition retransfer, (if, the phase, voltage and frequency at generator are in synchronization with that of utility) the emergency breaker will close after timer TDOL (100msec) expires the normal main breaker will open. **

L. Return from Load Test – Closed Transition Mode (Exerciser Off)

1. Per the time and day set points on the HMI touch screen. The Exerciser will turnoff after the duration time set point has expired. The system will initiate a closed transition retransfer, (if, the phase, voltage and frequency at generator are in synchronization with that of utility) the normal main breaker will close after timer TDOL (100msec) expires the emergency breaker will open. Once retransfer has occurred, the generator start request will be removed and cool down timer will begin timing (5 minutes). **

M. Load Test (Exerciser On) – Open Transition Mode

1. Per the time and day set points on the HMI touch screen. The Exerciser will turn on and be on for the duration set point on the HMI screen. The system will initiate a generator start request. Once the emergency system becomes available (at 90% rated voltage and frequency as indicated by the emergency source available light). The normal main breaker will open after timer TDOX (3sec) expires the emergency breaker will close.

N. Return from Load Test – Open Transition Mode (Retransfer from Emergency to Normal)

1. Per the time and day set points on the HMI touch screen. The Exerciser will turn off after the duration time set point has expired. The system will initiate an open transition retransfer, the emergency main breaker will open and after timer TDOX 7 (3sec) expires the normal main breaker will close. Once retransfer has occurred, the generator start request will be removed and cool down timer will begin timing (5 minutes). **

O. No Load Test (Exerciser On)

1. Per the time and day set points on the HMI touch screen. The Exerciser will turn on and be on for the duration set point on the HMI screen. A start signal will be sent to the generator. Return from No Load Test (Exerciser Off) Per the time and day set points on the HMI

touch screen. The Exerciser will turn off after the duration time set point has expired. The generator start request will be removed and cool down timer will begin timing (5 minutes).

P. Retransfer Inhibit (Maintain Emergency)

1. To inhibit retransfer, push the inhibit pushbutton on the control screen of HMI. The home and control screen will indicate retransfer is inhibited. The system will remain on emergency system until the bypass pushbutton on HMI is pressed or until retransfer mode is put back into auto by pressing auto pushbutton on control screen of HMI.
2. No transfers will be allowed if one of the mains trips on overcurrent. All such trips must be reset before operations can commence.
3. All interlocking of breakers shall be hardwired in the breaker close circuitry and programmed in a PLC to prevent paralleling of unsynchronized sources. All automatic and manual mode commands are subject to the boundaries set forth in the interlocking.
4. Manual operations are performed by placing the selector switch in Manual mode and via the use of the breaker control switches. No automatic operations are able to be performed while in the manual mode. The manual mode light (blue) will illuminate to alert the operator that the system is in manual mode.

2.6 CIRCUIT BREAKERS

- A. Circuit breakers shall comply with the requirements of IEEE/ANSI C37.13/C37.16/C37.17/C37.50, UL1066, NEMA SG3. All breakers shall be three-pole, 100% rated type WL low voltage power breaker manufactured by Eaton or Siemens.
1. All circuit breakers shall be 100% rated, **insulated-case design**. All circuit breakers shall have dual trip unit technology.
 2. Circuit breaker element shall have connected, test and disconnected position indicators, spring charged/discharged indicators and circuit breaker open or closed and ready to close indicators all of which shall be visible to the operator with the compartment door closed. It shall be possible to rack the circuit breaker element from the connected to the disconnected position with the compartment door closed otherwise known as “through the door draw out”.
 3. Provide interlocks to prevent racking the circuit breaker unless the breaker is open.
 4. Raking handle shall be integral to the breaker.
- B. Ratings: Interrupting up to 100 kA at 480V **without the use of series fusing**. Short time current ratings for each circuit breaker shall be as indicated on the drawings or data tables. Circuit breakers shall be 600-volt class.
- C. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:

1. Normal Closing Speed: independent of both control and operator
 2. Electrical operator, field installable with manual charging
 3. Operations counter
- D. Each low voltage power circuit breaker shall be equipped with self-powered, microprocessor-based trip-device to sense overload and short circuit conditions. The device shall measure true RMS current. The tripping system shall consist of Rogowski coil sensors on each phase, a release mechanism and the following features:
1. Field Installable and interchangeable so that any trip unit can be used with any frame size circuit breaker. Trip units can be upgraded for future expansion in functionality, such as communication.
 2. Functions: Long time, short time and extended instantaneous protection function shall be provided to allow the breaker to be applied at the withstand rating of the breaker with minus 0% tolerance so that there is no instantaneous override whatsoever. This feature shall furthermore allow the circuit breaker to be applied up to the full instantaneous rating of the breaker on systems where the available fault current exceeds the breakers withstand rating. Each shall have an adjustable pick-up setting. In addition, long time and short time bands shall each have adjustable time delay. Short time function shall include a switchable I^2t ramp and optionally $I4t$ to improve co-ordination with fuses or inverse relays.
 3. A software program shall be made available free of charge to support system co-ordination studies. The software will allow time current curves to be generated for the chosen settings.
 4. Individual LED's shall indicate an overcurrent, short circuit or ground fault trip condition. The data shall be maintained for a minimum of 48 hours without the need for a separate battery.
 5. Time-current characteristics shall be field adjustable locally or optionally remotely via a bus system Ethernet.
 6. Current Adjustability: Parameter settings and rating plugs on trip units.
 7. Pickup Points: 10 Long Time Settings.
 8. Field Installable Ground-fault protection with at least three time-delay bands. Adjustable current pickup and an I^2t ramp. Arrange to provide protection for four-wire service.
 9. A LCD graphical display with keypad shall be supplied to simplify settings & viewing data locally.
 10. The option to remotely switch protection settings shall be provided whenever a generator is part of the power distribution system.
 11. Waveform display option on LCD display.

- 12. Estimated contact wear shall be capable of being communicated remotely in addition to a local mechanical indication flag.
- E. MOC {mechanism operated cell switch} operated by the circuit breaker operating mechanism.
- F. Terminal Block Connections, shall be front mounted and utilize Tension Spring Terminals.
- G. Padlocking Provisions: For installing at least three padlocks on each circuit breaker to prevent movement of the drawout mechanism.
- H. Operating Handle: shall be built in complete with handle and integral to breaker. No external tools shall be required to rack the breaker
- I. Modular communication and relaying accessories are to be available for retrofitting by the clients chosen engineer. It shall not be necessary for the manufacturers personnel to retrofit accessories
- J. The following items must be capable of being changed in the field: main contacts, CT's, trip units, racking mechanism and all internal & external accessories
- K. The main breaker shall have a Dynamic Arc Flash Sentry. The main breaker shall have a dual protective setting capability with graphic waveform display. The main breaker shall allow the installer to set two different trip curves into one breaker. One curve shall be set for standard operating mode and the second curve, with instantaneous protection shall be set for arc flash mode. The switchgear shall be outfitted with a 24 VDC power supply, CubicleBus digital input module, annunciator panel with flashing light and a DC-UPS power supply. The arc flash mode shall be actuated by a remote-control HMI panel

2.7 ACCESSORIES

- A. Lifting yoke for circuit breakers
- B. Portable test set for testing all functions of circuit breaker, solid-state trip devices without removal from switchgear.
- C. Circuit-Breaker Removal Apparatus:
 - 1. Overhead circuit breaker lifting device, shall be track mounted at the top front of the switchgear, complete with hoist and lifting yokes.] NOTE: The overhead circuit breaker lifting device is not available in non-walk-in, outdoor enclosures. [Portable, floor-supported, roller-base, elevating carriage arranged for moving circuit breakers in and out of compartments.
- D. Spare Fuses: Six, of each type and rating of fuse used. Include spares for potential transformer fuses and control power fuses.
- E. **Provide one spare Insulated Case Circuit Breaker for each frame size indicated on the drawings.**
- F. Spare Indicating Lights: One of each type installed.

- G. Touchup Paint: One-half pint of paint matching enclosure finish.
- H. Test Cabinet: Wall mountable cabinet to hold necessary equipment for testing electrically operated breakers.

PART 3 - EXECUTION

3.1 EXAMINATION AND INSTALLATION

- A. Examine elements and surfaces to receive switchgear for compliance with installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Install and anchor switchgear in accordance with manufacturer's instructions.

3.2 CONNECTIONS

- A. Tighten bus joints, electrical connectors and terminals according to manufacturer's published torque-tightening values. Install equipment-grounding conductors for switchgear with ground continuity to main electrical ground bus.

3.3 ADJUSTING AND CLEANING

- A. Set field-adjustable trip devices per coordination study.
- B. Clean exposed surfaces using manufacturer recommended materials and methods. Touch-up damaged coating and finishes using non-abrasive materials and methods recommended by manufacturer. Eliminate all visible evidence of repair.

3.4 WARRANTY

- A. Equipment manufacturer warrants that all goods supplied are free of non-conformities in workmanship and materials for one year from date of initial operation, but not more than eighteen months from date of shipment.

3.5 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service. Provide up to three days at the project site for this service.
- B. Train Owner's maintenance personnel on procedures and schedules for energizing and de-energizing, troubleshooting, servicing and maintaining equipment and schedules. Provide up to four days at the project site for this service.
- C. Verify that switchgear is installed and connected according to the Contract Documents.
- D. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 26 Sections.

E. Complete installation and startup according to manufacturer's written instructions.

END OF SECTION 26 23 00

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Electronic-grade panelboards.

1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. VPR: Voltage protection rating.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard.
 - 1. Include materials, switching and overcurrent protective devices, accessories, and components indicated.
 - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.

3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Keys: Two spares for each type of panelboard cabinet lock.
 2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

1.10 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Construction Manager's written permission.
 - 3. Comply with NFPA 70E.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace equipment that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Enclosures: Flush and Surface-mounted, dead-front cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - 2. Height: 84 inches maximum.
 - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
 - 4. **Hinged Front Cover:** For all flush and surface mounted panelboards provide front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
 - 5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 - 6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 7. Finishes:
 - a. Panels and Trim: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
- G. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker using 100% rated, solid-state, molded-case circuit breaker. Using thermal-magnetic circuit breakers as a main breaker will not be accepted.

H. Phase, Neutral, and Ground Busses:

1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Buss: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Buss: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
6. Extra-Capacity Neutral Buss: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
7. Split Bus: Vertical busses divided into individual vertical sections.

I. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Sub-Feed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring,

connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

- K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
 - 1. Percentage of Future Space Capacity: Ten percent.
- L. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
 - 1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 - 2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.
- M. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
 - 1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 - 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- B. Surge Suppression: Provide space for surge suppression device as scheduled. Prepare and coordinate for surge suppression device with the Electrical Engineer. Surge suppression will be provided by SSI. Refer to specification 264313 for additional details.

2.3 POWER PANELBOARDS

- A. Manufacturers: Manufacturer of panelboards shall be the same manufacturer of the motor control centers; switchgear; switchboards; and dry-type transformers for this project.
- B. Subject to compliance with requirements, provide products manufactured by one of the following:
 - 1. SIEMENS;
 - 2. EATON;

3. No alternates will be accepted.
- C. Panelboards: NEMA PB 1, distribution type.
- D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 1. For doors more than 36 inches high, provide two latches, keyed alike.
- E. Mains: **Main circuit breakers shall be molded case; solid-state trip; LSIG classified; 100% rated for the frame size specified.**
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- G. Panelboards manufactured by Square D and ABB will not be accepted for this project.
- H. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- I. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (manufacture shall be the same manufacturer of the switchgear, panelboards, and transformers for this project):
 1. SIEMENS;
 2. EATON;
 3. No equal accepted.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic Trip Circuit Breakers:

- a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. 100% rated.
 - d. Digital display of settings, trip targets, and indicated metering displays.
 - e. Multi-button keypad to access programmable functions and monitored data.
 - f. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - g. Integral test jack for connection to portable test set or laptop computer.
 - h. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
 6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
 7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 8. Sub-Feed Circuit Breakers: Vertically mounted.
 9. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - i. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
 - j. Auxiliary Contacts: One, SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - k. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - l. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - m. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.

- n. Multipole units enclosed in a single housing with a single handle.
 - o. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
 - p. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
 - 1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 26 28 13 "Fuses."
 - 2. Fused Switch Features and Accessories:
 - a. Standard ampere ratings and number of poles.
 - b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.
 - c. Auxiliary Contacts: One normally open and normally closed contact(s) that operate with switch handle operation.

2.5 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
- D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407.
- D. Equipment Mounting:
 - 1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
 - 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- G. Mount panelboard cabinet plumb and rigid without distortion of box.
- H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- I. Mount surface-mounted panelboards to steel slotted supports 1 1/4 inch in depth. Orient steel slotted supports vertically.

- J. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- K. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- L. Install filler plates in unused spaces.
- M. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- N. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- O. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - C. Acceptance Testing Preparation:
 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
 - D. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Do not perform optional tests. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - E. Panelboards will be considered defective if they do not pass tests and inspections.
 - F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- 3.5 ADJUSTING
- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
 - B. Set field-adjustable circuit-breaker trip ranges recommended by manufacturer and equipment supplier.
 - C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature/humidity according to manufacturer's written instructions.

END OF SECTION 26 24 16

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SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Straight-blade convenience, hospital-grade, isolated-ground, and tamper-resistant receptacles.
2. USB charger devices.
3. GFCI receptacles.
4. SPD receptacles.
5. Hazardous (classified) location receptacles.
6. Twist-locking receptacles.
7. Pendant cord-connector devices.
8. Cord and plug sets.
9. Toggle switches.
10. Decorator-style convenience.
11. Wall switch sensor light switches with dual technology sensors.
12. Wall switch sensor light switches with passive infrared sensors.
13. Wall switch sensor light switches with ultrasonic sensors.
14. Digital timer light switches.
15. Residential devices.
16. Wall-box dimmers.
17. Wall plates.
18. Floor service outlets.
19. Poke-through assemblies.
20. Prefabricated multioutlet assemblies.
21. Service poles.

1.3 DEFINITIONS

A. Abbreviations of Manufacturers' Names:

1. Cooper: Cooper Wiring Devices; Division of Cooper Industries, Inc.
2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
3. Leviton: Leviton Mfg. Company, Inc.
4. Pass & Seymour: Pass& Seymour/Legrand.

- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.
- H. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.
- D. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STRAIGHT-BLADE RECEPTACLES

- A. Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour/Legrand (Pass & Seymour).
 - d. Or Approved Equal.

2.3 GFCI RECEPTACLES

- A. General Description:
 - 1. 125 V, 20 A, straight blade, non-feed-through type.
 - 2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
 - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour/Legrand (Pass & Seymour).
 - d. Or Approved Equal.

2.4 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

- A. Hazardous (Classified) Locations Receptacles: Comply with NEMA FB 11 and UL 1010.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. EGS/Appleton Electric.
 - b. Killark.
 - c. Or Approved Equal.

2.5 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
 - 1. Single Pole, Two Pole, Three Way, and Four Way:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hubbell Incorporated; Wiring Device-Kellems.
 - 2) Leviton Manufacturing Co., Inc.
 - 3) Pass & Seymour/Legrand (Pass & Seymour).
 - 4) Or Approved Equal.

2.6 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.035-inch-thick, satin-finished, Type 302 stainless steel.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.7 FINISHES

- A. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System: Red.

- B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
1. Coordinate all equipment and device locations with all other trades prior to installation.
 2. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 3. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 4. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 5. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

- A.** Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A.** Comply with Section 26 05 53 "Identification for Electrical Systems."
- B.** Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

- A. Test Instruments:** Use instruments that comply with UL 1436.
- B. Test Instrument for Convenience Receptacles:** Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:**
1. Test Instruments: Use instruments that comply with UL 1436.

2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- E. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.
- F. Wiring device will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

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SECTION 26 29 23 – PERFORMANCE VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Variable Frequency Drive (VFD).

1.2 RELATED SECTIONS:

- A. Section 26 05 53 – Electrical Identification: Engraved nameplates

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Vendor is required to submit shop drawing for approval. Shop Drawings shall include: Wiring diagrams, electrical schematics, front and side views of enclosures, overall dimensions, conduit entrance locations and requirements, nameplate legends, physical layout and enclosure details.
- C. Product Data: Provide data sheets showing; voltage, short circuit ratings, and weights.
- D. Manufacturer's Installation Instructions and Technical Manuals: Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of variable frequency drive. Document the sequence of operation, cautions and warnings, spare parts lists and programming guidance.

1.4 QUALITY ASSURANCE

- A. VFD shall have a minimum MTBF (Mean Time Between Failures) rating of 28 years (245,280 Hours).
- B. The drive manufacturing facility shall be ISO 9001 and 14001 certified.
- C. Each drive shall be factory energized and tested under normal loading procedure. Provide testing certification to the Engineer for each VFD provide.
- D. The drive shall be UL listed, or Canadian UL listed, or CSA listed and comply with EMC Directive 89/336 EEC, Low Voltage Directive 73/23 EEC in accordance with the European Union's CE directive.
- E. The drive shall utilize efficient "bidirectional switch" technology throughout the entire drive manufacturer's power and voltage range.
- F. The drive shall utilize the same communications architecture, utilizing plug-in communications cards, for high-speed noise immune connectivity throughout the entire drive manufacturer's power range.

- G. The drive manufacturer shall have an analysis laboratory to evaluate the failure of any component. The failure analysis lab shall allow the manufacturer to perform complete electrical testing, x-ray components, and decap or delaminate components and analyze failures within the component.
- H. The drive shall utilize surface mount technology in the manufacturing of internal printed circuit boards and electronics, for maximum reliability.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01 78 23.
- B. Include instructions for starting and operating VFD, and describe operating limits, which may result in hazardous or unsafe conditions.

1.6 QUALIFICATIONS

- A. Manufacturer must have a minimum of 25 years of documented experience, specializing in variable frequency drives.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site, under provisions of Section 01 60 00
- B. Buyer shall inspect for damage as soon possible.
- C. Store in a clean, dry space. Maintain factory wrapping, or provide an additional heavy canvas or heavy plastic cover, to protect units from dirt, water, construction debris, and traffic.
- D. Handle carefully, in accordance with manufacturer's written instructions, to avoid damage to components, enclosure, and finish.

1.8 WARRANTY

- A. Provide VFD warranty, for one year from date of startup, not to exceed 18 months from date of shipment. VFD vendor's standard published warranty shall apply.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. VFD shall be U1000 Industrial Matrix type, manufactured by Yaskawa America, Inc. Alternate manufactures will require prior approval by the Engineer. Submit alternate drive information to the Engineer three weeks prior to the bid date.
- B. Driven motors should be inverter duty rated (NEMA Premium Efficient) per NEMA MG1 parts 30 and 31, for motor-drive compatibility.

2.2 DESCRIPTION/ENCLOSURE

- A. Provide enclosed variable frequency drives suitable for operation at the current, voltage, and horsepower indicated on the schedule. Conform to requirements of NEMA ICS.
- B. Provide all of the following enclosure options:
 - 1. For indoor mounted applications: Provide NEMA 12 power ventilated with filter inlet.
 - 2. For outdoor mounted applications: Provide NEMA 4X power ventilated with filter inlet. Provide stainless four-sided solar shielding. Where specified or schedules on the drawings, provide cabinet mounted air conditioning unit with integral thermostat.
 - 3. For all locations: Provide dead-front enclosure for each VFD with inner door. Inner door shall contain all local HMI and applicable switches. Provide interlock so that each drive is complete de-energized when the inner door is opened.
 - 4. For all locations: Provide Red Run LED indicator light. Provide Green Ready-For-Call-To-Run LED indicator light. Provide Amber Fault LED indicator light.
 - 5. For all locations: Provide 30mm pilot and switch devices.
 - 6. Provide digital, non-resettable elapse time meter for each VFD.
 - 7. Provide HOA switch for each drive. Provide status contact for SCADA input.

2.3 RATINGS

- A. VFD must operate, without fault or failure, when voltage varies plus 10% or minus 15% from rating, and frequency varies plus or minus 5% from rating.
- B. VFD input shall be 480 volts, 60 Hz, 3 Phase
- C. True Power Factor: Greater than or equal to 0.98 at rated load.
- D. Service factor: 1.0
- E. Operating Ambient Temperature: NEMA 1 (IP20): -10°C to 40°C (14°F to 104°F)
- F. Ambient storage temperature: -20°C to 60°C (-4°F to 140°F)
- G. Humidity: 0% to 95% non-condensing.
- H. Altitude: to 3,300 feet (1000m), higher altitudes achieved by derating.
- I. Vibration: 9.81m/s² (1 G) maximum at 10 to 20 Hz, 2.0 m/s² (0.2 G) at 20 Hz to 55 Hz.
- J. Minimum Efficiency: 96% at half speed; 98% at full speed.
- K. Starting Torque: 150% starting torque shall be available from 3 Hz to 60 Hz without derating. Drive shall be able to run at 100% current at 0.0 Hz continuously.
- L. Overload capability: Normal Duty, 120% of rated FLA (Full Load Amps) for 60 seconds; Heavy Duty 150% of rated FLA for 60 seconds.
- M. Controlled speed range of 40:1
- N. Total Harmonic Distortion (THD) compliance to IEEE 519:

1. The Drive Manufacturer shall provide calculations showing total harmonic current distortion and total harmonic voltage distortion is less than 5%, both with no individual harmonic greater than 3%, at the drive input terminals. Calculations at the transformer are not acceptable. This requirement may be met by VFD's that use Matrix conversion technology. 18-Pulse input VFD's will be accepted in lieu of Matrix conversion technology. VFD's employing the use of 6-Pulse, Passive Filters, 12-Pulse, or "LCL" filter schemes will be rejected. Additional equipment required to meet this performance will be the responsibility of the contractor with no additional cost to the owner.
- O. VFDs must be suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, without additional branch circuit protection devices.

2.4 DESIGN

- A. VFD shall employ microprocessor based inverter logic, isolated from all power circuits.
- B. VFD shall include surface mount technology with protective coating.
- C. VFD shall employ use of matrix conversion technology for direct conversion of AC to AC. Active AC to DC rectifier schemes are not acceptable and will be rejected. 6 pulse, passive filters, and 12-pulse rectifiers are not acceptable and will also be rejected.
- D. Input / Output Section:
 1. VFD input power stage shall convert three-phase AC line power directly into variable AC output. The main circuit shall consist of a compact input filter and bidirectional switches. The bidirectional switches are power devices that carry the full current of the drive. VFD's without direct AC to AC conversion will require integral 18-Pulse Transformer input.
 2. VFD shall have an adjustable carrier frequency, from 4 kHz to 10 kHz.
 3. VFD must include an adjustable dynamic noise control for quiet motor operation.
 4. VFD must have a Harmonic Suppression Priority setting.
 5. VFD shall have embedded protocol for network communications Ethernet IP which shall be accessible via a RS-485 communication port.
 6. VFD shall include three independent analog inputs. Selectable for either 0-10 VDC or 4-20 mA. Either input shall respond to a programmable bias and gain.
 7. VFD shall include a 32 kHz pulse train input (programmable)
 8. VFD shall include a minimum of seven multi-function digital input terminals, capable of being programmed to determine the function on a change of state. These terminals shall include, but not limited to:
 - a. Run Enable
 - b. Fault Reset
 - c. Jog Speed
 - d. Preset Speed
 - e. External Fault
 9. VFD shall include two selectable 0-10 VDC or 4-20 mA analog outputs for monitoring, or "speed tracking" the VFD. The analog output signal will be proportional to output frequency, output current, output power, PI (Proportional & Integral control) feedback or power supply voltage.

10. VFD shall include at least one external fault input, which shall be programmable for a normally open or normally closed contact.
 11. VFD shall include one fixed "Fault" form "C" contact, and three programmable form "A" contacts capable of being programmed to determine conditions that must be met in order for them to change state. These output relay contacts shall be rated for at least 2A at 120 VAC and shall include, but not limited to:
 - a. Speed agree detection
 - b. Zero Speed
 - c. Drive Ready
 - d. No load detection (broken belt alert)
 - e. Drive Running
 - f. Drive Faulted
 - g. Serial communication status
- E. VFD shall include a power loss (control power) ride through capable of 2 seconds.
- F. VFD shall have "hold at zero speed" capability, to stop a load that is "wind milling" at start or stop.
- G. VFD shall have a motor preheat function to prevent moisture accumulation in an idle motor.
- H. VFD shall include diagnostic fault indication, fault log storage and heatsink cooling fan operating hours.
- I. VFD shall have a digital operator with program copy and storage functions to simplify set up of multiple drives. The digital operator shall be interchangeable for all drive ratings.
- J. VFD shall include a front mounted, sealed keypad operator, with an English language illuminated LCD display. The operator will provide complete programming, program copying, operating, monitoring, and diagnostic capability. Keys provided shall include industry standard commands for Start, Stop, and Jog functions.
- K. VFD plain language display shall provide readouts of; output frequency in hertz, PI feedback in percent, output voltage in volts, output current in amps, output power in kilowatts, power supply voltage in volts, interface terminal status, heatsink temperature and fault conditions. All displays shall be viewed in an easy-to-read illuminated LCD.
- L. VFD unit shall include the following meters to estimate use of energy:
1. Elapsed Time Meter
 2. Kilowatt Meter
 3. Kilowatt Hour Meter
 4. Energy Savings Meter
- M. VFD shall include a user selectable PI control loop, to provide closed loop set point control capability, from a feedback signal, eliminating the need for closed loop output signals from a machine automation system.

- N. The VFD shall include Industry specific application macros. The macros can be used to help facilitate start-up. The macros will provide initialization to program all parameters and customer interfaces for a particular application, to reduce programming time.
- O. An energy saving sleep function shall be available in both open loop (follower mode) and closed loop (PI) control, providing significant energy savings while minimizing operating hours on driven equipment. When the sleep function senses a minimal deviation of a feedback signal from set point, or low demand in open loop control, the system reacts by stopping the driven equipment. Upon receiving an increase in speed command signal deviation, the drive and equipment resume normal operation.
- P. VFD shall include loss of input signal protection, with a selectable response, including running at a percent of the most recent speed.
- Q. VFD shall include electronic thermal overload protection for both the drive and motor. The electronic thermal motor overload shall be approved by UL. If the electronic thermal motor overload is not approved by UL, a separate UL approved thermal overload relay shall be provided in the VFD enclosure
- R. VFD shall include the following program functions:
 - 1. Critical frequency rejection capability: 3 selectable, adjustable dead bands.
 - 2. Auto restart capability: 0 to 10 attempts with adjustable delay between attempts.
 - 3. Ability to close fault contact after the completion of all fault restart attempts.
 - 4. Stall prevention capability.
 - 5. "S" curve soft start / soft stop capability.
 - 6. Bi-directional "Speed search" capability, in order to start a rotating load.
 - 7. 14 preset and 1 custom volts per hertz pattern.
 - 8. Heatsink over temperature speed fold back capability.
 - 9. Terminal status indication.
 - 10. Program copy and storage in a removable digital operator.
 - 11. Programmable security code.
 - 12. Current limit adjustment capability, from 30% to 200% of rated full load current of the VFD.
 - 13. Motor pre-heat capability.
 - 14. Anti "wind-milling" function capability.
 - 15. Automatic energy saving function.
 - 16. Undertorque/Overtorque Detection.
 - 17. Fan failure detection and selectable drive action.
 - 18. "Bumpless" transfer between Local and Remote modes
 - 19. VFD shall include factory settings for all parameters, and the capability for those settings to be reset.
 - 20. VFD shall include user parameter initialization capability to re-establish project specific parameters.
 - 21. USB Type B port for quick and easy PC Connection.
 - 22. VFD shall include the capability to adjust the following functions, while the VFD is running:
 - a. Speed command input.
 - b. Acceleration adjustment from 0 to 6000 seconds.
 - c. Deceleration adjustment from 0 to 6000 seconds.

- d. Select from 17 preset speeds.
- e. Analog monitor display.
- f. Removal of digital operator.

2.5 VFD OPTIONS

A. VFD shall be equipped with the following optional features:

- 1. Network Communication: **EtherNET/IP**.
- 2. Provide local speed pot control for local/manual control when drive's HOA is in the 'Hand' position. Provide speed pot for each drive where bypass drives are required.
- 3. Auxiliary Control Power Unit: Provide separate auxiliary 24VDC CPU for all VFD's provided under this section.
- 4. Remote Operator Mounting Kit: Where specified or scheduled on the drawings, provide operator mounted in the control cabinet behind a UL Type 4X membrane.
- 5. Outdoor Operator: All VFD's mounted in outdoor locations shall be equipped with a special LCD capable of being seen outside in bright sun at high ambient temperatures.
- 6. Bypass Operation: Where specified or scheduled on the drawings provide a redundant variable frequency drive mounted integral within the same enclosure as the primary drive. Provide necessary NEMA rated isolation contactors. Provide redundant bypass drive manufactured by Yaskawa America, series FP-650. All SCADA or remote/local functions shall be transfer seamlessly between the two drives. The redundant variable frequency drive shall be equipped with the same network communications as the primary drive. Provide a local/manual rotary switch to select between primary and bypass drive. Both HMI screens (integral to each drive) shall be accessible from the exterior of the overall enclosure. Provide a bypass status contact for input to the plant SCADA system.

2.6 FABRICATION

A. All standard and optional features shall be included in a single enclosure with a UL certification label. See paragraph 2.02 of this Section.

2.7 SOURCE QUALITY CONTROL

- A. In-circuit testing of all printed circuit boards shall be conducted, to insure the proper mounting and correct value of all components.
- B. Final printed circuit board assemblies shall be functionally tested, via computerized test equipment. All tests and acceptance criteria shall be preprogrammed. All test results shall be stored as detailed quality assurance data.
- C. All fully assembled controls shall be functionally tested, with loaded induction motors. The combined test data shall then be analyzed, to insure adherence to quality assurance specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surface is suitable for VFD installation.
- B. Do not install VFD until the building environment can be maintained, within the service conditions required by the manufacturer.

3.2 INSTALLATION

- A. Install VFD where indicated, in accordance with manufacturer's written instructions and NEMA ICS 3.
- B. Tighten accessible connections and mechanical fasteners after placing VFD.
- C. Provide a nameplate label on each VFD with, full load amperes, model number, and voltage/phase rating.

3.3 FIELD QUALITY CONTROL

- A. Field inspection and testing to be performed under provisions of Section 01 40 00.
- B. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Section 01 40 00.
- B. The manufacturer shall provide three full work days for on-site startup and commissioning services. Schedule the startup work with the Electrical and/or Electrical Contractor.

3.5 ADJUSTING

- A. Carry out adjusting work under provisions of Section 01 70 00. Make final adjustments to installed VFD, to assure proper operation of industrial control system.

END OF SECTION 26 29 23

SECTION 26 32 13.14 - DIESEL ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets suitable for use in mission critical applications with the features as specified and indicated. Engine generators will be used as the standby power source for the system, but have a prime rating. Shall be capable of providing reliable power with no run-time limitations while the primary source of power is unavailable.
- B. Each required generator set shall have a Stand-By rating.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
 - 3. Sound test data, based on a free field requirement.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Wiring Diagrams: Control interconnection, Customer connections.
- C. Certifications:
 - 1. Submit statement of compliance which states the proposed product(s) is certified to the emissions standards required by the location and application of the Project.

1.5 INFORMATIONAL SUBMITTALS

- A. Source quality-control test reports.
 - 1. Certified summary of prototype-unit test report. See requirements in section 2.13.A. Include statement indicating torsional compatibility of components.
 - 2. Certified Test Report: Provide certified test report documenting factory test per the requirements of this specification, as well as certified factory test of generator set sensors per NFPA110 level 1.
 - 3. List of factory tests to be performed on units to be shipped for this Project.
 - 4. Report of exhaust emissions and compliance statement certifying compliance with applicable regulations.
- B. Warranty:
 - 1. Submit manufacturer's warranty statement to be provided for this Project.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 50 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Comply with NFPA 37 (Standard For the Installation and Use of Stationary Combustion Engines and Gas Turbines).
- E. Comply with NFPA 70 (National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702).
- F. Comply with NFPA 110 (Emergency and Standby Power Systems) requirements for Level 1 emergency power supply system.
- G. Comply with UL 2200.
- H. Comply with ISO 9001.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 15 to plus 40 deg C.

2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 5643 feet

1.8 WARRANTY

- A. Base Warranty: Manufacturer shall provide base warranty coverage on the material and workmanship of the generator set for a minimum of twenty-four (24) months for Stand-By Power rated products from registered commissioning and start-up. Warranty shall be comprehensive covering Parts, Labor, and Travel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Only approved bidders shall supply equipment provided under this contract. Equipment by other suppliers are acceptable provided they meet these specifications in its entirety and by submitting 6 copies of their complete submittal 2 weeks prior to bid.
 1. Caterpillar
 2. Cummins
 3. Generac
 4. Or Engineer pre-approved equal. **Kohler will not be accepted for this project.**
- B. The Generator controls must be capable of paralleling to any other generator via an isolated buss configuration for future expansion via Modbus-TCP communication. A master controller for paralleling **will not be required.**

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 1. Rigging Information: Indicate location of each lifting attachment, generator-set center of gravity, and total package weight in submittal drawings.
- C. Capacities and Characteristics:
 1. Power Output Ratings: Operation of not less than kW rating shown on the plans, at 80 percent lagging power factor, 480/277 volt, three phase, 4-wire, 60 hertz and Stand-By certified at that same kW rating. Two separate standby rated generator sets are required for this project.
 2. Alternator shall be capable of accepting maximum 250 kVA in a single step and be capable of recovering to a minimum of 90% of rated no load voltage. Following the application of the specified kVA load at near zero power factor applied to the generator set.

3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component. The engine-generator nameplate shall include information of the power output rating of the equipment.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 0.5 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 8 percent variation for 50 percent step-load increase. Voltage shall recover and remain within the steady-state operating band within 2 seconds. On application of a 100% load step the generator set shall recover to stable voltage within 4 seconds.
3. Steady-State Frequency Operational Bandwidth: 0.25 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Not more than 2 percent variation for 50 percent step-load increase. Frequency shall recover and remain within the steady-state operating band within 2 seconds. On application of a 100% load step the generator set shall recover to stable frequency within 4 seconds.
6. Output Waveform: At full load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for any single harmonic. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds without damage to generator system components. For a 1-phase, bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.
8. Start Time: Comply with NFPA 110, Level 1, Type 10, system requirements. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.
9. Load Sharing: Engine generator shall share real and reactive load proportionally within plus or minus 3 percent with all other engine generators in the system.
10. Noise Output: Engine generator shall be tested by the manufacturer per ANSI S12.34. Data documenting performance shall be provided with submittal documentation.

2.3 ENGINE

- A. Fuel: Engine Fuel oil, Grade DF-2
- B. Rated Engine Speed: 1800 RPM. Engine speed shall not exceed 1800RPM. Engine shall be directly coupled to the alternator. No gearbox couplers will be accepted.
- C. Lubrication System: The following items are mounted on engine or skid:

1. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.
 2. Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- D. Engine Fuel System: The engine fuel system shall be installed in strict compliance to the engine manufacturer's instructions.
1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
- E. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and performance.
1. Designed for operation on a single 208 or 480 volt AC, single phase, 60 hertz power connection. Heater voltage shall be shown on the project drawings.
 2. Installed with isolation valves to isolate the heater for replacement of the element without draining the engine cooling system or significant coolant loss.
 3. Provided with a 24VDC thermostat, installed at the engine thermostat housing
- F. Governor: Adjustable isochronous, with speed sensing. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.
- G. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
1. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 50C.
 2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 3. Size of Radiator overflow tank: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 6. Duct Flange: Generator sets installed indoors shall be provided with a flexible radiator duct adapter flange.
- H. Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping

system to not exceed engine manufacturer's engine backpressure requirements. Muffler/Silencers for this application shall be no less than Critical Grade.

- I. Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.
- J. Starting System: 24V, as recommended by the engine manufacturer; electric, with negative ground.
 - 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 - 2. Cranking Cycle: As required by NFPA 110 for level 1 systems.
 - 3. Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.
 - 4. Battery Compartment: Factory fabricated of metal with acid-resistant finish.
 - 5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.
 - 6. Battery Chargers: Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 ENCLOSURE / FUEL OIL STORAGE / LOAD BANK

- A. Comply with NFPA 30.
- B. Weather Enclosure Outdoor Weather-Protective Housing: The generator set shall be provided with a **Walk-In** Weather Protective Housing which allows the generator set to operate at full rated load in the ambient conditions previously specified. Provide **a minimum of six feet interior workspace completely around the engine and alternator assemblies**. The enclosure shall have a 3-phase transformer with 480V primary windings to supply power to all components within the enclosure (LED lights, receptacles, block heater, battery charger, controls, etc.) thru a low voltage

panelboard located within the enclosure. The enclosure shall be rated, by the engine manufacturer to withstand winds up to 150 mph. The enclosure shall be constructed of aluminum with stainless steel hardware. The measured sound level of the enclosure shall be 80 dB @ a 7 meters from the enclosure taken via an 8 position circular average. The enclosure shall include hinged doors for access to both sides of the engine and alternator, and the control equipment. Key-locking and pad lockable door latches shall be provided for all doors. Door hinges shall be stainless steel. The enclosure shall be provided with a critical grade exhaust silencer mounted inside of the enclosure. Mounting of the muffler outside of the enclosure will not be allowed. All panels shall be primed for corrosion protection and finish painted with the manufacturer's standard color. All surfaces of all metal parts shall be primed and electro statically or powder coated. Fasteners used shall be corrosion resistant and designed to minimize marring of the painted surface when removed for normal installation or service work. The enclosure shall be anchored to the sub-base fuel tank, prior to shipment. Provide vibration isolators, installed between the engine-generator set and sub-base diesel fuel storage tank, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location. In addition, please provide pad isolators to create an air gap between the fuel tank and foundation. Diesel fuel storage, sub-base day tank: The generator shall be supplied with a sub-base diesel fuel storage tank with a capacity for 72 hours at 75% full load capacity. The fuel tanks shall be U.L. 142 listed, double wall type and include low fuel level and internal tank leak detection alarm switches wired to the generator set control panel. The tank shall be able to run continuously for 32 hrs. Tank shall be provided with fuel by the Contractor before testing and shall be re-filled to the "full" mark on the fuel tank after testing is complete. Stairs and platform shall be included in the genset package as required.

- C. Provide an automatic LOAD BANK unit cooled by the engine cooling fan(s). **The Load Bank shall be rated for the 70% of the full capacity of the scheduled KW rating of the alternator.** The controller for the Load Bank shall include an HOA switch as well as individual switches for manual load settings (one switch for each 100KW). Provide IP based communication so the Load Bank can be controlled remotely by the Customers local SCADA system.
- D. The complete generator package, which includes the generator set, housing, and sub-base diesel fuel tank, shall be U.L. 2200 listed and labeled as a complete package. The U.L. 2200 listing on just the generator set does not meet this specification, and will not be accepted. Fuel storage tank shall be sized at full load running for 72 hours continuous.
 - 1. Closed top diked, open top diked and single wall fuel tanks shall not be allowed.
 - 2. For tanks over 24" in height at least two set of non-corrosive stairs with handrail shall be provided by the enclosure manufacturer for installation by the contractor.

2.5 CONTROL AND MONITORING

- A. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit
- B. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. (Switches with different configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or

derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.

- C. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- D. Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.
- E. Generator sets required in this project shall be capable of seamless **closed transition switching and/or paralleling with serving Electric Utility. Provide active synchronize generator controls.** (or passive control scheme as approved by the Electrical Engineer).
- F. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
 - 1. AC voltmeter (3-phase, line to line and line to neutral values).
 - 2. AC ammeter (3-phases).
 - 3. AC frequency meter.
 - 4. AC kW output (total and for each phase). Display shall indicate power flow direction.
 - 5. AC kVA output (total and for each phase). Display shall indicate power flow direction.
 - 6. AC Power factor (total and for each phase). Display shall indicate leading or lagging condition.
 - 7. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
 - 8. Emergency Stop Switch: Switch shall be a red “mushroom head” pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
 - 9. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
 - 10. DC voltmeter (alternator battery charging).
 - 11. Engine-coolant temperature gage.
 - 12. Engine lubricating-oil pressure gage.
 - 13. Running-time meter.
 - 14. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjustment of these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values
 - 15. AC Protective Equipment: The control system shall include over/under voltage, reverse kVAR, reverse kW, over current, over load (kW) short circuit, loss of voltage reference, and over excitation shut down protection. There shall be a ground fault alarm for generator sets rated over 1000 amps, overload warning, and overcurrent warning alarm.
 - 16. Status LED indicating lamps to indicate remote start signal present at the control, existing shutdown condition, existing alarm condition, not in auto, and generator set running.
 - 17. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall

also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.

18. Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.
19. Data Logging: The control system shall log the latest 20 different alarm and shut down conditions, the total number of times each alarm or shutdown has occurred, and the date and time the latest of these shutdown and fault conditions occurred.
20. DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control, and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Overcurrent Protection: The generator set shall be provided with a UL Listed/CSA Certified protective device that is coordinated with the alternator provided to prevent damage to the generator set on any possible overload or overcurrent condition external to the machine. The protective device shall be listed as a utility grade protective device under UL category NRGU. **The main output overcurrent protection device shall be solid-state trip, LISG, rated at 100% continuous current for the given trip/frame value.** The control system shall be subject to UL follow-up service at the manufacturing location to verify that the protective system is fully operational as manufactured. Protector shall perform the following functions:
 1. Initiates a generator kW overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 2. Under single phase or multiple phase fault conditions, or on overload conditions, indicates an alarm condition when the current flow is in excess of 110% of rated current for more than 10 seconds.
 3. Under single phase or multiple phase fault conditions, operates to switch off alternator excitation at the appropriate time to prevent damage to the alternator.
 4. The operator panel shall indicate the nature of the fault condition as either a short circuit or an overload.
 5. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot greater than 120% of nominal voltage.
 6. The protective system provided shall not include an instantaneous trip function.
 7. In addition to the Overcurrent Protection device above, the generator shall be provided with a UL listed, CSA certified, IEC rated, 3-pole, circuit breaker, rated for 100% output amperage (continuous duty). The circuit breaker has true RMS current sensing, adjustable rating plugs, LCD long-time pickup indication, The circuit breaker is UL listed at 100% of the frame rating for continuous duty. The output circuit breaker shall be rated LSIG at 100% continuous loading for all trip settings.
- B. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H
- D. Temperature Rise: 105C over a 40C environment.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Permanent Magnet Generator (PMG) shall provide excitation power for optimum motor starting and short circuit performance.
- G. Enclosure: Drip-proof.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, 3-phase true RMS sensing, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.
- I. The alternator shall be provided with anti-condensation heater(s).
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Sub-transient Reactance: 12 to 13 percent maximum, based on the rating of the engine generator set.

2.8 INTERNAL WIRING

- A. All internal power wiring within the generator enclosure shall be contained in conduit. Use aluminum rigid conduit within the generator enclosure.
- B. The use flexible conduit shall be kept to a minimum. The length of flexible conduit shall be limited to 18”.

2.9 VIBRATION ISOLATION DEVICES

- A. Vibration Isolation: Provide Spring Type Vibration Isolators. Quantity as recommended by manufacturer.

2.10 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters. In addition, the equipment engine, skid, cooling system, and alternator shall have been subjected to actual prototype tests to validate the capability of the design under the abnormal conditions noted in NFPA110. Calculations and testing on similar equipment which are allowed under NFPA110 are not sufficient to meet this requirement.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 1. Test engine generator set manufactured for this Project to demonstrate compatibility and functionality.
 2. Full load run.
 3. Maximum power.
 4. Voltage regulation.
 5. Steady-state governing.
 6. Single-step load pickup.
 7. Simulated safety shutdowns.
 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation, application, and alignment instructions and with NFPA 110.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

3.3 ON SITE ACCEPTANCE TEST

- A. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representative of the manufacture, with required full supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system. Test shall include:
- B. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.

- C. Installation acceptance test shall include a “cold start” test, a two (2) hour full load test, and a one step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for load test as necessary. During the load test, record the following at 15 minute intervals.
 - 1. Time of Day
 - 2. KW
 - 3. Volts per Phase
 - 4. Amps per Phase
 - 5. Engine RPM
 - 6. Frequency
 - 7. Engine Coolant Temperature
 - 8. Oil Pressure
- D. Perform a power failure test on the entire system installed. The test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system. Test other possible failure scenarios of the power system as needed.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators

3.5 SERVICE AGREEMENT:

- A. The supplier shall include in the base price, a one service agreement. The maintenance shall be performed by factory authorized service technicians capable of servicing the engine-generator set. This agreement shall include Preventive Maintenance as recommended by the manufacture to include oil and filter changes (Lube and Fuel Filters)

END OF SECTION 26 32 13.14

SECTION 26 35 33 – POWER FACTOR CORRECTION EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish and install Electronically switched transient free power factor correction equipment as specified herein and/or as shown on the contract drawings.
- B. This specification contains the minimum requirements for the design, manufacturer, and testing of electronically switched power factor correction capacitors rated 600 volts and below.
- C. Power factor correction equipment provided under other sections of the specifications as part of other equipment shall comply with this section.

1.2 REFERENCES

- A. The power factor correction equipment shall be designed and tested in accordance with the latest standards of NEMA, NEC, IEC, IEEE, and ANSI.
- B. The complete equipment including all components used shall be UL listed/recognized and labeled per UL 508, standard for Industrial Control Equipment. Internal capacitor cells are to be UL labeled and in compliance with UL 810, NEMA CP-1, EN60831-1/2, IEEE 18 and C37 and NEMA CP-1 standard.
- C. The equipment shall also be CUL certified.

1.3 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
 - 1. Master drawing index
 - 2. Front and Side view elevation
 - 3. Electrical Schematics
 - 4. Nameplate schedule
 - 5. Conduit entry/exit locations
 - 6. Equipment ratings including:
 - 7. Short-circuit rating
 - 8. Voltage
 - 9. Continuous current
- B. Major component ratings including:

1. Voltage
2. Continuous current
3. Cable terminal sizes
4. Product data sheets

1.4 SUBMITTALS – FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes:
 1. Final as-built drawings and information for items listed in Paragraph 1.04
 2. Certified production test reports
 3. Installation information
- B. The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

1.5 QUALIFICATIONS

- A. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.6 REGULATORY REQUIREMENTS

- A. The power factor correction equipment shall bear a UL label. Certified copies of production test reports shall be supplied demonstrating compliance with these standards when requested by the Engineer.
- B. The power conditioning equipment shall mitigate all common harmonic currents resulting in mitigation levels not greater than 2% THD of the fundamental current.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.8 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. ELSPEC
- B. Eaton (meeting all conditions of this document)
- C. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.2 RATINGS

- A. The system operating voltage shall be as indicated on the contract drawings.
- B. The total capacity of the power factor correction units shall be according to the following table:

Location	kVAR	Step Size	Step Number	Circuit Breaker
ritchgear 'MSBA' – Electrical Building #1	500	50 KVAR	10	600 Amp
ritchgear 'MSBB' – Electrical Building #2	500	50 KVAR	10	600 Amp

- C. The capacitor shall be rated for operation at ambient temperatures ranging from -25 degree C to +45 degree C and at 6000 ft. (1,800 meters) and below.
- D. A +/- 10% variation in line voltage shall not affect the life of the capacitor.

2.3 CONSTRUCTION

- A. Capacitors
 - 1. Individual capacitors shall be three-phase self-healing Metallized polypropylene type capacitors with a low loss design.
 - 2. Capacitors shall have minimum voltage ratings of 550V to 800V depending upon tuning frequencies listed in clause B.1
 - 3. Each capacitor cell shall be furnished with a UL recognized pressure sensitive interrupter. The interrupter shall disconnect all three phases at the same time to maintain a balanced circuit.

4. Capacitors shall be low loss, with maximum dielectric losses of 0.3W/kvar and total value less than 0.45 watts per kvar. The capacitors shall have integral finger safe terminals with an insulation voltage rating of 3kV AC or higher and be rated for 30kV BIL impulse strength.
5. Nominal design life of individual capacitor cells shall be 10 years under rated and defined operating conditions.
6. Capacitors shall be suitable for a high overcurrent carrying capacity of up to 130% rated current and capable of high inrush current capacity of up to 200 times the nominal current.
7. Capacitor cells shall be housed in anti-corrosion enclosures such as an extruded aluminum can and shall be provided with an integral grounding stud.
8. Individual capacitor cells shall be covered by a one-year warranty.

B. SERIES REACTORS

1. Each capacitor group/step shall include a three-phase low loss iron cored series connected 7%% (H3.8 228Hz).
2. Reactors shall have Enameled Copper wire windings, temperature class H/180oC. (E101843M).
3. Reactors shall have an oven impregnated varnished laminated steel core.
4. Reactors shall include an external thermistor, the thermistor to be included within the system over-temperature detection circuitry.
5. Reactors shall have an insulation voltage of 6Kv

C. WIRING

1. All power wiring shall be 600 volts rated using thermoplastic insulation rated for 105 degrees C temperature rise and sized with ampacity rating at 90 degrees C temperature rise.
2. System wiring connections shall be made to copper bus bars braced for 25,000 amps or greater.
3. Busbars where provided in a system without the integral door interlocked circuit breaker, shall be shielded from direct access by the operator by a barrier sheet and warning labels.
4. Each assembly shall be furnished with appropriately sized solderless connectors capable of handling conductors in accordance with the NEC. Minimum conductor size shall have the capacity 1.35 times rated capacitor current.
5. The complete equipment will come pre-wired and factory assembled. All wiring connections shall be mechanically secured to the specified torque values before shipment.

D. ELECTRONIC SWITCHING ELEMENTS

1. The system shall include Electronic switching elements (SCR/SCR) designed to switch power capacitor groups into the network without switching transients rated at a minimum of 250A with a minimum peak voltage rating of 3.2kV

2. Connection to the network will be performed during capacitors current zero-crossings, providing smooth connection and disconnection of the capacitor groups.

E. DISCHARGE RESISTORS

1. Capacitors shall be provided with ceramic discharge resistor module that will reduce the residual voltage on the capacitor to less than 50 volts within one minute of de-energization as required by the National Electrical Code Article 460.6. Resistors shall be chosen to ensure a 10-year minimum life.

F. FUSES

1. In line series fuses on all three phases shall be UL listed and labeled, and will provide major overcurrent protection.
2. Line fuses shall be current limiting Class T type. Minimum interrupting rating shall be 200,000 amperes at 480 volts for fuses rated 30 amperes and above. Fuses shall be designed for capacitor application and shall be rated not less than 150% current rating.

G. ENCLOSURE

1. The switched power factor correction equipment shall be provided with a floor-mounted OR wall-mounted enclosure. The enclosure shall be NEMA 3R powder coated steel.
2. An internal grounding lug shall be provided. Capacitor cells shall be accessible for visual inspection and replacement from the front of the cabinet. Removable lifting eyes shall be provided.
3. The cabinet shall be provided with a Thermal Edge air conditioning unit OR fan-forced filtered ventilation unit.

H. CONTROL POWER AND PROTECTION

1. The control power shall be 115V or 230V 60Hz AC derived from an internally mounted control transformer in the PFC cabinet.
2. The control power shall be adequately fuse protected.
3. The Controller shall be mounted on enclosure door for easy inspection and service.

I. REACTIVE POWER CONTROLLER/POWER FACTOR METER

1. Controller shall be capable of detecting four quadrant power flow and monitor voltage and current on all three phases of the network and two phases of the capacitor system.
2. Controller shall include a high contrast 4.7" LCD screen with LED backlight and display capacitor group connection and disconnection.
3. The controller shall include a user-friendly step by step Site Installation Wizard and allow programmable target cosine selection in the range of 0.75 Inductive to 0.7 Capacitive

4. The controller shall connect capacitor groups according to the network reactive power demand within $\frac{1}{4}$ to 1 network cycle.
5. In the event of main power interruption, the controller shall retain its programming, after the restoration of supply voltage the controller shall bring the capacitor system back online, and automatically connect capacitor groups as required by network demand.
6. Controller shall be able to display power factor with indication for an inductive or capacitive power factor.
7. Controller shall include a self-diagnostic function to test each capacitor step and calculate and display the kVAr value of each phase and the total
8. Controller shall include a Voltage free contact (N.O./N.C.) alarm relay
9. Controller shall recognize a defective capacitance step and eliminate that step from the operational circuit
10. Controller shall include automatic detection of the following system and network errors:
 - a. Blown fuse error
 - b. Failed SCR error
 - c. Over temperature alarm
 - d. Parallel resonance detection mechanism
 - e. Phase sequence error detection
11. Controller shall include a 1MB Flash memory to automatically record all troubleshooting related events including time stamp (year, month, day, hour, minute, second, cycle number), of up to 16,000 events, stored in FIFO configurations
12. Controller shall provide metering options and the selectable display of network and capacitor system parameters such as Voltage (V), Current (I), Power factor (pf), Reactive power (kVAr), Active Power (kW), Apparent power (kVA) and Total Harmonic Distortion (THD)] for each individual phase and the 3 phase total
13. Controller shall provide an option for supervisory monitoring functions such as undervoltage, overvoltage, harmonics, loss of power and number of operations, RS485 with either proprietary or Modbus RTU protocol.

J. OVERCURRENT PROTECTION

1. Overcurrent protection shall be provided using an integrally mounted UL listed and approved Molded Case Circuit Breaker rated for at least 135% of the total system current. The breaker shall be rated for an interrupting capacity of at least 35,000 symmetrical amperes and match the bus bar dynamic strength bracing rating.

2.4 NAMEPLATES

- A. Each unit will have a door mounted nameplate. The lettering shall be black on a grey background.

2.5 FINISH

- A. Power factor correction equipment enclosures shall be Epoxy powder coated, inside/out in gray (RAL 7035)

2.6 WARRANTY

- A. The entire equipment shall be warranted by the manufacturer for one year of operation or 24 months.

PART 3 - EXECUTION

3.1 FACTORY TESTING

- A. All capacitors shall be tested in compliance with NEMA, ANSI, UL and CUL requirements for capacitance, dissipation factor, terminal-to-terminal dielectric strength, and terminal-to-case dielectric strength. All capacitor cells shall be traceable through construction and testing.
- B. The automatic power factor capacitor correction unit shall have a full power test of each capacitor group prior to leaving the factory. At a minimum the following checks, measurements, and operations must be confirmed and recorded. The certified record of these tests shall become part of the permanent documentation package that travels with the automatic capacitor bank.
 - 1. Security of Wire connections
 - 2. Security of Electrical Connections & Torque
 - 3. Line fuse rating
 - 4. Capacitor type and rating.
 - 5. Controller Automatic and manual operation
 - 6. Controller model, serial number and internal firmware version.

3.2 EXAMINATION

- A. Installing Contractor shall fully inspect shipments for damage and report damage to manufacturer and file claim upon shipper, if necessary.
- B. Installing Contractor shall verify NEC clearances as dictated on the contract drawings prior to installation. Verify UL labeling of the assembly prior to installation.

3.3 INSTALLATION

- A. The Contractor shall follow the installation instructions according to local and NEC codes and as recommended in the manufactures User Manual.
- B. The Contractor shall install three (3) Current transformers (one per phase) with 5A secondary windings.
- C. The Contractor shall ensure the correct placement and phase rotation of the network monitoring C/T's according to the manufacturers User Manual.
- D. The Contractor shall confirm the correct rotation of the main feeder cables (clockwise L1,L2,L3).

- E. The installing contractor must utilize the services of a factory authorized technician to assist in the startup/commissioning of the system after successful installation is completed.

END OF SECTION 26 35 33

**SECTION 26 43 13 – SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER
CIRCUITS**

PART 1 - GENERAL

1.1 SUMMARY

- A. This section describes the quality, performance, and installation of Parallel Connected, AC Power, Panel Type, Surge Protective Devices (SPDs).

1.2 QUALITY ASSURANCE

- A. All Surge Protective Devices (SPDs) shall be tested and listed to ANSI/UL 1449-Current Edition by an independent testing agency, with the experience and capability to conduct the testing indicated, that is a Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction. This agency must comply with ANSI/IEEE C62.45 test procedures for all categories established in C62.41 (1991). “Manufactured in accordance with UL 1449” is not equivalent to being certified and listed to ANSI/UL 1449 and does not meet the intention of this specification. In addition to being UL 1449 listed, Type 2 SPDs shall be Complimentary Listed to UL 1283.

1.3 CODES AND STANDARDS

- A. ANSI/IEEE Std C62.41.1™-2002, IEEE Guide on the Surge Environment in Low- Voltage (1000 V and Less) AC Power Circuits
- B. ANSI/IEEE Std C62.41.2™-2002, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
- C. ANSI/IEEE Std C62.45™ -2002, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
- D. ANSI C84.1, American National Standard for Electric Power Systems and Equipment – Voltage Ratings (60 Hertz)
- E. ANSI/IEEE Standard 1100-2005, IEEE Recommended Practice for Power and Grounding Electronic Equipment (Emerald Book) – Clause 8.6.1
- F. National Fire Protection Association (NFPA) 70 (N.E.C.) –Article 285/242
- G. ANSI/UL Standards 1449, UL 1283 Listed, CUL Listed & CE compliant “low- voltage directive.”
- H. C62.62-2018 - IEEE Standard Test Specifications for Surge-Protective

- I. Devices (SPDs) for Use on the Load Side of the Service Equipment in Low Voltage (1000 Volts and less) AC Power Circuits
- J. IEEE Standard C62.72™ - 2016 –IEEE Guide for the Application of Surge-Protective Devices for Use on the Load Side of Service Equipment in Low-Voltage (1000 V or Less, 50 Hz or 60 Hz) AC Power Circuits

1.4 MANUFACTURER QUALIFICATIONS

- A. All surge protective devices shall be manufactured by an ISO 9001-2015 certified company normally engaged in the design, development, and manufacture of such equipment, with at least 10 years of engineering experience in the design and manufacture of permanently connected SPD devices.
- B. The surge protective device manufacturer shall provide unlimited free replacement of the entire SPD for all inoperable SPD units during the warranty period.
- C. All SPD's shall be manufactured by the same manufacturer.
- D. The listing of a manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included herein. Subject to compliance with requirements, provide products by the following manufacturers and models listed below only:
 - 1. Surge Suppression Incorporated (Advantage Series) / 256-797-5097 / surgesuppressionrep@gmail.com
 - 2. Liebert Corporation (ASCO) (560xx16 & 570xx17 Series) / 614-888-0246
 - 3. Current Technology (SL3-150 Series) / 800-238-5000 or pre-approved manufacturers.

1.5 SUBMITTALS

- A. Surge protective device submittals shall include, but shall not be limited to the following items:
 - 1. Complete data for all SPD indicating part numbers, conductor sizes, etc.
 - 2. Dimensioned drawing of each suppressor type indicating mounting arrangement. Manufacturer's ANSI/UL 1449 listing classification page and listing number(s).
 - 3. Manufacturer's UL 1283 listing classification page and listing number(s).
 - 4. Certified test data documenting ANSI/IEEE C62.41-2002 performance and the ability of the device to meet or exceed all requirements of this specification. Include complete let-through voltage/measured limiting voltage test data (not Voltage Protection Rating), test graphs, and scope traces for each mode for each product submitted for Category's C, B, A (including Category A 2kV, 30 Ohm Ring Wave at both 90 & 270 degree electrical phase angles).
 - 5. Letter from manufacturer stating products are in strict compliance with the recommendations of IEEE Standard 1100-2005, Clause 8.6.1 and incorporate 10 individual dedicated discrete modes of protection for three-phase Wye systems, including direct line-to-line components. (Reduced-mode variations will not be accepted).

6. Statement of manufacturer's warranty duration and replacement policy.

1.6 WARRANTY

- A. All SPD devices shall be warranted to be free from defects in materials and workmanship under normal use in accordance with the instructions provided for a period of twenty-five (25) years from date of substantial completion.
- B. Any SPD device that shows evidence of failure or incorrect operation, including damage as the result of lightning strikes, during the warranty period shall be replaced as a complete unit (not just modules, subassemblies, or components) by the manufacturer at no charge to the owner. Warranty will provide for multiple exchanges of any inoperable devices at any time during the warranty period that starts at the date of substantial completion of the system to which the surge suppressor is installed.
- C. SPD manufacturers whose warranty does not meet the requirements and standards listed above shall submit a letter on the SPD manufacturer's corporate letterhead stationery and signed by a corporate officer extending the warranty to meet these standards with the product submittal.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Surge Protective Devices (SPDs) shall be installed on all Motor Control Centers (MCCs), Switchboards, Low-Voltage Switch Gear, Mini-Powers Zones, Required Safety Switches, Feeder Safety Switches, and Branch Circuit and Distribution Panelboards, whether scheduled or not.
- B. All SPDs shall be tested and listed to ANSI/UL 1449 by a Nationally Recognized Testing Laboratory (NRTL) (i.e. CSA, UL, etc.). Type 2 SPDs shall be Complimentary Listed to UL1283.
- C. All SPDs shall be Type 2 SPDs unless otherwise directed by the Engineer; Type 4 SPDs are not permitted. (Definitions: Type 1 SPD – Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, as well as the load side, including watt- hour meter socket enclosures and intended to be installed without an external overcurrent protective device. Type 2 SPD – Permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device; including SPDs located at the branch panel.
- D. The SPD shall be tested and listed by an NRTL as a complete assembly to a Short-Circuit Current Rating (SCCR) greater than or equal to the available fault current at the location of installation at the connected panel without the need for upstream over current protection, in accordance with NEC Article 285/242 and shall be marked with the Short-Circuit Current Rating (SCCR). If the available fault current is unknown, then the SCCR of the SPD shall be 200 kAIC. The SPD shall have a sufficient Short-Circuit Current Rating (SCCR) for the point of application without relying upon any upstream circuit interrupt device (i.e. circuit breaker or fuse).

- E. Permanently connected surge protective devices mounted parallel to the service, distribution, and sub panels are required. SPD device drawings shall be available upon request.
- F. Service entrance SPD's shall have a Nominal Discharge Current (In) of 20 kA. All other SPDs shall have a Nominal Discharge Current (In) of 10 kA.
- G. Fusing:
 - 1. The SPD shall provide as a minimum, over-current, over temperature protection in the form of component-level thermal fusing to ensure safe failure and prevent thermal runaway. This component-level fusing shall be an integral part of the MOV itself and not silver wire (or other) independently laid across each MOV. SPDs without thermal fuses or disconnects, or SPDs with shared thermal devices that disconnect more than one MOV are not acceptable
 - 2. Surge protective devices shall contain integral short circuit current safety fusing within each device for over-current requirements of the NEC. This fusing will be independent of the "component-level" fusing and be specifically for over-current protection and shall be constructed utilizing surge rated, cartridge fuses and not rated 'silver-fuse-wire' (or other).
 - 3. The fusing mechanisms employed must effectively coordinate their performance in conjunction with the high current abnormal over-voltage testing under ANSI/UL 1449.
 - 4. The use of any mechanical or electro-mechanical thermal/over- current protection (i.e. moving parts and/or springs and shutters) in combination with or for the protection of the suppression elements is expressly prohibited and will be rejected. Large-Block 34mm (50kA) square Thermal Protected MOVs are expressly prohibited and will not be accepted.
- H. MCOV: The SPD shall have a maximum continuous operating voltage (MCOV) capable of sustaining 115% of nominal RMS voltage continuously without degrading.
- I. Component Limitations: The SPD shall only use solid-state clamping components to limit the surge voltage and divert the surge current. SPD components that "crowbar" short-circuit the AC power system (e.g. spark gaps, gas tubes, selenium cells, or SCR's) shall not be acceptable. Device circuitry shall be bi-directional, enclosed in a UL listed encapsulated thermal stress reducing compound, and be of a parallel design.
- J. Per Phase Ratings: 'Per-Phase' ratings for a three-phase Wye-connected SPD are determined by multiplying the kA per mode times the number of discrete modes of protection (directly connected suppression components), minus the value for the Neutral to Ground mode, divided by the number of phases.
 - 1.
$$\text{Per-Phase} = (((\text{kA per mode}) \times (\# \text{ of modes})) - (\text{N-G mode kA})) / (\# \text{ of phases})$$
- K. Protection Modes: The SPD system shall provide (per IEEE Std. 1100-2005- 8.6.1) dedicated, independent, distinct, individual protection circuitry for every possible mode in the electrical distribution system at the point of SPD application. For example, a 277/480V, 3-phase Wye, 4-wire plus ground system has 10 distinct modes that require independent and dedicated protection (i.e., L1-L2, L2-L3, L3-L1, L1-N, L2-N, L3-N, L1-G, L2-G, L3-G, N-G). None of these modes of protection depend on protection elements purposed for other protection modes. Reduced mode SPD with only 3, 4, or 7 dedicated, distinct, independent protection modes are not acceptable and are not to be submitted. For 6 mode delta systems, 6 dedicated,

independent, distinct protection modes are required (L1-L2, L2-L3, L3-L1, L1-G, L2-G, L3-G). When a mode of protection is specified, the protective mode must be specifically included. Thus, Line-to-Neutral-to-Line is not acceptable where Line-to-Line is specified.

- L. As an option, the Engineer may specify surge protection devices with a Frequency Responsive Circuitry (FRC) (or Sinewave Tracking Capability). NOTE TO SPECIFIER: THE FRC OPTION SHOULD NOT BE SELECTED WHEN THE SPD IS CONNECTED TO THE SAME POINT OF COMMON COUPLING WITH ACTIVE POWER CONDITIONING EQUIPMENT INJECTING CAPACITANCE AND/OR INDUCTANCE INTO THE ELECTRICAL NETWORK. Branch circuit panelboards; MCC's; LV Switchgear; and Switchboards serving sensitive electronic equipment shall utilize voltage independent, dedicated Frequency Responsive Circuitry (FRC) intended to mitigate the effects of switching or ringing surges that is specifically designed so that it can survive the surge environment. The FRC is used in conjunction with the Voltage Responsive Circuitry (VRC) which is included in every model and mitigates the impact of larger, impulse-type surges by activating at a preset voltage above the normal power frequency voltage. EMI/RFI filtering specifically will not be considered as equal to FRC. The performance of FRC is defined by the level to which it mitigates Ring Wave transients and can be demonstrated in the test results of IEEE C62.41.2-2002, Category A 2kV, 30 Ohm Ring Wave. For those applications not serving sensitive electronic equipment, utilize SPDs that are of Voltage Responsive Circuitry (VRC) design (responds to a change in voltage only rather than to a change in frequency).
- M. To demonstrate the FRC capability of the submitted devices, manufacturers shall submit 3rd party, independent tests results for units claiming FRC capability. Such tests shall include testing under the standards of ANSI/IEEE C62.41 and C62.45 Category A (2kV, 67A, 100kHz ring wave) applied at the 270-degree phase angle, positive polarity. On a 3-phase Wye device, on each of the following modes: line-to-neutral, line-to-ground, and line-to-line (dynamic tests with normal voltage applied to the unit under test), and neutral-to-ground (static test with no normal voltage applied to unit under test) shall be tested. The "let-through voltage" derived from each of these tests shall have a maximum amplitude of less than 50V peak deviation from the insertion point of the surge on the sine wave to the peak of the transient. Measurement of the let-through voltage shall be made with six-inches of lead length external to the SPD housing in accordance with ANSI/UL 1449. Performance requirements are as stated in the table in Section VIII below (ANSI/IEEE C62.41 Let-Through Voltage) at Test Category A Ring Wave (2kV).
- N. Status Indicators: SPD units shall have panel front status monitors as a minimum to indicate a continuous positive status of each protected phase. A remote audible alarm option must be supplied where the Engineer deems it necessary and cost effective under the circumstances. Refer to the appropriate drawings and schedules for these details.
- O. Equipment Certification: Items shall be listed to ANSI/UL 1449-Current Edition, shall bear the seal of the NRTL, shall bear the Marking "Listed to UL 1449", shall have been tested under ANSI/UL 1449-Current Edition, and shall be marked in accordance with the referenced standard. SPD units shall be UL 1283 Listed as an Electromagnetic Interference Filter and marked accordingly. All surge suppression devices shall be manufactured by an ISO 9001-2015 certified company normally engaged in the design, development, and manufacture of such equipment.

- P. Circuit Configuration: The circuit configuration of the suppression units shall be bi-directional, thermal stress reducing, encapsulated, custom parallel connected, and solid state. (Series units or units equipped with “load carrying” components are expressly prohibited due to the possibility of single point series failures causing power interruption to protected loads.)
- Q. Enclosures: Unless otherwise noted, provide NEMA 1 or better enclosures for indoor mounting and NEMA 4X enclosures for all outdoor locations. All units will contain Form C, N/O or N/C, dry relay contacts, if so specified, and weatherproof fittings to maintain the required NEMA integrity.
- R. Maintenance Restrictions: No suppression unit shall be supplied which requires scheduled preventive maintenance or replacement parts. Units requiring functional testing, special test equipment, or special training to monitor surge protection device (SPD) status are not acceptable. SPD shall require NO routine maintenance. SPD devices are considered non-repairable items and shall be fully replaced upon failure.
- S. Commonality: All SPDs at the service entrance, distribution panels, and sub- panels shall be from the same manufacturer.
- T. Performance Criteria: All SPDs shall meet or exceed the performance criteria shown in the Peak Surge Current & Performance Table below. SPDs must meet the Let-Through Voltage criteria as shown in the Section VII, below.

2.2 ANSI/IEEE C62.41 LET-THROUGH VOLTAGE

- A. The SPD shall meet the Let-Through Voltage requirements shown in the tables below for voltage and locations specified. All voltages shall be peak ($\pm 10\%$), Positive Polarity, Time base = 10 μ s, Sampling Rate = 500 Mega samples per second to ensure maximum transient capture. [These settings assure Let-through Voltage test results are accurate]. Surge voltages shall be measured from the insertion of the surge on the sine wave to the peak of the surge. All tests are Static (unpowered), except for the 120V circuits that are Dynamic (powered). Let-through voltages on static tests calculated by subtracting sine wave peak from let-through measured from zero. All tests shall be performed in accordance with UL144 latest edition with measurements performed at a point on the leads 15.24 cm (6 inches) outside of the device enclosure. No data measured at a module, lugs, component, or undefined location will be accepted. These settings assure Let-through Voltage test results are accurate. SPDs shall meet the following criteria:
 - 1. Service Entrance ANSI/IEEE Cat. C Impulse Wave: The let-through voltage based on ANSI/IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. C (High) (10,000 amps), shall be less than (values are total let-through voltage (LTV) measured from the insertion point of the transient on the sine wave to the peak of the transient):

Mode / Voltage	120/208Y	277/480Y	480V, 3Ø Δ
L-N	1075V	1340V	N/A
L-L	1390V	1990V	1990V
L-G	1056V	1310V	2150V
N-G	1441V	1730V	N/A

2. Distribution and Branch Panels/Panelboards (Non-Electronics): ANSI/IEEE Cat. A Combination Wave Impulse Let-Through Voltage: The let-through voltage based on ANSI/IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. A Combination Wave Impulse (6kV, 200 amps) at the 90 degree phase angle, shall be less than; (values are total let-through voltage (LTV) measured from the insertion point of the transient on the sine wave to the peak of the transient):

Mode / Voltage	120/208Y	277/480Y	480V, 3Ø Δ
L-N	315V	437V	N/A
L-L	467V	535V	515V
L-G	340V	424V	515V
N-G	597V	960V	N/A

3. Branch Panels/Panelboards (Electronics) ANSI/IEEE Cat. A Ring Wave Let- through-Voltage: The let-through voltage based on ANSI/IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Category A 2kV, 30 Ohm Ring Wave at the 270 degree phase angle, shall be less than (values are total let-through voltage (LTV) measured from the insertion point of the transient on the sinewave to the peak of the transient):

Mode / Voltage	120/208Y	277/480Y	480V, 3Ø Δ
L-N	30V	60V	N/A
L-L	40V	66V	114V
L-G	65V	81V	1605V
N-G	65V	70V	N/A

4. In addition to the above requirements, Service Entrance, Distribution Panels, Mini-Powers Zones, and Panelboards directly feeding Electronics or where the specifying engineer deems Frequency Responsive Circuitry to be necessary shall meet the requirements of 3 above whether scheduled or not.

2.3 ANSI/UL 1449 LATEST EDITION VOLTAGE PROTECTION RATING

- A. Voltage Protection Rating (VPR) is a rating selected from a list of preferred values as detailed in ANSI/UL 1449-1449 latest edition and assigned to each mode of protection. The value of a VPR is determined as the nearest highest value taken from a list of preferred values (as detailed in ANSI/UL 1449-1449 latest edition compared to the measured limiting voltage determined during the transient voltage surge suppression test using the combination wave generator at a setting of 6 kV, 3 kA.
- B. The SPD shall have Voltage Protection Ratings (VPRs) no greater than those shown below:

Nominal System Voltage	Mode	VPR
Single-Phase 120/240	L-N	600 V
	L-G	600 V
	N-G	700 V
	L-L	1000 V

Three-Phase 120/240 Delta	L-N	600 V
	HL-N	1200 V
	L-G	600 V
	HL-G	1200 V
	N-G	700 V
	L-L	1000 V
	HL-L	1000 V
120/208 Wye	L-N	600 V
	L-G	600 V
	N-G	700 V
	L-L	1000 V
277/480 Wye	L-N	1200 V
	L-G	1200 V
	N-G	1200 V
	L-L	1800 V
480 No Neutral (Delta)	L-G	1800 V
	L-L	1800 V

PART 3 - EXECUTION

3.1 INSTALLATION

- A. For proper performance, the SPD shall be installed with the leads short and straight as possible. Any sharp bend in the wire is unacceptable! This applies to phase, neutral, and ground leads. The objective is to reduce the lengths of wire provided on each unit, not add to it. The priority is to the phase leads, then the neutral, and then the ground lead.
- B. Install the breaker for the SPD close to the neutral buss, if present, on the neutral buss side of the panel. If no neutral circuit is present in the electrical panel, install the breaker close to the ground buss if possible.
- C. Install the SPD on a dedicated breaker. If the unit is piggybacked on a breaker that feeds other equipment, when that breaker is turned off to service the other equipment, you have lost the surge suppression for that panel.
- D. Mount the SPD directly across from the breaker. While holding the SPD on the wall or side of the panel, determine the shortest distance between the hub on the SPD and the hub to be installed on the panel. If using the flexible conduit supplied with the SPD, cut the flexible conduit to the shortest length possible to fit securely over both hubs. Twist the trimmed flexible conduit onto the extra hub. Slide the conduit and hub over the wires of the SPD and twist the conduit onto to the hub of the SPD. Connect the extra hub to the panel and mount the SPD to the wall or the panel.
- E. The breaker, the neutral buss, and the SPD should be close together to keep the wires as short and straight as humanly possible. Twist the phase and neutral wires together for 3 or 4 twists between the SPD and the breaker. Then these wires should be cut short as possible and connected to the breaker or the neutral buss, as appropriate, with no sharp bends in the wire.

- F. The ground wire should be connected to the panel ground buss if it is close to the SPD. If this is not possible, connect the ground wire to a ground lug installed near the SPD in the can or frame as they are grounded. If necessary, once this is done, the ground wire can be extended from the lug to the ground buss if the AHJ requires this connection.
- G. These same principles apply to installation on switchboards and MCCs. On MCCs, locate the SPD as close to the main buss as possible so that the lead lengths are short.
- H. Install the SPD in a bucket with a feeder breaker and use a remote light mounted on the door. The Remote Light Kit (option –LP) must be ordered with the SPD. The remote light kit cannot be ordered to add to the SPD as an in-the-field modification.
- I. Provide surge protective devices at each building service entrance and at other distribution and panelboard locations as indicated on the drawings. The SPD shall be located immediately adjacent to the switchboard or panelboard being protected (close-nipple to panel-boards). The SPD may not be located integral (switchgear manufacturer installed) within the switchboard or panelboard(s) unless the switchgear manufacturer providing such SPD products expressly meets or exceeds ALL parameters of this specification for the SPD. These SPDs shall be individually tested and Listed to ANSI/UL 1449 according to their type (Type 1 or Type 2) and not be listed solely as part of the larger assembly. SPD devices not meeting or exceeding the performance of this specification will be deemed unacceptable.
- J. Do not energize or connect service entrance equipment and panelboards to their sources until SPD devices are properly installed and connected.
- K. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect all conductors including the neutral and/or ground before conducting insulation resistance tests, and reconnect immediately after the testing is over.
- L. Install the SPD with #10 AWG conductors to dedicated 30-amp breaker(s) in panel per manufacturer's installation instructions and close to the neutral buss. The dedicated breaker shall serve as a means of service disconnect for the SPD so that the electrical panel remains energized during SPD servicing. The installer may rearrange breaker locations to ensure the shortest and straightest leads to the SPD. If a dedicated breaker is not provided, an SPD with internal 30-amp fuse or a UL Listed disconnect switch shall be installed as a minimum. The conductors (neutral and phase wires) serving the SPD shall be twisted together (3 or 4 twists per 12" of wire) to reduce the SPD system input impedance and shall be kept at the minimum length. The SPD shall be installed in strict accordance with the manufacturer's recommended practices and in compliance with N.E.C. requirements, State, and Local Codes.
- M. If any SPD lead lengths are required to be longer than 18", the Contractor responsible for installation must contact the Electrical Engineer and the surge protective device manufacturer or distributor (256-797-5097) for installation assistance.
- N. The Electrical Contractor shall verify the proper application of the SPD (i.e., voltage, phases, etc.). The Electrical Contractor shall ensure all neutral conductors are bonded to the system ground at the service entrance. The electrical contractor shall ensure that neutral-to-ground bonds do not exist at locations that are not service entrances or separately derived power sources.

- O. The Electrical Contractor shall furnish all labor, materials, equipment, and services necessary for and incidental to the installation of the SPD system components as specified herein.
- P. The Electrical Contractor shall coordinate with other electrical work as necessary to interface installation of the transient voltage surge suppression systems with other work on the site.
- Q. The SPD installation shall be completed by a certified or licensed electrician to ensure that the installation is in accordance with the manufacturer's recommendations, applicable electrical code requirements and the requirements of the specification above. Any deficiencies noted shall be corrected by the Contractor. Provide written documentation of this inspection as part of the closeout documentation.

END OF SECTION 26 43 13

SECTION 26 43 20 – SURGE PROTECTION FOR CONTROLS & COMMUNICATION CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Description: This section describes surge protective devices (SPD) to be furnished to protect dedicated 120VAC circuits within control panels; network CAT5E or CAT6 data transmission circuits; 24VDC low-voltage field instrumentation circuits; low-voltage loop powered networks; as well as 120VAC and low-voltage point-of-use loads whether scheduled or not. The devices will protect the following:
1. Dedicated 120V, 120/208V, 277V, and 480-volt AC circuits, series connected.
 2. Dedicated 120-volt control signals.
 3. Analog instrumentation signal, field mounted.
 4. Network Cable, High-Speed Data Circuit

1.2 REFERENCED CODES AND STANDARDS

- A. ANSI/IEEE Std C62.41.1TM-2002, IEEE Guide on the Surge Environment in Low- Voltage (1000 V and Less) AC Power Circuits
- B. ANSI/IEEE Std C62.41.2TM-2002, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
- C. ANSI/IEEE Std C62.45TM -2002, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
- D. ANSI C84.1, American National Standard for Electric Power Systems and Equipment – Voltage Ratings (60 Hertz)
- E. ANSI/IEEE Standard 1100-2005, IEEE Recommended Practice for Power and Grounding Electronic Equipment (Emerald Book) - Clause 8.6.1
- F. National Fire Protection Association (NFPA) 70 (N.E.C.) - Article 285/242
- G. ANSI/UL Standards 1449-2006 Listed (UL 1449 Third Edition), UL 1283 Listed, CUL Listed & CE compliant “low-voltage directive.”
- H. C62.62-2018 - IEEE Standard Test Specifications for Surge-Protective Devices (SPDs) for Use on the Load Side of the Service Equipment in Low Voltage (1000 Volts and less) AC Power Circuits
- I. IEEE Standard C62.72TM - 2016 – IEEE Guide for the Application of Surge-Protective Devices for Use on the Load Side of Service Equipment in Low-Voltage (1000 V or Less, 50 Hz or 60 Hz) AC Power Circuits

- J. UL 1283, Standard for Safety Electromagnetic Interference Filters

1.3 DEFINITIONS

- A. Let-Through Voltage (LTV) – The voltage that is measured at the end of the output leads of the surge protective device (SPD) measured from the zero voltage reference to the peak of the surge when the applied surge is induced at a specified phase angle; i.e., 90 or 270 degree phase angle.
- B. Clamping Voltage – The voltage level where the SPD begins to conduct and handle the excess energy of the surge thus providing a low-resistance direct path for the surge.
- C. Maximum Continuous Operating Voltage (MCOV) – The maximum steady state voltage at which the SPD can operate and meet its specification. This is the maximum designated root-means square (RMS) value of the power frequency voltage that may be continuously applied to each mode of protection of the SPD.
- D. Protection Modes: This parameter identifies the modes for which the SPD has directly connected protection elements; i.e. line-to-neutral (L-N), line- to-ground (L-G), and neutral-to-ground (N-G).
- E. Peak Surge Current (PSC): The maximum 8 x 20 microsecond surge current pulse the SPD device is capable of surviving on a single-impulse basis without suffering either performance degradation or more than 10 percent deviation of clamping voltage at a specified current.
- F. System Peak Voltage: The supply voltage sine wave peak (i.e., for a 120-volt system the L-N peak voltage is 170 volts).
- G. EMI/RFI Filtering (Electromagnetic/Radio Frequency Interference): This filter is designed to attenuate unwanted electromagnetic and radio frequency signals (such as noise and interference) generated from electromagnetic sources.
- H. Frequency Responsive Circuitry/Sine Wave Tracking (FRC): A term used to describe the circuitry of a low-pass filter designed to attenuate “switching” or “ring wave” transients/surges.

1.4 SUBMITTALS

- A. Surge protective device submittals shall include, but shall not be limited to the following items:
 - 1. Complete data for all SPDs indicating part numbers, conductor sizes, etc.
 - 2. Dimensioned drawing of each suppressor type indicating mounting arrangement.
 - 3. Manufacturer’s UL 1283 listing classification page and listing number(s).
 - 4. Certified test data documenting ANSI/IEEE C62.41-2002 performance and the ability of the device to meet or exceed all requirements of this specification. Include complete let-through voltage/measured limiting voltage test data (not Voltage Protection Rating), test graphs, and scope traces for each mode for each product submitted for Category’s

C, B, A (including Cat A, 2 kV, 67 A, 100 kHz ring wave at both 90 & 270 degree electrical phase angles).

5. Letter from manufacturer stating products are in strict compliance with the recommendations of IEEE Standard 1100-2005, Clause 8.6.1 and incorporate individual dedicated discrete modes of protection for each mode including direct line-to-line components. (Reduced-mode variations will not be accepted).
6. Statement of manufacturer's warranty duration and replacement policy.

1.5 WARRANTY

- A. All SPD devices shall be warranted to be free from defects in materials and workmanship under normal use in accordance with the instructions provided for a period of-five (25) years from date of purchase unless otherwise specified below.
- B. Any SPD device that shows evidence of failure or incorrect operation, including damage as the result of lightning strikes, during the warranty period shall be replaced as a complete unit (not just modules, subassemblies, or components) by the manufacturer at no charge to the owner. Warranty will provide for multiple exchanges of any inoperable devices at any time during the warranty period that starts at the date of substantial completion of the system to which the surge suppressor is installed.
- C. SPD manufacturers whose warranty does not meet the requirements listed above standard shall submit a letter on Corporate Letterhead Stationery and signed by a corporate officer extending the warranty to meet these standards with the product submittal

PART 2 - PRODUCTS

2.1 MANUFACTURER QUALIFICATIONS

- A. All surge protective devices (SPD) shall be manufactured by an ISO 9001-2015 certified company normally engaged in the design, development, and manufacture of such equipment, with at least 10 years of engineering experience in the design and manufacture of permanently connected SPD devices.
- B. The SPD manufacturer shall provide unlimited free replacement of the entire SPD for all inoperable SPD units during the warranty period.
- C. The use of any mechanical or electro-mechanical thermal/over-current protection (i.e. moving parts and/or springs and shutters), in combination with or for the protection of the suppression elements are expressly prohibited and will be rejected
- D. The listing of a manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included herein. Subject to compliance with requirements, provide products by the following manufacturers and specific models listed below only:

1. Surge Suppression Incorporated or ECS International LLC (Contact ITD of Huntsville, LLC at 256-797-5097 or surgesuppressionrep@gmail.com) or Pre-approved manufacturers.
2. Pre-Approval submittals for products by manufacturers not listed above must be submitted not less than ten (10) business days prior to bid date to allow ample engineering time for review of submitted products. Products not submitted within this timeframe will not be reviewed.
3. Submit proper documentation showing detailed (line-by-line) compliance with this specification. Prior approvals not received by the deadline date defined above will not be considered.
4. Along with the line-by-line comparison from manufacturers not listed herein, pre-approval surge suppression submittals shall include all of the items listed in Part 2.2, below.
5. Incomplete submittal packages will not be reviewed.

2.2 REQUIREMENTS

- A. Dedicated 120 Volt AC Control Power Circuit Protection (Surge Suppression Incorporated Model USPT1P1-21):
 1. Maximum Continuous Operating Voltage: 150 volts
 2. Maximum Continuous Operating Current: 30 Amps
 3. Peak Surge Current: 40 kA per mode; 120 kA total
 4. SPD circuitry shall include only solid-state clamping components consisting of a multi-stage hybrid design. Device shall be bi-directional, enclosed in a UL listed/recognized encapsulated thermal stress reducing compound.
 5. Discrete and dedicated protection components must be provided for each mode of protection (L-N, Normal Mode) (L-G, N-G Common Mode).
 6. Frequency Responsive Circuitry (sine-wave tracking) must be provided for each mode of protection. Products utilizing basic EMI/RFI filter performance (dB insertion loss rating) will not be considered.
 7. Let-Through Voltages of product tested with the IEEE C62.41.1 & C62.41.2-2002; 100 KHz Ring Wave and Combination Wave must be equal to or better than the following:
 - a. Cat A, 30 Ohm 100 kHz Ring Wave, 2 kV-67 kA @ 270-degree Phase Angle
 - b. P-N: ≤ 25 volts
 - c. P-G: ≤ 100 volts
 - d. P-G: ≤ 75 volts
 8. Enclosure: ABS Plastic, UL 94-5VA Flame Rating (UL's highest rating) and must be electrically non-conductive.
 9. Warranty: 25 Years Unlimited Free Replacement
- B. Analog Signal/Current Loop (4-20 mA) Circuit Protection (ECS International Model CLP24A6DINS-B-21 can accommodate up to three 2- wire loops)
 1. Maximum Continuous Operating Voltage: 36 volts DC

2. Maximum Continuous Operating Current: 500mA
 3. Series Resistance: 5 Ohms per wire (10 Ohms loop)
 4. Maximum Data Rate: 2 Mbps
 5. Peak Surge Current: 10 kA per mode; 20 kA total per loop.
 6. SPD circuitry shall include only solid-state clamping components consisting of a multi-stage hybrid design. Model shall be bi-directional and encapsulated in a high dielectric compound.
 7. Discrete and dedicated protection components must be provided for each mode of protection. (L-L, Normal Mode) (L-G, Common Mode)
 8. Let-Through Voltages of product tested with the IEEE C62.41.1 & C62.41.2-2002; Cat B, 2 Ohm Impulse (Combination) Wave, 6kV/3k Amp @ 90-degree Phase Angle must be equal to or better than the following:
 - a. L-L < 40 volts
 - b. L-G < 40 volts
 9. Enclosure: Devices shall be enclosed in an enclosure constructed of a temperature and fire-rated material (UL94 5VA high-range temperature material) and must be electrically non-conductive. DIN rail mounted.
 10. Warranty: 15 Years Unlimited Free Replacement
- C. Dedicated 480 Volt Single Phase (L, L, G) AC Site Pole Lighting Circuit Protection (Surge Suppression LLC Model USPW2N4-21) Requires 30 Amp Class R Inline Fusing:
1. Maximum Continuous Operating Voltage: 552 volts
 2. Maximum Continuous Operating Current: 30 Amps
 3. Peak Surge Current: 40 kA per mode; 120 kA total
 4. SPD circuitry shall include only solid-state clamping components consisting of a multi-stage hybrid design. Device shall be bi-directional, enclosed in a UL listed/recognized encapsulated thermal stress reducing compound.
 5. Discrete and dedicated protection components must be provided for each mode of protection (L-N, Normal Mode) (L-G, N-G Common Mode).
 6. Frequency Responsive Circuitry (sine-wave tracking) must be provided for each mode of protection. Products utilizing basic EMI/RFI filter performance (dB insertion loss rating) will not be considered.
 7. Let-Through Voltages of product tested with the IEEE C62.41.1 & C62.41.2-2002; 100 KHz Ring Wave and Combination Wave must be equal to or better than the following:
 - a. Cat A, 30 Ohm 100 kHz Ring Wave, 2 kV @ 270-degree Phase Angle
 - b. L-L $\leq$ 75 volts
 - c. L-G $\leq$ 75 volts
 8. Enclosure: ABS Plastic, UL 94-5VA Flame Rating (UL's highest rating) and must be electrically non-conductive. Dimensions not to exceed L=5.22", W=3.12", H=1.88" to permit installation inside of pole inspection port.
 9. Warranty: 25 Years Unlimited Free Replacement

- D. Dedicated 240- or 277-Volt Single Phase (P, N, G) AC Site Pole Lighting Circuit Protection (Surge Suppression LLC Model USPWI2-21) Requires 30 Amp Class R Inline Fusing:
1. Maximum Continuous Operating Voltage: 320 volts
 2. Maximum Continuous Operating Current: 30 Amps
 3. Peak Surge Current: 40 kA per mode; 120 kA total
 4. SPD circuitry shall include only solid-state clamping components consisting of a multi-stage hybrid design. Device shall be bi-directional, enclosed in a UL listed/recognized encapsulated thermal stress reducing compound.
 5. Discrete and dedicated protection components must be provided for each mode of protection (L-N, Normal Mode) (L-G, N-G Common Mode).
 6. Frequency Responsive Circuitry (sine-wave tracking) must be provided for each mode of protection. Products utilizing basic EMI/RFI filter performance (dB insertion loss rating) will not be considered.
 7. Let-Through Voltages of product tested with the IEEE C62.41.1 & C62.41.2-2002; 100 KHz Ring Wave and Combination Wave must be equal to or better than the following:
 - a. Cat A, 30 Ohm 100 kHz Ring Wave, 2 kV @ 270-degree Phase Angle
 - b. $L-N \leq 25$ volts
 - c. $L-G \leq 100$ volts
 - d. $N-G \leq 75$ volts
 8. Enclosure: ABS Plastic, UL 94-5VA Flame Rating (UL's highest rating) and must be electrically non-conductive. Dimensions not to exceed L=5.22", W=3.12", H=1.88" to permit installation inside of pole inspection port.
 9. Warranty: 25 Years Unlimited Free Replacement
- E. Dedicated 120 Volt Single Phase (H, N, G) AC Site Pole Lighting Circuit Protection (Surge Suppression LLC Model USPWI1-21) Requires 30 Amp Class R Inline Fusing:
1. Maximum Continuous Operating Voltage: 150 volts
 2. Maximum Continuous Operating Current: 30 Amps
 3. Peak Surge Current: 40 kA per mode; 120 kA total
 4. SPD circuitry shall include only solid-state clamping components consisting of a multi-stage hybrid design. Device shall be bi-directional, enclosed in a UL listed/recognized encapsulated thermal stress reducing compound.
 5. Discrete and dedicated protection components must be provided for each mode of protection (L-N, Normal Mode) (L-G, N-G Common Mode).
 6. Frequency Responsive Circuitry (sine-wave tracking) must be provided for each mode of protection. Products utilizing basic EMI/RFI filter performance (dB insertion loss rating) will not be considered.
 7. Let-Through Voltages of product tested with the IEEE C62.41.1 & C62.41.2-2002; 100 KHz Ring Wave and Combination Wave must be equal to or better than the following:
 - a. Cat A, 30 Ohm 100 kHz Ring Wave, 2 kV @ 270-degree Phase Angle
 - b. $L-N \leq 25$ volts
 - c. $L-G \leq 100$ volts
 - d. $N-G \leq 75$ volts

8. Enclosure: ABS Plastic, UL 94-5VA Flame Rating (UL's highest rating) and must be electrically non-conductive. Dimensions not to exceed L=5.22", W=3.12", H=1.88" to permit installation inside of pole inspection port.
 9. Warranty: 25 Years Unlimited Free Replacement
- F. Network Cable – Ethernet High Speed Data Circuit Protection (ECS International Model DRJ45##C8DIN-B-21) (## equals voltage; i.e. 5, 12, 24, 48, or 140 volts)
1. SPD devices shall be rated for the class of service necessary for the application.
 2. Signal/Operating Voltage: 5 to 140 Volts.
 3. Maximum Continuous Operating Current: 500 mA
 4. Series Resistance: Zero Ohms per wire for 100 Mbps
 5. Data Rates: Up to 100 Mbps
 6. SPD circuitry shall include only solid-state clamping components. Device shall be bi-directional.
 7. Protection Modes: Data transmission pairs shall be protected Line-to- Line and Line-to-Ground.
 8. Each data carrying conductor shall have no internal series resistance per wire and no internal series resistance on the ground conductor.
 9. Each conductor must have a peak surge current rating of 1,500 Watts per mode.
 10. The device must be designed to be series connected and mounted internally to control panels for protection of equipment connected to data lines.
 11. Enclosure: Devices shall be enclosed in a plastic enclosure constructed of a superior temperature/fire-rated material (UL94 5VA high-range temperature material) and must be electrically non- conductive. DIN rail mounted.
 12. Warranty: 25 Years Unlimited Free Replacement. SPD manufacturers whose warranty does not meet the requirements and standards listed above shall submit a letter on the SPD manufacturer's corporate letterhead stationery and signed by a corporate officer extending the warranty to meet these standards with the product submittal.
- G. Discrete control circuits – (ECS International Model PCMF##DCDIN-21) (## equals voltage; i.e. DC 5, 12, 24, or 48 volts)
1. SPD devices shall be rated for the class of service necessary for the application.
 2. Operating Voltage: 12 to 48 Volts, other voltages available upon request.
 3. Maximum Continuous Operating Current: 20 Amps
 4. Series Resistance: Zero Ohms per wire.
 5. SPD circuitry shall include only solid-state clamping and frequency response components. Device shall be bi-directional.
 6. Protection Modes: Circuit shall be protected Line-to-Neutral, Line-to-Ground and Neutral-to-Ground or Line-to-Line and Line-to-Ground where applicable.
 7. Each conductor shall have no internal series resistance per wire and no internal series resistance on the ground conductor.
 8. The device must be designed to be series connected and mounted internally to control panels for protection of equipment connected to data lines.
 9. Enclosure: Devices shall be enclosed in a plastic enclosure constructed of a superior temperature/fire-rated material (UL94 5VA high-range temperature material) and must be electrically non- conductive. Enclosure shall be designed for Panel Mount DIN Rail Mount compatible without any modification to the device or requirement of an alternative model number.

10. Warranty: 25 Years Unlimited Free Replacement. SPD manufacturers whose warranty does not meet the requirements and standards listed above shall submit a letter on the SPD manufacturer's corporate letterhead stationery and signed by a corporate officer extending the warranty to meet these standards with the product submittal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Connect the Ground of the SPD to the grounding bar of the control cabinet using a minimum of No. 10 AWG wire. Further, the grounding bar of the cabinet shall be connected to the basic grounding system using a minimum of No. 6 AWG wire.
- B. All labor, materials, equipment, and services necessary for, and incidental to the installation of the SPDs as specified, shall be provided by the Electrical Contractor.
- C. Provide low voltage surge products on BOTH ends of ALL 4-20mA signal circuits leaving a building or ALL 4-20mA circuits exceeding 150 feet in length. Provide DIN rail mounted surge products installed within control cabinets. Provide surge units rated Class 1 Div 2 for all surge devices mounted in valve or metering pits. All related surge devices mounted exterior to a building shall be rated and listed as NEMA 4X, water-proof. All surge devices mounted in corrosive areas within a building shall be rated for such environments and listed as corrosive resistant and NEMA 4X.
- D. Provide low voltage surge products on BOTH ends of ALL copper Ethernet circuits leaving a building or ALL copper Ethernet circuits exceeding 200 feet in length. Provide DIN rail mounted surge products installed within control cabinets. All related surge devices mounted exterior to a building shall be rated and listed as NEMA 4X, water-proof. All surge devices mounted in corrosive areas within a building shall be rated for such environments and listed as corrosive resistant and NEMA 4X.
- E. Provide low voltage surge products on BOTH ends of ALL proprietary network circuits leaving a building or ALL copper Ethernet circuits exceeding 200 feet in length. Provide DIN rail mounted surge products installed within control cabinets. All related surge devices mounted exterior to a building shall be rated and listed as NEMA 4X, water-proof. All surge devices mounted in corrosive areas within a building shall be rated for such environments and listed as corrosive resistant and NEMA 4X.
- F. Provide low voltage surge products on BOTH ends of discrete low-voltage control circuits leaving a building or ALL discrete low-voltage control circuits exceeding 300 feet in length. Provide DIN rail mounted surge products installed within control cabinets. All related surge devices mounted exterior to a building shall be rated and listed as NEMA 4X, water-proof. All surge devices mounted in corrosive areas within a building shall be rated for such environments and listed as corrosive resistant and NEMA 4X.
- G. When installing a series connected SPD, bind the supply side conductors separately and away from the load side conductors.

END OF SECTION 26 43 20

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SECTION 26 51 19 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following types of LED luminaires:
 - 1. Linear industrial.
 - 2. Lowbay.
 - 3. Strip light.
 - 4. Surface mount, linear.
 - 5. Surface mount, nonlinear.
 - 6. Suspended, linear.
 - 7. Suspended, nonlinear.
 - 8. Materials.
 - 9. Finishes.
 - 10. Luminaire support.
- B. Related Requirements:
 - 1. Section 26 09 23 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 2. Luminaire Schedule located on plan sheets.

DEFINITIONS

- C. CCT: Correlated color temperature.
- D. CRI: Color Rendering Index.
- E. Fixture: See "Luminaire."
- F. IP: International Protection or Ingress Protection Rating.
- G. LED: Light-emitting diode.
- H. Lumen: Measured output of lamp and luminaire, or both.
- I. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-79 and IES LM-80.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Samples for Verification: For each type of luminaire.

1. Include Samples of luminaires and accessories to verify finish selection.

D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

- C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Product Certificates: For each type of luminaire.
- F. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- G. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.

- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Standards:
 - 1. ENERGY STAR certified.
 - 2. California Title 24 compliant.
 - 3. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
 - 4. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
 - 5. UL Listing: Listed for damp location.
 - 6. Recessed luminaires shall comply with NEMA LE 4.
 - 7. User Replaceable Lamps:
 - a. Bulb shape complying with ANSI C78.79.
 - b. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- C. CRI of minimum 70. CCT of 3000 K.
- D. Rated lamp life of 50,000 hours to L70.
- E. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- F. Internal driver.
- G. Nominal Operating Voltage: 120 V ac, 240 V ac, 277 V ac Multi-Tap.
 - 1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

H. Housings:

1. Extruded-aluminum or steel housing and heat sink.
2. Clear anodized powder-coat painted finish.

2.2 LINEAR INDUSTRIAL

A. Approved Manufacturer:

1. Lithonia.
2. Phillips.
3. Or Approved Equal.

B. Minimum 5,000 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. Housing and heat sink rated to the following:

1. IP 66.
2. CSA C22.2 No 137.

2.3 STRIP LIGHT

A. Approved Manufacturer:

1. Lithonia.
2. Phillips.
3. Or Approved Equal.

B. Minimum 750 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.4 SURFACE MOUNT, LINEAR

A. Approved Manufacturer:

1. Lithonia.
2. Phillips.
3. Or Approved Equal.

B. Minimum 750 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.5 SURFACE MOUNT, NONLINEAR

A. Approved Manufacturer:

1. Lithonia.
2. Phillips.
3. Or Approved Equal.

B. Minimum 750 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.6 SUSPENDED, LINEAR

A. Approved Manufacturer:

1. Lithonia.
2. Phillips.
3. Or Approved Equal.

B. Minimum 1,500 lumens. Minimum allowable efficacy of 85 lumens per watt.

2.7 SUSPENDED, NONLINEAR

A. Approved Manufacturer:

1. Lithonia.
2. Phillips.
3. Or Approved Equal.

B. Minimum 1,500 lumens. Minimum allowable efficacy of 85 lumens per watt.

C. Integral junction box with conduit fittings.

2.8 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Prismatic glass or diffuse glass clear, UV-stabilized acrylic
2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
3. Glass: Annealed crystal glass unless otherwise indicated.

4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:

1. Extruded-aluminum or steel housing and heat sink.
2. Powder-coat painted finish.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.9 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.10 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 1/4-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and replacing.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaire Support:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls
 - 2. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Mounted Luminaire Support:
 - 1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.
 - 2. Ceiling mount with pendant mount with 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.
 - 3. Ceiling mount with hook mount.
- H. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
 - 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- I. Ceiling-Grid-Mounted Luminaires:
 - 1. Secure to any required outlet box.

2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- J. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 3. Adjust the aim of luminaires in the presence of the Owner.

END OF SECTION 26 51 19

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SECTION 265613 - LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Poles and accessories for support of luminaires.
 - 2. Luminaire-lowering devices.

1.3 DEFINITIONS

- A. EPA: Equivalent projected area.
- B. Luminaire: Complete lighting fixture.
- C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.
- D. Standard: See "Pole."

1.4 ACTION SUBMITTALS

- A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.
 - 1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
 - 2. Include finishes for lighting poles and luminaire-supporting devices.
 - 3. Anchor bolts.
 - 4. Manufactured pole foundations.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Detail fabrication and assembly of poles and pole accessories.

4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
 5. Anchor bolt templates keyed to specific poles and certified by manufacturer.
 6. Method and procedure of pole installation. Include manufacturer's written installations.
- C. Samples: For each exposed lighting pole, standard, and luminaire-supporting device and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.
- B. Qualification Data: For Installer and testing agency.
- C. Seismic Qualification Certificates: For accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Material Test Reports:
1. For each foundation component, by a qualified testing agency.
 2. For each pole, by a qualified testing agency.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample Warranty: Manufacturer's standard warranty.
- H. Soil test reports

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include pole inspection and repair procedures.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Pole repair materials.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for foundation testing.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than 1/4 inch deep. Do not apply tools to section of pole to be installed below finished grade.
- D. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.
- E. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
 - 2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.
 - 3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design pole foundation and pole power system.

- B. Seismic Performance: Foundation and pole shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
 - 2. Component Importance Factor: 1.5.
- C. Structural Characteristics: Comply with AASHTO LTS-6-M.
- D. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.
- E. Live Load: Single load of 500 lbf distributed according to AASHTO LTS-6-M.
- F. Ice Load: Load of 3 lbf/sq. ft., applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.
- G. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.
 - 1. Basic wind speed for calculating wind load for poles exceeding 50 feet in height is 100 mph.
 - a. Wind Importance Factor: 1.0.
 - b. Minimum Design Life: 50 years.
 - c. Velocity Conversion Factor: 1.0.
 - 2. Basic wind speed for calculating wind load for poles 50 feet high or less is 100 mph.
 - a. Wind Importance Factor: 1.0.
 - b. Minimum Design Life: 25 years.
 - c. Velocity Conversion Factor: 1.0.
- H. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.
- I. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 STEEL POLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 2. LSI Industries.
 - 3. Engineer Approved Equal.

- B. Source Limitations: Obtain poles from single manufacturer or producer.
- C. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.
- D. Poles: Type as indicated on the plans.
- E. Brackets for Luminaires: Detachable, cantilever, without underbrace.
 - 1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adaptor, then bolted together with galvanized-steel bolts.
 - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
- F. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- G. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
 - 1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- H. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.
- I. Steps: Fixed steel, with nonslip treads.
 - 1. For climbing positions, install at 15-inch vertical spacing, alternating on opposite sides of pole, oriented 180 degrees from each other; first step shall be at an elevation 10 feet above finished grade.
 - 2. For working positions, install steps on opposite side of pole, oriented 180 degrees from each other at the same elevation.
- J. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- K. Intermediate Handhole and Cable Support: Weatherproof, 3-by-5-inch handhole located at midpoint of pole, with cover for access to internal welded attachment lug for electric cable support grip.
- L. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported load multiplied by a 5.0 safety factor.

- M. Platform for Lamp and Ballast Servicing: Factory fabricated of steel, with finish matching that of pole.
- N. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- O. Galvanized Finish: After fabrication, hot-dip galvanize according to ASTM A 123/A 123M.
- P. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 - 2. Powder Coat: Comply with AAMA 2604.
 - a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.
 - b. Color: As indicated by manufacturer's designations.

2.3 PRESTRESSED CONCRETE POLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Baldwin pole & Piling Co., Inc.
 - 2. Holophane; an Acuity Brands company.
 - 3. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 4. Engineer Approved Equal
- B. Poles: Comply with ASTM C 1089 and manufactured by centrifugal spin-casting process
 - 1. Shape: Round, tapered.
 - 2. Mounting Provisions: Embedded.
 - 3. Finishing: Capped at top and plugged at bottom. Seat each reinforcing strand with epoxy adhesive.
 - 4. Grounding: Continuous copper ground wire cast into pole. Terminate at top of pole.
 - 5. Raceway: Smooth, internal, and not less than 3 inches in diameter.
- C. Concrete: Minimum 28-day compressive strength of 7000 psi.
- D. Cured with wet steam and aged for a minimum of 15 days prior to installation.
- E. Reinforcement: Reinforcing bars complying with ASTM A 615/A 615M.
- F. Surface Treatment: Hard, nonporous, and resistant to water, frost, and road and soil chemicals; and shall have a maximum water-absorption rate of 3 percent.

- G. Finish Texture: Standard form.
- H. Fasteners: Stainless steel, size and type as determined by manufacturer. Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
- I. Nameplate: Aluminum cast into pole wall at approximately 5 feet above ground line, listing name of manufacturer, Project identifier, overall height, and approximate weight.
- J. Pole Brackets: Comply with ANSI C136.31.

2.4 FIBERGLASS POLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carsonite Composites; a Philips company
 - 2. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 3. Engineer Approved Equal
- B. Poles:
 - 1. Designed specifically for supporting luminaires, with factory-formed cable entrance and handhole.
 - 2. Not less than 65 percent by weight of fiberglass roving, with resin and pigment making up the remainder.
 - 3. Roving shall be continuously applied with uniform tension, with multiple layers placed to meet axial and compressive strength requirements.
 - 4. Shape: Round, tapered
 - 5. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
 - 6. Resin Color: Dark uniform coloration throughout entire wall thickness.
 - 7. Surface Finish: Smooth and uniform along surface of pole.
 - 8. Paint Finish: Pigmented polyurethane, with a minimum dry film thickness of 1.5 mils. Polyurethane may be omitted if the surface layer of the pole is inherently UV inhibited.
- C. Mast Arms: Steel type, continuously welded to pole attachment plate. Material and finish same as plate. Adaptor plate shall be steel hot-dip galvanized according to ASTM A 153 or 6061-T6 aluminum encased within fiberglass roving, allowing the mast arm adaptor to be bolted to the pole.
- D. Brackets for Luminaires: Detachable, cantilever, without underbrace.
 - 1. Adaptor fitting: Steel, hot-dip galvanized according to ASTM A 153, or 6061-T6 aluminum, permanently bonded within fiberglass roving, allowing the bracket to be bolted to the pole-mounted adapter. Bolt together with galvanized-steel bolts; use anti-seize compound when bolting dissimilar metals.
 - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

- E. Pole-Top Tenons: Steel, hot-dip galvanized according to ASTM A 153, or 6061-T6 aluminum, permanently bonded to the fiberglass shaft. Fabricated to support luminaire or luminaires and brackets indicated.
- F. Fasteners: Galvanized steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
 - 1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- G. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- H. Grounding: Bare, stranded copper, #6 AWG, inside a 3/4-inch conduit fastened to the interior of the pole, connected to luminaire(s), ground lug near handhole and ground rod.
- I. Grounding and Bonding Lugs: Bolted 1/2-inch threaded lug, complying with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- J. Anchor Base: Integral galvanized steel or aluminum casting, enclosing and permanently bonded to the exterior of the fiberglass shaft.

2.5 POLE ACCESSORIES

- A. Duplex Receptacle: Ground-fault circuit interrupter type, 120 V ac, 20 A in a weatherproof assembly. Comply with requirements in Section 26 27 26 "Wiring Devices."
 - 1. Surface mounted 12 inches above finished grade.
 - a. NEMA 250, Type 3R, nonmetallic polycarbonate plastic or reinforced fiberglass, enclosure with cover; color to match pole.
 - b. Lockable hasp and latch complying with OSHA lockout and tag-out requirements.
- B. Minimum 1800-W transformer, protected by replaceable fuses, mounted behind access cover.
- C. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

2.6 MOUNTING HARDWARE

- A. Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi.
 - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
 - 2. Threading: Uniform National Coarse, Class 2A.

- B. Nuts: ASTM A 563, Grade A, Heavy-Hex
 - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
 - 2. Two nuts provided per anchor bolt, shipped with nuts pre-assembled to the anchor bolts.
- C. Washers: ASTM F 436, Type 1.
 - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
 - 2. Two washers provided per anchor bolt.

2.7 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.
- C. Examine roughing-in for foundation and conduit to verify actual locations of installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 03 30 00 "Cast-in-Place Concrete."
- B. Pre-Cast Foundations: Factory fabricated, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 03 30 00 "Cast-in-Place Concrete."

- C. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories.
 - 1. Baseplate: Stamped with manufacturer's name, date of production, and cable entry.
- D. Direct-Buried Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.
 - 1. Make holes 6 inches in diameter larger than pole diameter.
 - 2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days and finish in a dome above finished grade.
 - 3. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
 - 4. Cure concrete a minimum of 72 hours before performing work on pole.
- E. Anchor Bolts: Install plumb using manufacturer-supplied steel template, uniformly spaced.

3.3 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.
 - 1. Fire Hydrants and Water Piping: 60 inches.
 - 2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.
 - 3. Trees: 15 feet from tree trunk.
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
 - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 - 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 - 3. Install base covers unless otherwise indicated.
 - 4. Use a short piece of 1/2 -inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete

slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch below top of concrete slab.

- F. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.
- B. Steel Conduits: Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.5 GROUNDING

- A. Ground Metal Poles and Support Structures: Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground Nonmetallic Poles and Support Structures: Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole.
 - 2. Install grounding conductor and conductor protector.
 - 3. Ground metallic components of pole accessories and foundation.

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 - 1. Inspect poles for nicks, mars, dents, scratches, and other damage.
 - 2. System function tests.

END OF SECTION 26 56 13

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SECTION 26 56 19 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
- 2. Luminaire supports.
- 3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

- 1. Section 26 09 23 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
- 2. Section 26 09 26 "Lighting Control Panelboards" for panelboard-based lighting control.
- 3. Section 26 09 33 "Central Dimming Controls" or Section 26 09 36 "Modular Dimming Controls" for architectural dimming systems specified in Section 26 51 00.
- 4. Section 26 09 43.16 "Addressable-Luminaire Lighting Controls" and Section 26 09 43.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
- 5. Section 26 56 13 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.
 - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
6. Wiring diagrams for power, control, and signal wiring.
7. Photoelectric relays.
8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.

D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For luminaire supports.

1. Include design calculations for luminaire supports and seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Structural members to which equipment and luminaires will be attached.
3. Underground utilities and structures.
4. Existing underground utilities and structures.

5. Above-grade utilities and structures.
6. Existing above-grade utilities and structures.
7. Building features.
8. Vertical and horizontal information.

- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of the following:
1. Luminaire.
 2. Photoelectric relay.
- E. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- F. Source quality-control reports.
- G. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
 2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
 3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- F. Mockups: For exterior luminaires, complete with power and control connections.
 1. Obtain Architect's approval of luminaires in mockups before starting installations.
 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: 5 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. Lamp base complying with ANSI C81.61.
- F. Bulb shape complying with ANSI C79.1.
- G. CRI of minimum 70. CCT of 3000 K.
- H. L70 lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.

- J. Internal driver.
- K. Nominal Operating Voltage: 120 V ac or 277 V ac.
- L. In-line Fusing: On the primary for each luminaire.
- M. Lamp Rating: Lamp marked for outdoor use.
- N. Source Limitations: Obtain luminaires from single source from a single manufacturer.
- O. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 2. Philips Lighting Company.
 - 3. Engineer approved equal.
- B. Comply with UL 773 or UL 773A.
- C. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at **1.5 to 3 fc (16 to 32 lx)** and off at **4.5 to 10 fc (48 to 108 lx)** with 15-second minimum time delay.
 - 1. Relay with locking-type receptacle shall comply with ANSI C136.10.
 - 2. Adjustable window slide for adjusting on-off set points.

2.4 LUMINAIRE TYPES

- A. Area and Site:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. H.E. Williams.
 - b. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - c. Engineer approved equal.
 - 2. Luminaire Shape: As indicated on plans.
 - 3. Mounting: As indicated on plans.
 - 4. Luminaire-Mounting Height: As indicated on plans.
 - 5. Distribution: As indicated on plans.
 - 6. Diffusers and Globes: Tempered Fresnel glass.
 - 7. Housings:

- a. Extruded-aluminum housing and heat sink.
- b. Powder-coat finish to match color indicated on drawings..

B. Roadway:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. H.E. Williams.
 - b. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - c. Engineer approved equal.
- 2. Luminaire-Mounting Height: As indicated on the drawings.
- 3. Mounting Type: Arm.
- 4. Distribution: As indicated on the drawings.
- 5. Diffusers and Globes: As indicated on the drawings.
- 6. Housings:
 - a. Extruded-aluminum housing and heat sink.
 - b. Powder-coat finish to match color indicated on drawings.

2.5 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
 - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.

G. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage and coating.
 - c. CCT and CRI for all luminaires.

2.6 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
 - a. Color: As indicated on the drawings.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a

smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.

2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.
 - b. Color: Match Architect's sample of manufacturer's standard color.
 - c. Color: As selected by Architect from manufacturer's full range.

2.7 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

2.8 SURGE PROTECTION FOR ALL POLE MOUNTED LUMINAIRES

- A. Provide one Surge Suppression Inc series-wired surge device at the pole base for each pole-mounted luminaire. See specification section 26 43 20 for details.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.
- I. Coordinate layout and installation of luminaires with other construction.
- J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- K. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and 26 05 33 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with ~~0.010-inch-~~ (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
 - a. IES LM-5.
 - b. IES LM-50.
 - c. IES LM-52.
 - d. IES LM-64.
 - e. IES LM-72.
 - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

3.8 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 56 19

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SECTION 31 05 16 - AGGREGATES FOR EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Coarse aggregate materials.
2. Fine aggregate materials.

B. Related Sections:

1. Section 31 20 00 - Earth Moving.
2. Section 31 25 00 - Erosion and Sedimentation Control: Slope protection and erosion control.
3. Section 31 50 00 - Excavation Support and Protection.
4. Geotechnical Report

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.
2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³).
3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³).
4. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
5. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

C. South Carolina Department of Transportation. *Standard Specifications for Highway Construction*. 2007.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Samples: Submit, in air-tight containers, 10 lb sample of each type of fill to testing laboratory.
- C. Materials Source: Submit name of imported materials suppliers.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.
- B. Perform Work according to State of South Carolina Highways standards.
- C. Maintain one copy of each document on site.

PART 2 - PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

- A. Aggregate Designation: Macadam Base Course/Recycled Portland Cement Concrete (RPCC) Base Course
 - 1. Conform to the South Carolina Department of Transportation. *Standard Specifications for Highway Construction*, 2007, Section 800.
 - 2. Aggregate Designation: Macadam Base Course/Recycled Portland Cement Concrete (RPCC) Base Course
 - a. Macadam Base Course: Use coarse aggregate for Macadam Base Course consisting of hard, durable particles of crushed slag or stone, excluding marine limestone. Ensure that the aggregate is free from vegetable matter, sand, lumps or balls of clay, or other deleterious matter. Ensure minimum weight for crushed slag used in Macadam Base Course, when dry and rodded, is 70 pounds per cubic foot. Use crushed slag that consists of angular fragments, reasonably uniform in density and quality, and reasonably free from glassy, thin or elongated pieces, dirt, or other objectionable material.
 - b. Recycled Portland Cement Concrete (RPCC) Base Course: Use coarse aggregate for Recycled Portland Cement Concrete Base Course consisting of sound, durable particles of recycled Portland cement concrete aggregate, excluding crushed concrete block or pipe.
 - 3. Percent Passing per Sieve Size:
 - a. 2 inches: 100.
 - b. 1 1/2 inches: 95 to 100.
 - c. 1 inch: 70 to 100.
 - d. 3/4 inch: n/a.
 - e. 1/2 inch: 48 to 75.
 - f. 3/8 inches: n/a.

g.	No. 4:	30 to 50.
h.	No. 8:	n/a.
i.	No. 16:	n/a.
j.	No. 30:	11-30.
k.	No. 100:	n/a.
l.	No. 200:	0 to 12

B. Aggregate Designation: 57

1. Conform to the South Carolina Department of Transportation. *Standard Specifications for Highway Construction*, 2007, Section 800.
2. Percent Passing per Sieve Size:
 - a. 2 inches: n/a.
 - b. 1 1/2 inches: 100.
 - c. 1 inch: 95 to 100.
 - d. 3/4 inch: n/a.
 - e. 1/2 inch: 25 to 60.
 - f. 3/8 inches: n/a.
 - g. No. 4: 0 to 10.
 - h. No. 8: 0 to 5.
 - i. No. 16: n/a.
 - j. No. 100: n/a.

C. Aggregate Designation: 67

1. Conform to the South Carolina Department of Transportation. *Standard Specifications for Highway Construction*, 2007, Section 800.
2. Percent Passing per Sieve Size:
 - a. 2 inches: n/a.
 - b. 1 1/2 inches: n/a.
 - c. 1 inch: 100.
 - d. 3/4 inch: 90 to 100.
 - e. 1/2 inch: n/a.
 - f. 3/8 inches: 20 to 55.
 - g. No. 4: 0 to 10.
 - h. No. 8: 0 to 5.
 - i. No. 16: n/a.
 - j. No. 100: n/a.

D. Aggregate Designation: Riprap Class A

1. Conform to the South Carolina Department of Transportation. *Standard Specifications for Highway Construction*, 2007, Section 800.
2. Provide riprap conforming to the gradation classes in the following:
 - a. Rock Size (ft): 0.75, Rock Size (lbs): 37, Percent of Riprap Smaller Than: 100.
 - b. Rock Size (ft): 0.50, Rock Size (lbs): 11, Percent of Riprap Smaller Than: 50.
 - c. Rock Size (ft): 0.20, Rock Size (lbs): 0.7, Percent of Riprap Smaller Than: 15.

E. Aggregate Designation: Riprap Class B

1. Conform to the South Carolina Department of Transportation. *Standard Specifications for Highway Construction*, 2007, Section 800.
 2. Provide riprap conforming to the gradation classes in the following:
 - a. Rock Size (ft): 1.33, Rock Size (lbs): 200, Percent of Riprap Smaller Than: 100.
 - b. Rock Size (ft): 1.0, Rock Size (lbs): 75, Percent of Riprap Smaller Than: 85.
 - c. Rock Size (ft): 0.75, Rock Size (lbs): 37, Percent of Riprap Smaller Than: 50.
 - d. Rock Size (ft): 0.42, Rock Size (lbs): 5, Percent of Riprap Smaller Than: 10.
- F. Aggregate Designation: Riprap Class C
1. Conform to the South Carolina Department of Transportation. *Standard Specifications for Highway Construction*, 2007, Section 800.
 2. Provide riprap conforming to the gradation classes in the following:
 - a. Rock Size (ft): 1.80, Rock Size (lbs): 500, Percent of Riprap Smaller Than: 100.
 - b. Rock Size (ft): 1.300, Rock Size (lbs): 200, Percent of Riprap Smaller Than: 50.
 - c. Rock Size (ft): 0.40, Rock Size (lbs): 5, Percent of Riprap Smaller Than: 10.
- G. Aggregate Designation: Riprap Class D
1. Conform to the South Carolina Department of Transportation. *Standard Specifications for Highway Construction*, 2007, Section 800.
 2. Provide riprap conforming to the gradation classes in the following:
 - a. Rock Size (ft): 2.25, Rock Size (lbs): 1000, Percent of Riprap Smaller Than: 100.
 - b. Rock Size (ft): 1.80, Rock Size (lbs): 500, Percent of Riprap Smaller Than: 50.
 - c. Rock Size (ft): 0.95, Rock Size (lbs): 75, Percent of Riprap Smaller Than: 10.
- H. Aggregate Designation: Riprap Class E
1. Conform to the South Carolina Department of Transportation. *Standard Specifications for Highway Construction*, 2007, Section 800.
 2. Provide riprap conforming to the gradation classes in the following:
 - a. Rock Size (ft): 2.85, Rock Size (lbs): 2000, Percent of Riprap Smaller Than: 100.
 - b. Rock Size (ft): 2.25, Rock Size (lbs): 1000, Percent of Riprap Smaller Than: 50.
 - c. Rock Size (ft): 1.80, Rock Size (lbs): 500, Percent of Riprap Smaller Than: 5.
- I. Aggregate Designation: Riprap Class F
1. Conform to the South Carolina Department of Transportation. *Standard Specifications for Highway Construction*, 2007, Section 800.
 2. Provide riprap conforming to the gradation classes in the following:
 - a. Rock Size (ft): 3.60, Rock Size (lbs): 4000, Percent of Riprap Smaller Than: 100.
 - b. Rock Size (ft): 2.85, Rock Size (lbs): 2000, Percent of Riprap Smaller Than: 50.
 - c. Rock Size (ft): 2.25, Rock Size (lbs): 1000, Percent of Riprap Smaller Than: 5.

2.2 FINE AGGREGATE MATERIALS

A. Fine Aggregate

1. Conform to State of South Carolina Highways Standard
2. Aggregate No.: FA-10M.
3. Percent Passing per Sieve Size:

- | | | |
|----|-------------|------------|
| a. | 1/2 inch: | n/a. |
| b. | 3/8 inches: | 100. |
| c. | No. 4: | 95 to 100. |
| d. | No. 8: | 84 to 100. |
| e. | No. 16: | 45 to 95. |
| f. | No. 30: | 25 to 75. |
| g. | No. 50: | 8 to 35. |
| h. | No. 100: | 0.5 to 20. |
| i. | No. 200: | 0 to 10*. |

*Dust of fracture essentially free from clay or shale, final job site testing only.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing and inspection services.
- B. Coarse Aggregate Material - Testing and Analysis: Perform according to AASHTO T96 or ASTM C131 and AASHTO T11.
- C. Fine Aggregate Material - Testing and Analysis: Perform according to ASTM D1557 or AASHTO T180.
- D. When tests indicate materials do not meet specified requirements, change material and retest.

PART 3 - EXECUTION

3.1 INSTALLATION OF RIP RAP

- A. All rip-rap shall be embedded in place so that the top surfaces are at the grade established for the surface of rip-rap. The inclusion of objectionable quantities of overburden and rock dust will not be permitted. The rock fragments in rip-rap need not be compacted, but shall be dumped and graded off in a manner to ensure that the larger rock fragments are uniformly distributed and that the small rock fragments serve to fill the spaces between the layer of rip-rap of the specified thickness. Hand placing will be required only to the extent necessary to secure the results specified herein.
- B. Unless otherwise specified or shown, rip-rap shall have a minimum thickness of 12".
- C. The Contractor shall maintain the rip-rap until accepted and any material displaced by any cause shall be replaced to the lines and grades shown on the plans.

- D. All rip-rap shall be underlain by an approved geotextile fabric to prevent erosion.

3.2 INSTALLATION OF CRUSHED STONE

- A. Crushed stone shall be placed in areas shown on the drawings. Stone shall be consolidated by mechanical means.
- B. Unless otherwise specified or shown, crushed stone shall have a minimum thickness of 6”.
- C. All crushed stone shall be underlain by an approved geotextile fabric to prevent erosion

3.3 STOCKPILING

- A. Stockpile materials on site at locations designated by Architect/Engineer.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.
- D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- E. Stockpile unsuitable materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.4 STOCKPILE CLEANUP

- A. Leave unused materials in neat, compact stockpile.
- B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION 31 05 16

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and removing site utilities or abandoning site utilities in place.
8. Initial erosion and sedimentation control.

B. Related Requirements:

1. Section 01 50 00 - Temporary Facilities and Controls for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.
- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

- E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and as indicated on Drawings. Defined by a circle concentric with each tree with a radius 105 times the diameter of the drip line unless otherwise indicated.
- F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Time and location TBD

1.5 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or video recordings.
- B. Topsoil stripping and stockpiling program.
- C. Rock stockpiling program.
- D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.
- E. Burning: Not allowed.

1.7 QUALITY ASSURANCE

- A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.
- B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.8 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's property offsite.
- C. Utility Locator Service: Notify "Call Before You Dig" for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant protection measures are in place.
- E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 20 00 - Earth Moving.
1. Obtain approved borrow soil material on-site for construction area as indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed.
- C. Protect existing site improvements to remain from damage during construction.
1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

- A. Contractor will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing.
 - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities, if required.
 - 2. Contractor will arrange to shut off indicated utilities that cannot be cut off by contractor (gas, electric, communication).
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Engineer not less than 2 days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Engineer's written permission.
- E. Excavate for and remove underground utilities indicated to be removed.
- F. Arrange for temporary pumping if necessary for sewer main work.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Grind down stumps and remove roots larger than 3 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 3. Use only hand methods or air spade for grubbing within protection zones.
 - 4. Chip removed tree branches and stockpile in areas approved by Engineer.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth of 4 inches, or per Geotechnical Report, in a manner to prevent intermingling with underlying subsoil or other waste materials.
 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 1 inch in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 1. Limit height of topsoil stockpiles to 72 inches.
 2. Do not stockpile topsoil within protection zones.
 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
 4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.6 STOCKPILING ROCK

- A. Remove from construction area naturally formed rocks that measure more than 1 foot across in least dimension. Do not include excavated or crushed rock.
 1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.
 1. Limit height of rock stockpiles to 72 inches.
 2. Do not stockpile rock within protection zones.
 3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.
 4. Stockpile Topsoil and reuse on lawn areas.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Burning: Not allowed.
- C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 31 10 00

SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for process structures and buildings walks and pavements.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete walks and pavements.
6. Subbase course and base course for asphalt paving.
7. Subsurface drainage backfill for walls and trenches.
8. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:

1. Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.
2. Section 01 32 00 - Construction Progress Documentation and Section 01 32 33 - Photographic Documentation for recording pre-excavation and earth-moving progress.
3. Section 03 30 00 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
4. Section 31 10 00 - Site Clearing for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
5. Section 31 23 19 - Dewatering for lowering and disposing of ground water during construction.
6. Section 32 92 00 - Turf and Grasses for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
 - 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch (1065-mm-) maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom.
 - 2. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket.
 - 3. Blasting may be required for foundation preparation.
- I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

- M. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference:

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
 - a. Personnel and equipment needed to make progress and avoid delays.
 - b. Coordination of Work with utility locator service.
 - c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
 - d. Extent of trenching by hand or with air spade.
 - e. Field quality control.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Geofoam.
4. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches.
2. Warning Tape: 12 inches long; of each color.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and off-site soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 698.

C. Blasting plan approved by Town of Pendleton, City of Clemson, and Anderson County.

D. Seismic survey report from seismic survey agency.

E. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.7 QUALITY ASSURANCE

- A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:
 - 1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
 - 2. Seismographic monitoring during blasting operations.
- B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
 - 1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
 - 2. Seismographic monitoring during blasting operations.
- C. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.8 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by Engineer.
- C. Utility Locator Service: Notify "Call Before You Dig" for area where Project is located before beginning earth-moving operations.
- D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 311000 "Site Clearing" are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.
- J. Sand: ASTM C 33; fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Survivability: As follows:
 - a. Grab Tensile Strength: 157 lbf ; ASTM D 4632.
 - b. Sewn Seam Strength: 142 lbf ; ASTM D 4632.
 - c. Tear Strength: 56 lbf ; ASTM D 4533.

- d. Puncture Strength: 56 lbf ; ASTM D 4833.
 - 3. Apparent Opening Size: No. 40, No. 60 sieve, maximum; ASTM D 4751.
 - 4. Permittivity: **[0.5] [0.2] [0.1] per** second, minimum; ASTM D 4491.
 - 5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
- 1. Survivability: Class 2; AASHTO M 288.
 - 2. Survivability: As follows:
 - a. Grab Tensile Strength: 247 lbf ; ASTM D 4632.
 - b. Sewn Seam Strength: 222 lbf ; ASTM D 4632.
 - c. Tear Strength: 90 lbf ; ASTM D 4533.
 - d. Puncture Strength: 90 lbf ; ASTM D 4833.
 - 3. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
 - 4. Permittivity: 0.02 per second, minimum; ASTM D 4491.
 - 5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting, low-density, flowable concrete material produced from the following:
- 1. Portland Cement: ASTM C 150, Type I.
 - 2. Fly Ash: ASTM C 618, Class C or F.
 - 3. Normal-Weight Aggregate: ASTM C 33, 3/4-inch, or 3/8-inch nominal maximum aggregate size.
 - 4. Foaming Agent: ASTM C 869.
 - 5. Water: ASTM C 94.
 - 6. Air-Entraining Admixture: ASTM C 260.
- B. Produce low-density, controlled low-strength material with the following physical properties:
- 1. As-Cast Unit Weight: 30 to 36 lb/cu. ft., or 36 to 42 lb/cu. ft. at point of placement, when tested according to ASTM C 138.
 - 2. Compressive Strength: 80 psi, or 140 psi, when tested according to ASTM C 495.
- C. Produce conventional-weight, controlled low-strength material with 80-psi 140-psi compressive strength when tested according to ASTM C 495.

2.4 GEOFOAM

2.5 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.
- B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Retain one of two "Explosives" paragraphs below. Retain second paragraph if explosives are permitted.
- B. Explosives: Obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.
 1. Perform blasting without damaging adjacent structures, property, or site improvements.
 2. Perform blasting without weakening the bearing capacity of rock subgrade and with the least-practicable disturbance to rock to remain.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42inches.
- B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.
 - a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
 3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to minimum 12 inches higher than top of pipe or conduit unless otherwise indicated.
 - 1. Clearance: 12 inches each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - 1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
 - 3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
 - 4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
 - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- E. Trenches in Tree- and Plant-Protection Zones:
 - 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 - 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.8 SUBGRADE INSPECTION

- A. Notify Engineer when excavations have reached required subgrade.
- B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs, plant structures and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.
 - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring, bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- D. Trenches under Roadways: Provide 4-inch thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- E. Backfill voids with satisfactory soil while removing shoring and bracing.
- F. Initial Backfill:
 - 1. Soil Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
 - a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
 - 2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.
- G. Final Backfill:
 - 1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
 - 2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- H. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 GEOFOAM FILL (NOT USED)

3.15 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 - 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 95

3.17 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1/2 inch.
 - 3. Pavements: Plus or minus 1/2 inch.

- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.18 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Section 334600 "Subdrainage."
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
- C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
 - 2. Place and compact impervious fill over drainage backfill in 6-inch thick compacted layers to final subgrade.

3.19 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place base course material over subbase course under hot-mix asphalt pavement.
 - 3. Shape subbase course and base course to required crown elevations and cross-slope grades.
 - 4. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
 - 5. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and

compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.20 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place drainage course 6 inches or less in compacted thickness in a single layer.
 - 3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.21 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material classification and maximum lift thickness comply with requirements.
 - 3. Determine, during placement and compaction that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.

2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length but no fewer than two tests.
 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.22 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 20 00

SECTION 31 23 16.13 – TRENCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavating trenches for utilities
 - 2. Compacted fill from top of utility bedding
 - 3. Backfilling and compaction
- B. Related Requirements
 - 1. 31 10 00 – Site Clearing
 - 2. 31 23 16.26 – Rock Removal
 - 3. 33 05 13 – Manholes and Structures
 - 4. 33 31 00 – Sanitary Utility Sewerage Piping
 - 5. 33 14 16 – Water Distribution Piping

1.2 REFERENCE STANDARDS

- A. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- B. ASTM D2487 – Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- C. ASTM D488 – Standard Sizes of Coarse Aggregate
- D. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400-ft-lbf/ft³ (600 kN-m/m³))
- E. AASHTO T 99 – Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in) Drop
- F. AWWA C600 – Installation of Ductile-Iron Mains and Their Appurtenances
- G. 29 CFR PART 1926 (OSHA) – Safety and Health Regulations for Construction

1.3 SUBMITTALS

- A. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan. The plan shall be stamped by a qualified professional engineer registered in the state of South Carolina.

- B. Method of dewatering including type of systems, equipment, material, and other pertinent data of dewatering system. The system shall be designed by a qualified professional engineer registered in the state of South Carolina
- C. Product Data
 - 1. Geotextile fabric
 - 2. Bedding materials
 - 3. Restoration materials
- D. Materials Source: Name and location of imported fill materials suppliers.
- E. Classification of imported materials by Laboratory analysis or other certification.
- F. Submit information found from test boring and pits.

1.4 QUALITY ASSURANCE

- A. Perform Work according latest requirements of OSHA excavation safety standards and all applicable state and local requirements.
- B. Design of excavation support and stabilization systems shall be performed by a professional engineer, registered in the State of South Carolina, with at least five (5) years of experience in design of similar excavation support systems.
- C. Design of the dewatering system shall be performed by a professional engineer, registered in the State of South Carolina with at least five (5) years of experience in design of similar dewatering systems.

1.5 FIELD MEASUREMENTS

- A. Prior to construction, the Contractor shall be responsible for taking sufficient measurements, horizontal and vertical, to ensure that all existing facilities, which includes but is not limited to; pavements, curbs, gutters, drainage facilities, fences, gates, mailboxes, signs, guardrails, markers, and monuments are restored to their original lines and grades.

1.6 COORDINATION

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.
- B. The Contractor shall comply with the requirements of all encroachment permits obtained for the work. If the Contractor wishes to deviate from the permit requirements he shall obtain a revision to the permit at no additional cost to the Owner.
- C. Any additional Permit applications from State or County Highway Departments, Municipal Street Departments, Railroads, and Utility Companies shall be prepared by the Contractor. Permit applications shall be prepared by the Contractor even though the permanent contract agreement is made between the Controlling Authority and the Owner.

- D. The Contractor will be required under the terms of this contract to furnish the performance bond, insurance coverage, and any other security required by the Controlling Authority, either directly from him or indirectly from the Owner.
- E. The Contractor shall include in the amount bid for this item all costs related to field staking, measurements and surveys, sketches and drawings, and permit application form completion, bonds and insurance as required by the Controlling Authority. The Contractor shall also pay the cost of any supervision by an Inspector of the Controlling Authority if such is stipulated in the permit.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All excavation shall be “unclassified” unless it can be classified as “rock” excavation as specified in Section 31 23 16.26 of these specifications, if applicable.
- B. Soils type shall be based upon ASTM D2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- C. Stone or Coarse Aggregate type shall be based upon ASTM D488, Standard Sizes for Coarse Aggregates.
- D. Rip rap type shall be based upon SCDOT Standard Specifications for Highway Construction Section 804.

2.2 MATERIALS

- A. Structural backfill shall be imported or excavated trench material meeting the following requirements:
 - 1. Class I through III per ASTM D2321
 - 2. Free of clay lumps, roots, debris, rubbish, frozen material, and stones larger than one inch in diameter, have < 35% fines, and capable of being compacted to 95% density per AASHTO T-99.
- B. Common backfill material shall consist of excavated materials meeting the following requirements:
 - 1. Class I through III per ASTM D2321
 - 2. Highly organic silts, clays and Class IV and V materials shall not be used.
 - 3. Materials shall be free roots, stumps, debris, rubbish, frozen material, and stones larger than one inch in capable of being compacted to 85% density per AASHTO T-99.
 - 4. Contain no stone blocks, broken concrete, masonry rubble, or other similar materials.
 - 5. Physical properties such that it can be readily spread and compacted during filling.
 - 6. Snow, ice, and frozen soil will not be permitted.
- C. Crushed Stone:

1. Crushed stone for pipe bedding, structure bases, and other used indicated on the Drawings shall be angular, clean-washed, crushed stone graded in accordance with size #5 or #57 in ASTM D488 .
- D. Foundation Conditioning Material: Crusher-run rock, conforming to ASTM D448.
- E. Geotextile Fabric shall be used as directed by the Engineer or as indicated on the Drawings and shall conform to the following requirements:
 1. Geotextile fabric shall be non-woven Mirafi, Type HP570, Type 140N; Dupont, Type PAR, Style 3401; or approved equal.
- F. Trench Plugs:
 1. Trench plugs shall be concrete filled sacks, Bentonite Clay or material having a "GC" soil rating per ASTM D2487 and shall have a coefficient of permeability no greater than 0.001 CM/SEC per ASTM D2434.
 2. If excavated material is to be used the contractor shall submit verification and test results from a qualified laboratory that the material meets the classification and permeability specification above.

PART 3 - EXECUTION

3.1 LINES AND GRADES

- A. Excavate trench as necessary to install pipes at indicated lines and grades at the depths specified on the drawings.
 1. The Engineer may make changes in lines, grades, and depths of utilities when changes are required for Project conditions
- B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

- A. Ensure sediment and erosion control measures are installed per the Drawings and Section 31 25 00 prior to performing any disturbing activity.
- B. Complete site clearing operations per the Drawings and Section 31 10 00.
- C. Contact local utility line information service not less than three (3) working days before performing Work.
 1. Request underground utilities to be located and marked within and surrounding construction areas.
- D. Identify required lines, levels, contours, and datum locations.

- E. All trees, telephone and power line poles along the line of the work must be protected, and at night a sufficient number of barricades and lights to prevent accidents shall be provided. Where sewers are laid between the curb and the sidewalk or in other places where shrubbery and grass lawns are encountered, the Contractor shall carefully remove and replace the shrubbery and cut the grass sod in sections, laying it to the side and replacing it after the trench has been backfilled and allowed to settle.
- F. Unless otherwise indicated on the Drawings, protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- G. Maintain and protect above and below grade utilities indicated to remain.
- H. Establish temporary traffic control and detours when trenching is performed in public rights-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. All sheeting and shoring shall be furnished and placed in accordance with the requirements of OSHA Standards, Subpart P, Part 1926, of the Code of Federal Regulations.
- C. Design sheeting and shoring to be left in place as part of completed Work, cut off minimum of 6" above the top of pipe and 18 inches below finished grade.
- D. No sheeting installed closer than one (1) pipe diameter or two (2) feet (whichever is greater) from the outside edge of the pipe shall be withdrawn if driven below mid-diameter of any pipe. Any sheeting beyond these limits which is withdrawn shall be done in a manner in which the sheeting slides smoothly out of position without any disturbance of adjacent bedding. The remaining hole shall immediately be filled by hand with sand.
- E. If trench sloping is substituted for shoring, the slope shall be in accordance with all OSHA requirements. Sloping of the pipe trench shall only be allowed at depths of ten (10) feet or less below existing grade. The sloping of the trench wall shall terminate twelve inches above the top of the pipe and, from that point to the trench bottom, the trench wall shall be vertical.
- F. All excavations deeper than ten (10) feet below grade shall have appropriate excavation support systems from the bottom of the excavation to within a minimum of ten (10) feet from the top of the excavation.
- G. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing at no additional cost to the Owner.
- H. The Contractor may, at his option, use movable earth retaining devices (trench boxes) to stabilize excavations for pipes where these devices can be effectively used. Trench boxes shall not be considered as a substitute for sheeting systems specifically called out on the drawings. Trench boxes shall not be used for tunnel launch and exit shafts.

- I. Where movable earth retaining devices such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and backfill.
- J. Trench box systems shall be designed by a professional engineer registered in the State of South Carolina. Design drawings and computations for non-commercial trench boxes shall be submitted to the Engineer for information prior to construction.

3.4 DEWATERING

- A. The Contractor shall, at all times during construction, provide and maintain ample means and devices with which to promptly remove and properly dispose of all water entering the excavation or other parts of the work and shall keep said excavation and work dry until the structures to be built therein are completed, or until the Engineers direct the Contractor to discontinue dewatering operations. Wherever judged necessary by the Engineer, the Contractor shall employ well points to insure a dry excavation. No claims for an amount of money in excess of the bid price for the work will be entertained or allowed on account of the character of the ground in which the trench or other excavations are made.
- B. Dewatering shall at all times be conducted in such a manner as to preserve the natural undisturbed bearing capacity of the sub-grade soils at the proposed bottom of the excavation. Groundwater shall be lowered to at least two (2) feet below the excavation level at all times.
- C. The Contractor shall provide for the disposal of the water removed from the excavation in such a manner as not to cause erosion, siltation, or turbidity increases in any water course; injury to public health; degradation or damage to private or public property, to any portion of the work completed or in progress, or to roads or streets; or cause any impediment to the reasonable use of the site by others.

3.5 EXCAVATION & TRENCHING

- A. Underpin adjacent structures which may be damaged by excavation work.
- B. Trenches and excavations shall be open cut to proper depth and alignment for the installation of pipe, structures, and appurtenances as shown on the plans.
- C. The minimum trench width shall be at least the nominal pipe diameter plus twenty-four (24) inches.
- D. Remove lumped subsoil, boulders, and rock up of six (6) feet in diameter.
- E. Slope banks with machine to angle of repose or less until shored.
- F. Grade top perimeter of excavations to prevent surface water from draining into excavation.
- G. Excavated material shall be stockpiled within the construction easement of the work.

1. The excavated material shall be piled on the side of the trench at least four (4) feet (horizontally) extending away from the top of the excavated trench so that a clear walkway will be maintained at the edge. Excavated material shall be kept clear of the sidewalks except where unusual conditions prevent this being done. All driveways shall be backfilled as soon as the pipe is laid and no driveway shall remain inaccessible at the end of the day's work.
 2. Excavated material which has suitable characteristics for backfill shall be stockpiled in such a manner that it will not collect either surface water or rainwater. The stockpile top surface shall be sloped to drain away from the excavation site and graded smooth and compacted to drain rainwater rapidly. It shall be the Contractor's responsibility to control or adjust the moisture content of excavated materials to the requirements for common fill before such materials may be used for backfill at no additional cost to the Owner.
- H. Excess excavation shall be disposed of offsite by the Contractor. All handling, hauling, and disposal costs shall be considered incidental to the work. Disposal shall be in compliance with all applicable regulations. Excess excavation shall be as described below:
1. All rocks, stumps, roots, and organic muck, clay, or silt lenses removed in the preparation of the excavation for common fill.
 2. Soils which cannot qualify as common fill after preparation such as muck soils, high organic soil, or non-granular soil high in silt and clay content.
 3. Excavated material remaining at the end of the work after all stockpiles, and prepared backfill has been utilized as needed.
- I. Do not advance open trench more than fifty (50) feet ahead of the pipe laying unless prior approval is given by the Engineer
- J. Excavate trenches to the bottom elevation of the bedding for structures and pipes. The width shall be at least two (2) feet beyond the neat lines of structure footings and as shown on the Drawings for pipelines. Over-excavation that is not directed in writing by the Engineer shall be backfilled with structural fill at no additional cost to the Owner.
- K. Do not interfere with 45-degree bearing splay of foundations.
- L. When subsurface materials at bottom of trench are loose or soft, excavate to; a depth of no more than one (1) foot below the trench bottom, unless additional depth is authorized by Architect/Engineer, or until suitable material is encountered. Backfill with foundation conditioning material to the original trench bottom compacted to 95% maximum density. Underlay foundation conditioning material with geotextile overlapping each seam by a minimum eighteen (18) inches.
- 3.6 FOUNDATION, BEDDING AND EMBEDMENT
- A. Foundation stone for structures and pipe shall be #5 or #57 stone placed to the minimum excavation widths as shown on the Drawings, and shall be at least 6 inches deep below the bottom of footings, base slabs, and to a depth as shown on the drawings below the bottoms of pipe.
- B. Foundation stone shall be placed only on dry, stable, compacted subgrade or on rock.

- C. Loose earth in the sub-grade shall not be acceptable. Where required, sub-grade compaction shall be with a vibratory type mechanical compactor.
- D. Trim excavation. Hand trim for bell and spigot pipe joints.
- E. No foundation contamination with earth shall be allowed. Immediately remove any earth mat that falls into the foundation during placement or compaction.

3.7 TRENCH PLUGS

- A. An impervious clay ditch check or trench plug shall be required on the downstream side of all stream crossings, on both sides of all wetland crossings, where shown on the Drawings or as directed by the Engineer.
- B. The trench plug shall be constructed for a length of three (3) feet as measured along the centerlines of the pipe and the full width of the trench excavation from the trench bottom to six (6) inches above the top of the pipe.

3.8 BACKFILLING

- A. All trenches and excavations shall be backfilled immediately after the pipe has been laid and inspected. Backfill material shall be approved in all cases by the Engineer and shall be free of objectionable debris. Backfilling shall include the refilling and compacting the fills in the trenches or excavation to the existing ground surface or to the existing road subgrade.
- B. Following the laying of the pipe, the pipe shall be centered in the trench, adjusted to line and grade and the initial bedding material shall be carefully placed on both sides of the pipe so as not to disturb the alignment and grade of the pipeline. The bedding material shall be sliced under the haunches of the pipe and compacted to fill all voids.
- C. Backfill structures carefully, bringing the fill up evenly on all sides.
- D. Backfill material shall consist of crushed stone, structural, or common backfill depending upon location as detailed on the Drawings.
- E. Cut out soft areas of subgrade not capable of compaction in place. Backfill with common backfill and compact to density equal to or greater than requirements for subsequent backfill material.
- F. Maintain optimum moisture content of fill materials to attain required compaction density.
- G. Do not leave trench or excavation open at end of working day.

3.9 COMPACTION

- A. Foundation and bedding stone shall be installed in maximum 6-inch lifts, as placed, and compacted with suitable compaction equipment to at least 90% of maximum dry density or as required by pipe manufacturers. Lift thickness shall be reduced to 4 inches in confined areas accessible only to hand-guided compaction equipment.

- B. Structural backfill shall be placed in maximum 6-inch level layers and compacted to at least 95% of maximum dry density as determined by ASTM D698.
- C. Common backfill shall be placed in maximum 12-inch layers and compacted to at least 90% of maximum dry density or as shown on the Drawings.
- D. Trench Plugs shall be placed in maximum 6 inch lifts and compacted to 95% density per ASTM D698.
- E. Compaction shall be by a vibratory-type mechanical compactor adjacent to structures and including between the pipe and trench sides, sheeting or trench box. Larger compaction equipment may be used as desired after backfill has reached at least two feet above the top of the pipe. For structures, the mechanical compactor shall be used between the structures and sheeting until the elevation at which sheeting is withdrawn, at which elevation the entire excavated area may be compacted with larger equipment if desired.

3.10 PROTECTION OF UTILITIES

- A. The Contractor shall locate and protect all utilities which could be affected by the Work including but not limited to; overhead cables, poles, buried cables, duct banks, wastewater pipes, gas pipes, water pipes, and drainage pipes and appurtenances. Before working in any area, the Contractor shall contact the local utility locating service to mark the locations of underground utilities. Any underground utilities that could interfere with the work shall be staked and flagged.
- B. Underground pipes and cables which cross the excavations shall be carefully exposed and temporarily supported by the Contractor to the satisfaction of the utility owner. The utility shall be carefully incorporated in the backfill with full support and protection. Length of utility support shall be based on actual field conditions.
- C. Utility relocation shall be discussed at a meeting with the Engineer and utility owner.
- D. Before operating any equipment near a buried or overhead electric cable, the contractor shall contact the owner of the cable to arrange for protection of the cable and the Contractor's personnel and equipment.
- E. At least 48 hours prior to operating any equipment near a buried gas pipe line that Contractor shall contact the owner of the line and inform them of the work.
- F. Compliance with the conditions of the Owner of an electric or gas utility shall be considered a subsidiary obligation under the Contract.
- G. The Engineer shall be invited to attend all meetings between the Contractor and utility owner for information only.

3.11 FIELD QUALITY CONTROL

- A. The Contractor shall retain and pay for compaction tests performed by an independent testing firm acceptable to the Owner on the compacted backfill to verify compliance with these specifications.
- B. Perform laboratory material tests according to ASTM D698, or AASHTO T 99 Method A.
- C. Perform in place compaction tests according ASTM D2167 for density and ASTM D3017 for moisture content.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.
- E. Frequency of Tests:
 - 1. Trenches: One location every 500 feet.
 - 2. Structures (Manholes): Two locations around each manhole in separate lifts.
 - 3. Structures: At least two-density test shall be made beneath each structure, or as directed by the Engineer.

3.12 MAINTENANCE

- A. The Contractor shall maintain all project areas during the specified warranty period. Maintenance shall include the following:
 - 1. Immediately filling and reseeding any eroded areas.
 - 2. Reseeding any areas where a full stand of grass does not develop.
 - 3. Removal and replacement of any trees which die or show distress.
 - 4. Refilling and reseeding any backfilled areas which settle and develop depressions.

END OF SECTION 31 23 16.13

SECTION 31 23 19 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes construction dewatering.
- B. Related Requirements:
 - 1. Section 01 32 33 - Photographic Documentation for recording preexisting conditions and dewatering system progress.
 - 2. Section 31 20 00 - Earth Moving for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.

1.3 ALLOWANCES

- A. Dewatering observation wells shall be part of dewatering allowance.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at project site.
 - 1. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review condition of site to be dewatered including coordination with temporary erosion-control measures and temporary controls and protections.
 - 3. Review geotechnical report.
 - 4. Review proposed site clearing and excavations.
 - 5. Review existing utilities and subsurface conditions.
 - 6. Review observation and monitoring of dewatering system.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For dewatering system, prepared by or under the supervision of a qualified professional engineer.
 - 1. Include plans, elevations, sections, and details.

2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
3. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
4. Include written plan for dewatering operations including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.
- D. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.

1.8 FIELD CONDITIONS

- A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.
 1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
 2. The geotechnical report is included elsewhere in Project Manual.
- B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
 - 1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
 - 2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
 - 3. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 5. Remove dewatering system when no longer required for construction.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
 - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Protect and maintain temporary erosion and sedimentation controls during dewatering operations.

3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
 - 1. Space well points or wells at intervals required to provide sufficient dewatering.
 - 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.
- C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATION

- A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
 - 2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
 - 3. Maintain piezometric water level a minimum of 24 inches 60 inches below bottom of excavation.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.
- D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

3.4 FIELD QUALITY CONTROL

- A. Observation Wells: Provide observation wells or piezometers, take measurements, and maintain at least the minimum number indicated; additional observation wells may be required by authorities having jurisdiction.
 - 1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.

2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
 3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.
- B. Survey-Work Benchmarks: Resurvey benchmarks regularly/monthly during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Engineer if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.
- C. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.
- D. Prepare reports of observations.

3.5 PROTECTION

- A. Protect and maintain dewatering system during dewatering operations.
- B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION 312319

SECTION 31 25 00 - EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Construction Entrance/Exits
2. Diversion Channels.
3. PAM
4. Rock Energy Dissipator.
5. Rock Barriers.
6. Sediment Control: including silt fences, inlet protection, etc.
7. Sediment Ponds.
8. Sediment Traps.
9. Silt Fences

B. Related Sections:

1. Section 033000 - Cast-In-Place Concrete.
2. Section 055000 - Metal Fabrications.
3. Section 310516 - Aggregates for Earthwork.
4. Section 312000 - Earthmoving.
5. Section 321313 - Concrete Paving.
6. Section 329113 - Soil Preparation.
7. Section 329200 - Turf and Grasses.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T88 - Standard Specification for Particle Size Analysis of Soils.
2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.

C. ASTM International:

1. ASTM C127 - Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.
2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³).
3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³).

4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- D. Precast/Prestressed Concrete Institute:
1. PCI MNL-116S - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
- E. South Carolina Erosion and Sediment Reduction Act of 1983.
- F. The Department of Transportation, State of South Carolina, Standard Specifications Construction of Roads and Bridges latest edition.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Product Data: Submit data on joint filler, joint sealer, admixtures, curing compounds, and geotextiles.
- C. Submit proposed mix design of each class of concrete for review prior to commencement of Work.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

1.5 QUALITY ASSURANCE

- A. Perform Work according to the Department of Transportation, State of South Carolina standards.

1.6 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

PART 2 - PRODUCTS

2.1 ROCK AND GEOTEXTILE MATERIALS

- A. Furnish materials according to Department of Transportation, State of South Carolina standards.

- B. Rock: As specified in Section 31 05 16 - Aggregates for Earthwork. Furnish according to Department of Transportation, State of South Carolina standards.
- C. Geotextile Fabric: Furnish according to Department of Transportation, State of South Carolina standards.

2.2 CONCRETE MATERIALS AND REINFORCEMENT

- A. Cement: As specified in Section 033000 Concrete.

2.3 PLANTING MATERIALS

- A. Seeding and Soil Supplements: As specified in Section 329113 Soil Preparation.
- B. Turf and Grasses: As specified in Section 329200 Turf and Grasses.

2.4 POLYACRYLAMIDE (PAM)

- A. Only the anionic form of PAM shall be used. PAM and PAM mixtures shall be environmentally benign, harmless to fish, wildlife, and plants.
- B. Anionic PAM in pure form shall have less than or equal to 0.05% acrylamide monomer by weight, as established by the FDA and US EPA.

2.5 Mats and Blankets (ECB's)

- A. 3:1 Slopes and flatter
 - 1. ECB must be rated for shear stresses up to 1.55 lbs/sq ft, must weigh at least 0.50 lbs/yd², and the netting made of biodegradable polypropylene or FibreNet™ material
- B. 1.5:1 to 3:1 Slopes
 - 1. ECB must be rated for shear stresses up to 1.75 lbs/sq ft, must weigh at least 0.73 lbs/yd², and the netting made of biodegradable polypropylene or FibreNet™ material
- C. Acceptable manufacturer
 - 1. American Excelsior Company, Arlington, TX
 - 2. Or approved equal
- D. Inlet Protection Products
 - 1. Drop Inlets
 - a. Silt Savers
 - b. Dandy Sacks
 - 2. Curb Inlet
 - a. Dandy Curb
 - b. Gutter Eel
 - 3. The filter shall be a weighted sediment tube filter with a diameter of 9.5-inches at the ends and tapering to 5 inches in the center. Lengths shall be 6 to 9 feet with a build-in triangular overflow for relief during high-intensity storm events.

- a. Unit Weight: 13 lbs/ft
 - b. Interior Filter
 - c. Materials: Shredded, recycled tire rubber particles with less than 2% metal and the rubber shall be washed during manufacturing.
 - d. Particle Size: ½ inch to ¾ inch particle size
 - e. Geotextile Bag
 - 1) Percent Open Area: 8%
 - 2) Apparent Opening Size: 30 U.S. Sieve
 - 3) Grab Tensile Strength: 400 lbs
 - 4) Flow Rate: 115 gal/min/ft²
 - 5) Puncture Strength: 125 lbs
- E. Fiber Rolls
- 1. Fiber rolls should be prefabricated rolls or rolled tubes of geotextile fabric. When rolling the tubes, make sure each tube is at least 8 inches in diameter. Bind the rolls at each end and every 4 feet along the length of the roll with jute-type twine
- F. Silt Fence
- 1. The height of a silt fence shall not exceed 36 inches (0.9 m). Storage height and ponding height shall never exceed 18 inches (0.5 m).
 - 2. The standard-strength filter fabric shall be stapled or wired to the fence, and 6 inches (0.2 m) of the fabric shall extend into the trench.
 - 3. Type A Silt Fence
 - a. A wire mesh support fence shall be fastened securely to the upslope side of the posts (between the posts and fabric) using heavy duty wire staples at least ½” (12.7mm) long and ¾” wide, tie wires or hog rings. The wire shall extend into the trench a minimum of 6 inches (51 mm) and shall not extend more than 36 inches (0.9 m) above the original ground surface.
 - b. Posts shall be 4’ long steel that each weigh at least 5.2 lbs.
 - 4. Type B Silt Fence
 - a. The spacing between posts shall be a maximum of 6’, and the filter fabric shall be stapled or wired directly to the posts.
 - b. Posts may be soft wood 2x4, oak 2x2, or steel as indicated for Type A Silt Fence

2.6 PIPE MATERIALS

- A. Pipe: Corrugated steel, as specified in the Department of Transportation, State of South Carolina, Highways Standards.

2.7 ACCESSORIES

- A. Trash Rack: Bars welded to angles and at each intersection of bars, as specified in Section 051200 Misc. Metals.

2.8 SOURCE QUALITY CONTROL (AND TESTS)

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.

- B. Perform tests on cement, aggregates, and mixes to ensure conformance with specified requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify compacted stabilized soil is acceptable and ready to support devices and imposed loads.
- B. Verify gradients and elevations of base or foundation for other work are correct.

3.2 DIVERSION CHANNELS

- A. Windrow excavated material on low side of channel.
- B. Compact to 95 percent maximum density.
- C. On entire channel area, apply soil supplements and sow seed as specified in Section 329200.
- D. Mulch seeded areas with hay as specified in Section 329200.

3.3 POLYACRYLAMIDE (PAM)

- A. The maximum application rate of PAM in pure form shall not exceed 200 lbs/acre/year. Over application of PAM can lower infiltration rates or suspend solids in water, and, therefore, over application should be avoided.
- B. Users of PAM shall obtain and follow all MSDS requirements.
- C. The manufacturer or supplier shall provide written application methods for PAM and PAM mixtures. The application shall provide uniform coverage to the target area.

3.4 MATS AND BLANKETS

- A. After the site has been shaped and graded to the approved design, prepare a seedbed free from clods and rocks more than 1 inch in diameter, and any foreign matter that will prevent the contact of the mat with the soil surface.
- B. Lime, fertilizer, and seed shall be applied in accordance with seeding or other type of planting plan as suggested by the ENGINEER.
- C. Erosion control blanket products should be installed in accordance with the manufacturer's recommendations and specifications, including check slots and stapling materials.
- D. Anchor product so that a continuous, firm contact with the soil surface/seed bed is maintained. This is best accomplished on slopes by working from the bottom to the top.

3.5 SEDIMENT CONTROL

- A. Filter Ring/Rock Filter Ring
 - 1. Mechanical or hand placement of fiber rolls/straw wattles/stone shall be required to uniformly surround the structure to be supplemented.
 - 2. The filter ring may be constructed on natural ground surface, excavated surface, or on machine compacted fill.
 - 3. When placed below a storm drain outlet, it shall be constructed so that it does not allow water to back up into the storm drain.
- B. Inlet Protection Products
 - 1. For information on installation, refer to the manufacturers' drawings provided by the distributor. Strict adherence to the manufacturers' suggested installation procedures is required for proper inlet protection.
- C. Fiber Rolls
 - 1. On slopes, install fiber rolls along the contour with a slight downward angle at the end of each row to prevent ponding at the midsection. Turn the ends of each fiber roll upslope to prevent runoff from flowing around the roll. Install fiber rolls in shallow trenches dug 3 to 5 inches deep for soft, loamy soils and 2 to 3 inches deep for hard, rocky soils.
 - 2. Determine the vertical spacing for slope installations on the basis of the slope gradient and soil type. A good rule of thumb is:
 - a. 1:1 slopes = 10 feet apart
 - b. 2:1 slopes = 20 feet apart
 - c. 3:1 slopes = 30 feet apart
 - d. 4:1 slopes = 40 feet apart
 - 3. For soft, loamy soils, place the rows closer together. For hard, rocky soils, place the rows farther apart. Stake fiber rolls securely into the ground and orient them perpendicular to the slope. Drive the stakes through the middle of the fiber roll and deep enough into the ground to anchor the roll in place. About 3 to 5 inches of the stake should stick out above the roll, and the stakes should be spaced 3 to 4 feet apart. A 24-inch stake is recommended for use on soft, loamy soils. An 18-inch stake is recommended for use on hard, rocky soils.
- D. Rock Filter Dam
 - 1. The center of the rock dam should be at least 6" lower than the outer edges of the dam at the channel banks. Side slopes shall be 2:1 or flatter. The top width of the dam should be at least 6'.
 - 2. The dam should not be higher than the channel banks or the elevation of the upstream property line.
 - 3. Set a marker stake to indicate the clean out elevation.

3.6 CONSTRUCTION ENTRANCE/EXIT

- A. The entrance/exit must be excavated to a depth of 3" and cleared of all vegetation and roots.
- B. If the action of the vehicle travelling over the gravel pad does not sufficiently remove the mud, the tires should be washed prior to entrance onto public rights-of-way. When washing is necessary, it should be done on an area stabilized with crushed stone.

- C. A geotextile fabric underliner should be placed the full length and width of the entrance.

3.7 ROCK ENERGY DISSIPATOR

- A. Excavate to indicated depth of rock lining or nominal placement thickness as follows. Remove loose, unsuitable material below bottom of rock lining, then replace with suitable material. Thoroughly compact and finish entire foundation area to firm, even surface.
 - 1. Nominal Placement Thickness per NCSA Class:
 - a. R7: 36 Inches
 - b. R6: 30 Inches
 - c. R5: 24 Inches
 - d. R4: 18 Inches
 - e. R3: 12 Inches
- B. Lay and overlay geotextile fabric over substrate. Lay fabric parallel to flow from upstream to downstream. Overlap edges upstream over downstream and upslope over downslope. Provide a minimum overlap of 3 feet. Cover fabric as soon as possible and in no case leave fabric exposed more than 4 weeks.
- C. Carefully place rock on geotextile fabric to produce an even distribution of pieces, with minimum of voids and without tearing geotextile.
- D. Unless indicated otherwise, place full course thickness in one operation to prevent segregation and to avoid displacement of underlying material. Arrange individual rocks for uniform distribution.

3.8 ROCK BARRIER

- A. Determine length required for ditch or depression slope and excavate, compact and foundation area to firm, even surface.
- B. Produce an even distribution of rock pieces, with minimum voids to the indicated shape, height and slope.
- C. Construct coarse aggregate filter blanket against upstream face of rock barrier to the indicated thickness.

3.9 SEDIMENTATION POND

- A. Clear and grub storage area and embankment foundation area site as indicated and specified.
- B. Excavate key trench for full length of dam. Excavate emergency spillway in natural ground.
- C. Install pipe spillway, with anti-seep collar attached, at location indicated.
- D. Place forms, and reinforcing for concrete footing at bottom of riser pipe with trash rack and anti-vortex device. Construction of embankment and trench prior to placing pipe is not required.

- E. Mix, place, finish, and cure concrete, as specified in Section 033000.
- F. Do not use coarse aggregate as backfill material around pipe. Backfill pipe with suitable embankment material to prevent dam leakage along pipe.
- G. Construct rock basin at outlet end of pipe. Place embankment material, as specified.
- H. On entire sedimentation pond area, apply soil supplements and sow seed as specified in Section 329200.
- I. Mulch seeded areas with hay.
- J. Apply PAM.

3.10 SEDIMENT TRAPS

- A. Clear site, as indicated.
- B. Construct trap by excavating and forming embankments as indicated in the drawings.
- C. Place coarse aggregate or rock at outlet as indicated on Drawings.
- D. Place geotextile fabric, as specified for rock energy dissipator.
- E. When required, obtain borrow excavation for formation of embankment.
- F. On entire sediment trap area, apply soil supplements and sow seed as specified in Section 329219.
- G. Mulch seeded areas with hay.

3.11 SITE STABILIZATION

- A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.
- B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.
- C. Stockpile and waste pile heights shall not exceed 35 feet. Slope stockpile sides at 2:1 or flatter.
- D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
- E. Stabilize diversion channels, sediment traps, and stockpiles immediately.

3.12 FIELD QUALITY CONTROL & INSPECTIONS

- A. Section 014000 - Quality Requirements and 017000 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- D. It is the CONTRACTOR'S responsibility to perform all required inspections in accordance with all Authorities having Jurisdiction.
- E. CONTRACTOR is responsible for continually maintaining all temporary erosion control measures until permanent measures are properly installed and performing as required.

3.13 CLEANING

- A. Section 017000 - Execution and Closeout Requirements: Requirements for cleaning.
- B. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.
- C. Do not damage structure or device during cleaning operations.
- D. Do not permit sediment to erode into construction or site areas or natural waterways.
- E. Clean channels when depth of sediment reaches approximately one-half channel depth.

3.14 PROTECTION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Immediately after placement, protect paving from premature drying, excessive hot or cold temperatures, and mechanical injury.
- C. Protect paving from elements, flowing water, or other disturbance until curing is completed.

END OF SECTION 312500

SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes temporary excavation support and protection systems.
- B. Related Requirements:
 - 1. Section 31 20 00 - Earthmoving
 - 2. Section 31 23 19 - Dewatering" for dewatering excavations.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.
- B. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer.
 - 1. Include plans, elevations, sections, and details.
 - 2. Show arrangement, locations, and details of soldier piles, piling, lagging, tiebacks, bracing, and other components of excavation support and protection system according to engineering design.
 - 3. Indicate type and location of waterproofing.
 - 4. Include a written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation.

1.4 INFORMATIONAL SUBMITTALS

- A. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.

- C. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Notify Engineer no fewer than two days in advance of proposed interruption of utility.
 - 2. Do not proceed with interruption of utility without Engineer's written permission.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.
 - 2. The geotechnical report is included elsewhere in Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide, design, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads.
 - 1. Contractor Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 4. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

2.2 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36, ASTM A 690, or ASTM A 992.

- C. Steel Sheet Piling: ASTM A 328, ASTM A 572, or ASTM A 690; with continuous interlocks.
 - 1. Corners: Site-fabricated mechanical interlock or Roll-formed corner shape with continuous interlock.
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.
- E. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- F. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- G. Tiebacks: Steel bars, ASTM A 722.
- H. Tiebacks: Steel strand, ASTM A 416.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

3.2 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.
- B. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- C. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

- A. Drill, install, grout, and tension tiebacks.
- B. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
 - 1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.
- C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 - 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Engineer.
 - 2. Install internal bracing if required to prevent spreading or distortion of braced frames.
 - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 FIELD QUALITY CONTROL

- A. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.
- B. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.7 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to

avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.
2. Fill voids immediately with approved backfill compacted to density specified in Division 31 and as required by the geotechnical engineer.
3. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.

B. Leave excavation support and protection systems permanently in place.

END OF SECTION 31 50 00

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Hot-mix asphalt patching.
- 2. Hot-mix asphalt paving.
- 3. Hot-mix asphalt overlay.
- 4. Asphalt surface treatments.

- B. Related Requirements:

- 1. Section 02 41 16 "Structure Demolition" and Section 02 41 19 "Selective Demolition" for demolition and removal of existing asphalt pavement.
- 2. Section 07 92 00 "Joint Sealants"
- 3. Section 31 05 16 "Aggregates for Earthwork"

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
 - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include technical data and tested physical and performance properties.
- 2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
- 3. Job-Mix Designs: For each job mix proposed for the Work.

- B. Samples for Verification: For the following product, in manufacturer's standard sizes unless otherwise indicated:

- 1. Paving Fabric: 12 by 12 inches minimum.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and testing agency.
- B. Material Certificates: For each paving material. Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.
- C. Material Test Reports: For each paving material, by a qualified testing agency.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located in accordance with South Carolina Department of Transportation (SCDOT), standard specifications, latest edition.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.
- C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of SCDOT, standard specifications, latest edition.
 - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.
- D. Materials: Obtain paving materials from the same source throughout.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 - 1. Prime Coat: Minimum surface temperature of 60 °F.
 - 2. Tack Coat: Minimum surface temperature of 60 °F.
 - 3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
 - 4. Asphalt Base Course: Minimum surface temperature of 40 °F and rising at time of placement.
 - 5. Asphalt Surface Course: Minimum surface temperature of 60 °F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- C. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
 - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.
- D. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

- A. Hot Mix Asphaltic Concrete Construction: SCDOT Section 400, ASTM D 946.
- B. Aggregate Base Course: SCDOT Section 305.
- C. Asphalt Binder Course: In accordance with SCDOT Standards Section 305.
- D. Aggregate Wearing Course: In accordance with SCDOT Standards Section 305.
- E. Fine Aggregate: In accordance with SCDOT Standards Section 305.
- F. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.
- G. Prime Coat: In accordance with SCDOT Standards, ASTM D 2027, AASHTO MC-30, MC-70 or MC-250.
- H. Tack Coat: Homogenous, medium curing, liquid asphalt. Conforming with SCDOT Standards Section 413.
- I. Emulsified Asphalt Slurry: In accordance with SCDOT Standards Section 401.
- J. Water: Potable.

2.3 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled asphalt shingles or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

- B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.
- C. Sand: ASTM D 1073, Grade No. 2 or No. 3.
- D. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.
- E. Joint Sealant: ASTM D 6690, Type I, hot-applied, single-component, polymer-modified bituminous sealant.

2.4 MIXES

- A. Sustainable Design Acceptance
 - 1. Surface Course Limit: Recycled content no more than 20 percent by weight on surface course and 25 on intermediate and base courses.
- B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction (SCDOT) complying with the following requirements:
 - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
 - 2. Base Course: 8" Graded Aggregate Base (GAB).
 - 3. Binder Course: 3" (330 lb/sy) 19 mm Superpave
 - 4. Surface Course: 2" (165 lb/sy) 12.5 mm Superpave or as directed by Engineer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet, saturated or frozen subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PATCHING

- A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompress existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
 - 1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
 - 2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompress existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.
- E. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.3 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
 - 1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
 - 1. Clean cracks and joints in existing hot-mix asphalt pavement.
 - 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
 - 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.4 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
 - 1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.
- C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
 - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 - 2. Protect primed substrate from damage until ready to receive paving.
- D. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth.—Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
 - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 - 2. Protect primed substrate from damage until ready to receive paving.
- E. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.10 gal./sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.5 PAVING GEOTEXTILE INSTALLATION

- A. Apply asphalt binder uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd.
- B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.
- C. Protect paving geotextile from traffic and other damage, and place hot-mix asphalt overlay the same day.

3.6 PLACING HOT-MIX ASPHALT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
 - 2. Place hot-mix asphalt surface course in single lift.
 - 3. Spread mix at a minimum temperature of 250 °F.
 - 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 - 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
 - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
 - 2. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.7 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
 - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
 - 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 - 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.8 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 °F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent or greater than 100 percent.
 2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.9 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 1. Base Course: Plus or minus 1/2 inch.
 2. Surface Course: Plus 1/4 inch; no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 1. Base Course: 1/4 inch.
 2. Surface Course: 1/8 inch.
 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.
- C. Asphalt Traffic-Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus or minus 1/8 inch of height indicated above pavement surface.

3.10 SURFACE TREATMENTS

- A. Slurry Seals: Apply slurry coat in a uniform thickness according to SCDOT 401.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. Asphalt Traffic-Calming Devices: Finished height of traffic-calming devices above pavement will be measured for compliance with tolerances.
- E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 2726.
- F. Replace and compact hot-mix asphalt where core tests were taken.
- G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.12 WASTE HANDLING

- A. General: Handle asphalt-paving waste according to approved waste management plan and as required by the South Carolina Department of Health and Environmental Control (SCDHEC).

END OF SECTION 32 12 16

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes Concrete Paving. Including the following:
 - 1. Driveways.
 - 2. Curbs and gutters.
 - 3. Walks.
- B. Related Requirements:
 - 1. Section 03 30 00 - Cast-in-Place Concrete for general building applications of concrete.

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site
 - 1. Review methods and procedures related to concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and concrete paving construction practices.
 - 2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete paving Subcontractor.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.
- B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or epoxy adhesive.
 - 8. Joint fillers.
- C. Material Test Reports: For each of the following:
 - 1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.7 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 °F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 °F and not more than 80 °F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 °F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064, fabricated from as-drawn steel wire into flat sheets.
- B. Reinforcing Bars: ASTM A 615, Grade 60 (Grade 420); deformed.

- C. Plain-Steel Wire: ASTM A 1064, as drawn galvanized.
- D. Joint Dowel Bars: ASTM A 615, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.
- E. Tie Bars: ASTM A 615, Grade 60 (Grade 420); deformed.
- F. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.4 CONCRETE MATERIALS

- A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C 150, gray white Portland cement Type I, Type II, or Type I/II
 - 2. Fly Ash: ASTM C 618, Class F.
 - 3. Slag Cement: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4M Class 1N, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Air-Entraining Admixture: ASTM C 260.
- D. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry or cotton mats.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.6 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Pozzolan: 25 percent.
 - 2. Slag Cement: 50 percent.

3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 1. Air Content: 4-1/2 percent plus or minus 1-1/2 percent for 1-1/2-inch nominal maximum aggregate size.
 2. Air Content: 4-1/2 percent plus or minus 1-1/2 percent for 1-inch nominal maximum aggregate size.
 3. Air Content: 5 percent plus or minus 1-1/2 percent for 3/4-inch nominal maximum aggregate size.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing admixture or plasticizing and retarding admixture in concrete as required for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- F. Concrete Mixtures: Normal-weight concrete.
 1. Compressive Strength (28 Days): 4000 psi
 2. Maximum W/C Ratio at Point of Placement: 0.50
 3. Slump Limit: 4 inches, plus or minus 1 inch.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Furnish batch certificates for each batch discharged and used in the Work.
 1. When air temperature is between 85 and 90 °F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 °F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 31 20 00 - Earth Moving.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 2. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 2. Extend joint fillers full width and depth of joint.
 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction (Control) Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
 - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true

planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 1. Elevation: 3/4 inch.
 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 3. Surface: Gap below 10-feet- long; unlevelled straightedge not to exceed 1/2 inch.

4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
6. Vertical Alignment of Dowels: 1/4 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.11 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Engineer.
- B. Drill test cores, where directed by Engineer, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with Portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13

SECTION 32 17 23 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes painted markings applied to asphalt and concrete pavement.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to marking pavement including, but not limited to, the following:
 - a. Pavement aging period before application of pavement markings.
 - b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include technical data and tested physical and performance properties.
- B. Shop Drawings: For pavement markings.
 - 1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
 - 2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Samples: For each exposed product and for each color and texture specified; on rigid backing, 8 inches square.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of SCDOT for pavement-marking work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for alkyd materials for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Aexcel Inc
- B. Or Approved Equal

2.2 PAVEMENT-MARKING PAINT

- A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N; colors complying with FS TT-P-1952.
 1. Color: As indicated.
- B. Pavement-Marking Paint: MPI #32, alkyd traffic-marking paint.
 1. Color: As indicated.
- C. Pavement-Marking Paint: MPI #97, latex traffic-marking paint.
 1. Color: As indicated.
- D. Glass Beads: AASHTO M 247, Type 1 made of 100 percent recycled glass.
 1. Roundness: Minimum 75/80 percent true spheres by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.
- B. Allow paving to age for a minimum of 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
 - 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond the stencil. Apply paint so that it cannot run beneath the stencil.

3.3 PROTECTING AND CLEANING

- A. Protect pavement markings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 32 17 23

SECTION 32 31 13 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Chain-link fences.
 - 2. Swing gates.
 - 3. Horizontal gates.
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for cast-in-place concrete.

1.3 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.
 - 1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
 - 2. Review sequence of operation for each type of gate operator.
 - 3. Review coordination of interlocked equipment specified in this Section and elsewhere.
 - 4. Review required testing, inspecting, and certifying procedures.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Fence and gate posts, rails, and fittings.
 - b. Chain-link fabric, reinforcements, and attachments.
 - c. Accessories: Barbed wire.
 - d. Gates and hardware.
 - e. Gate operators, including operating instructions and motor characteristics.
- B. Shop Drawings: For each type of fence and gate assembly.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include accessories, hardware, gate operation, and operational clearances.
3. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
4. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of chain-link fence, operator, and gate.
- B. Product Test Reports: For framework strength according to ASTM F 1043, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gate operators to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing fence grounding; member company of NETA or an NRTL.
 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- B. Emergency Access Requirements: According to requirements of authorities having jurisdiction for gates with automatic gate operators serving as a required means of access.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.9 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Failure to comply with performance requirements.

- b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - c. Faulty operation of gate operators and controls.
- 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Products from qualified manufacturers having a minimum of five years-experience manufacturing galvanized coated chain link fencing will be acceptable by the Engineer as equal, if approved in writing, ten days prior to bidding, and if they meet the following specifications for design, size gauge of metal parts and fabrication.
- B. Obtain chain link fences and gates, including accessories, fittings, and fastenings, from a single source.

2.2 CHAIN-LINK FENCE FABRIC

- A. Galvanized Wire: Zinc coated Wire, ASTM A 392 – 1.2 oz/sf. Wire Spec-A817-83, Class 1.
- B. Size: Helically wound and woven to height as indicated on drawings with 2” diamond mes, 9 gauge, with a wire diameter of 0.148 inch and a breakload of 1,290 lbf.
- C. Selvage of fabric twisted at top and knuckled at bottom.

2.3 STEEL FENCE FRAMING

- A. Steel pipe – Type 1: ASTM F 1083, standard weight schedule 40; minimum yield strength of 30,000 psi (205 MPa); sizes as indicated. Hot-dipped galvanized with minimum average 1.8 oz/ft² (550 g/m²) of coated surface area.
- B. Member Sizes
 - 1. End and Corner Post 2.375” od, 3.65 lbs/ft
 - 2. Line (intermediate) Post 1.9” od, 2.72 lbs/ft
 - 3. Rail and Braces 1.66” od, 2.27 lbs/ft

2.4 ACCESSORIES

- A. Chain link fence accessories: [ASTM F 626] Provide items required to complete fence system. Galvanize each ferrous metal item and finish to match framing.
- B. Post caps: Formed steel or cast malleable iron weather tight closure cap for tubular posts. Provide one cap for each post. Cap to have provision for barbed wire when necessary. “C” shaped line post without top rail or barbed wire supporting arms do not require post caps. (Where top rail is used, provide tops to permit passage of top rail.)

- C. Top rail and rail ends: Pressed steel per ASTM F 626, for connection of rail and brace to terminal posts.
- D. Top rail sleeves: 7" (178 mm) expansion sleeve with a minimum .137" wire diameter and 1.80" length spring, allowing for expansion and contraction of top rail.
- E. Wire ties: 9 gauge, 0.148", galvanized steel wire for attachment of fabric to line posts. Double wrap 13 gauge, 0.092", for rails and braces. Hog ring ties of 12-1/2 gauge, 0.0985", for attachment.
- F. Brace and tension (stretcher bar) bands: Pressed steel, minimum 300 degree profile curvature for secure fence post attachment. At square post provide tension bar clips.
- G. Tension (stretcher) bars: One piece lengths equal to 2 inches (50 mm) less than full height of fabric with a minimum cross-section of 3/16" x 3/4" (4.76 mm x 19 mm). Provide tension (stretcher) bars where chain link fabric meets terminal posts.
- H. Tension wire: Galvanized coated steel wire, 6 gauge, 0.192", and diameter wire with tensile strength of 75,000 psi.
- I. Truss rods & tightener: Steel rods with minimum diameter of 5/16" (7.9 mm). Capable of withstanding a tension of minimum 2,000 lbs.
- J. Barbed wire: (ASTM A 121] Class 3, zinc coated steel wire double-strand, 12-1/2 gauge ,0.099" (2.51 mm)] twisted line with galvanized steel, 4 point barbs spaced approximately 5" (127 mm) on center.
- K. Barbed wire supporting arms: Pressed steel arms with provisions for attaching 3 row or barbed wire. Arms shall withstand 250 lb. (113.5 kg) downward pull at the outermost end of arm without failure.
 - 1. Provide 45° sloped outward, 3 strands, single arm.
 - 2. Provide intermediate arms with hole for passage of top rail.
- L. Nuts and bolts are galvanized.

2.5 SETTING MATERIALS

- A. Concrete: Minimum 28 day compressive strength of 3,500 psi.

2.6 SWING GATES

- A. General: ASTM F 900 for gate posts and single and double swing gate types.
 - 1. Gate Leaf Width: 36 inches or As indicated Insert width.
 - 2. Framework Member Sizes and Strength: Based on gate fabric height as indicated in the details.
- B. Pipe and Tubing:

1. Zinc-Coated Steel: ASTM F 1043 and ASTM F 1083; protective coating and finish to match fence framework.
 2. Gate Posts: Round tubular steel.
 3. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: Welded or assembled with corner fittings.
- D. Extended Gate Posts and Frame Members: Fabricate gate posts and frame end members to extend as indicated above top of chain-link fabric at both ends of gate frame to attach barbed wire assemblies.
- E. Hardware:
1. Hinges: 180-degree swing.
 2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
 3. Lock: Provided by owner
 4. Closer: Manufacturer's standard.

2.7 HORIZONTAL-SLIDE GATES

- A. General: ASTM F 1184 for gate posts and single and double sliding gate types.
1. Classification: Type II Cantilever Slide, Class 1 with external roller assemblies.
 - a. Gate Frame Width and Height: As indicated.
- B. Pipe and Tubing:
1. Zinc-Coated Steel: Protective coating and finish to match fence framework.
 2. Gate Posts: ASTM F 1184. Provide round tubular steel posts.
 3. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: Welded or assembled with corner fittings.
- D. Extended Gate Posts and Frame Members: Extend gate posts and frame end members above top of chain-link fabric at both ends of gate frame as indicated as required to attach barbed wire assemblies.
- E. Overhead Track Assembly: Manufacturer's standard track, with overhead framework supports, bracing, and accessories, engineered to support size, weight, width, operation, and design of gate and roller assemblies.
- F. Hardware:
1. Hangers, Roller Assemblies, and Stops: Fabricated from galvanized steel.
 2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
 3. Lock: Manufacturer's standard internal device.
 4. Padlock and Chain: By Owner.

2.8 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

2.9 GROUNDING MATERIALS

- A. Comply with requirements Division 26 and the grounding details.
- B. Connectors and Grounding Rods: Listed and labeled for complying with UL 467.
 - 1. Connectors for Below-Grade Use: Exothermic welded type.
 - 2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
 - 1. Do not begin installation before final grading is completed unless otherwise permitted by Engineer.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F 567 and more stringent requirements specified.
 - 1. Install fencing on established boundary lines inside property line.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.
 - b. Concealed Concrete: Place top of concrete 2 inches below grade to allow covering with surface material.
 - c. Posts Set into Sleeves in Concrete: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.
 - d. Posts Set into Holes in Concrete: Form or core drill holes not less than 5 inches deep and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.
- D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.
- E. Line Posts: Space line posts uniformly at 10 feet o.c.
- F. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
 - 1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- G. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
 - 1. Extended along top and bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.
 - 2. Extended along top of barbed wire arms or extended posts and top of fence fabric to support barbed wire or tape.
- H. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and

terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

- I. Intermediate and Bottom Rails: Secure to posts with fittings.
- J. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- K. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.
- L. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
 - 1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.
- M. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side.
- N. Barbed Wire: Install barbed wire uniformly spaced, angled toward security side of fence or as indicated on Drawings. Pull wire taut, install securely to extension arms, and secure to end post or terminal arms.
- O. Barbed Tape: Install according to ASTM F 1911. Install barbed tape uniformly in configurations indicated and fasten securely to prevent movement or displacement.

3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 GATE-OPERATOR INSTALLATION

- A. Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.
- B. Excavation: Hand-excavate holes for posts, pedestals, and equipment bases/pads, in firm, undisturbed soil to dimensions and depths and at locations according to gate-operator component manufacturer's written instructions and as indicated.

3.6 GROUNDING AND BONDING

- A. Comply with requirements in the details and as required in Division 26 Electrical.
- B. Fence and Gate Grounding:
 - 1. Ground for fence and fence posts shall be a separate system from ground for gate and gate posts.
 - 2. Install ground rods and connections at maximum intervals of 1500 feet.
 - 3. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 500 feet.
 - 4. Ground fence on each side of gates and other fence openings.
 - a. Bond metal gates to gate posts.
 - b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
- C. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a ground rod located a maximum distance of 150 feet on each side of crossing.
- D. Fences Enclosing Electrical Power Distribution Equipment: Ground according to IEEE C2 unless otherwise indicated.
- E. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
 - 1. Make grounding connections to each barbed wire strand with wire-to-wire connectors designed for this purpose.
 - 2. Make grounding connections to each barbed tape coil with connectors designed for this purpose.
- F. Connections:
 - 1. Make connections with clean, bare metal at points of contact.
 - 2. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 3. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 4. Make above-grade ground connections with mechanical fasteners.
 - 5. Make below-grade ground connections with exothermic welds.
 - 6. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- G. Bonding to Lightning Protection System: Ground fence and bond fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor according to NFPA 780.

3.7 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION 323113

SECTION 32 91 13 - SOIL PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes planting soils and layered soil assemblies specified by composition of the mixes.
- B. Related Requirements:
 - 1. Division 31 - Earthwork
 - 2. Section 32 92 00 "Turf and Grasses" for placing planting soil for turf and grasses.

1.3 DEFINITIONS

- A. AAPFCO: Association of American Plant Food Control Officials.
- B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
- C. CEC: Cation exchange capacity.
- D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
- E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- F. Imported Soil: Soil that is transported to Project site for use.
- G. Layered Soil Assembly: A designed series of planting soils, layered on each other that together produce an environment for plant growth.
- H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.
- I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

- J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."
- K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
- M. SSSA: Soil Science Society of America.
- N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- Q. USCC: U.S. Composting Council.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include recommendations for application and use.
 - 2. Include test data substantiating that products comply with requirements.
 - 3. Include sieve analyses for aggregate materials.
 - 4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:
 - a. Manufacturer's qualified testing agency's certified analysis of standard products.
 - b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
 - c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

1.6 INFORMATIONAL SUBMITTALS

- A. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

- B. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil.
 - 1. Notify Engineer seven days in advance of the dates and times when the contractor requests samples will be taken.
- B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
 - 1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.9 SOIL-SAMPLING REQUIREMENTS

- A. General: Extract soil samples according to requirements in this article.
- B. Sample Collection and Labeling: Have samples taken and labeled by Contractor in presence of Engineer under the direction of the testing agency.
 - 1. Number and Location of Samples: Minimum of three representative soil samples from varied locations for each soil to be used or amended for landscaping purposes.
 - 2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
 - 3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
 - 4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.10 TESTING REQUIREMENTS

- A. General: Perform tests on soil samples according to requirements in this article.
- B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
 - a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
 - b. Hydrometer Method: Report percentages of sand, silt, and clay.
 2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
 3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
 4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D 698 (Standard Proctor).
- C. Chemical Testing:
1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
 2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
- D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAFT SERA-6, including the following:
1. Percentage of organic matter.
 2. CEC, calcium percent of CEC, and magnesium percent of CEC.
 3. Soil reaction (acidity/alkalinity pH value).
 4. Buffered acidity or alkalinity.
 5. Nitrogen ppm.
 6. Phosphorous ppm.
 7. Potassium ppm.
 8. Manganese ppm.
 9. Manganese-availability ppm.
 10. Zinc ppm.
 11. Zinc availability ppm.
 12. Copper ppm.
 13. Sodium ppm.
 14. Soluble-salts ppm.
 15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
 16. Other deleterious materials, including their characteristics and content of each.
- E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

- F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.
 - 1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.
 - 2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Do not move or handle materials when they are wet or frozen.
 - 4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED BY COMPOSITION

- A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.
- B. Planting-Soil Type: Provide offsite topsoil or amend existing, on-site surface soil, with the duff layer, if any, retained; modified to produce viable planting soil. Blend existing, on-site surface soil with the soil amendments and fertilizers required for the topsoil to have the following qualities or provide from offsite as follows:
 - 1. Fertile, friable, naturally occurring. Free of stones, clay, lumps, hardpan, roots, stumps, branches, sticks and other debris larger than one inches in any dimension; free of noxious weeds, grasses, seeds, plants, extraneous matter and any substance harmful to plant growth. Topsoil from open fields will not be accepted.
 - 2. Ph: 5.0 to 7.0
 - 3. Organic Matter: 5% to 10%
 - 4. Sand: 50% to 70%

5. Silt: less than 30%
6. Clay: 10% to 25%
7. Permeability Rate of 5 x 10 ⁻³ centimeters or greater at 85% compaction.
8. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass.
9. Unacceptable Properties: Clean soil of the following:
 - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
 2. Class: O, with a minimum of 95 percent passing through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
 3. Form: Provide lime in form of ground dolomitic limestone or calcitic limestone.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Perlite: Horticultural perlite, soil amendment grade.
- E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.
- F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:
 1. Feedstock: May include sewage sludge.
 2. Reaction: pH of 5.5 to 8.

3. Moisture Content: 35 to 55 percent by weight.
 4. Particle Size: Minimum of 98 percent passing through a 1-inch sieve.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.
- D. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.

- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.
- C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

- A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.
- B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
- C. Unsuitable Materials: Clean soil to contain a maximum of 5 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.
- D. Screening: Pass unamended soil through a 2-inch sieve to remove large materials.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 6. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.
- C. Mixing: Spread unamended soil to total depth of 4 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
 - 1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.
 - a. Mix lime with dry soil before mixing fertilizer.
 - b. Mix fertilizer with planting soil no more than seven days before planting.
 - 2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than in loose depth for material compacted by hand-operated tampers.

- D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place except where a different compaction value is required due to use or as directed by the Engineer.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply approximately half the thickness of planting soil over prepared, loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
- C. Application: Spread planting soil to total depth of 4 inches, but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
 - 1. Lifts: Apply planting soil in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.
- D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place except where a different compaction value is required due to use or as directed by the Engineer.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

- A. Application: Apply compost component of planting-soil mix 4 inches of compost to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698. Space tests at no less than one for each 2000 sq. ft. of in-place soil or part thereof.
- C. Soil will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.7 PROTECTION

- A. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
 1. Storage of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.
 3. Vehicle traffic.
 4. Foot traffic.
 5. Erection of sheds or structures.
 6. Impoundment of water.
 7. Excavation or other digging unless otherwise indicated.
- B. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Engineer and replace contaminated planting soil with new planting soil.

3.8 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
 1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 32 91 13

SECTION 32 92 00 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Seeding.
 - 2. Hydroseeding.
 - 3. Sodding.
 - 4. Erosion-control material(s).
- B. Related Requirements:
 - 1. Section 32 91 13 "Soil Preparation"

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 32 91 13 "Soil Preparation."
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Certification of each seed mixture for grass and seeds. Include identification of source and name and telephone number of supplier.
- C. Product Certificates: For fertilizers, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.
 - 1. Experience: Three years' experience in turf installation in addition to requirements in Section 01 40 00 "Quality Requirements."
 - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 3. Pesticide Applicator: State licensed, commercial.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
- C. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.9 FIELD CONDITIONS

- A. Planting Restrictions: Plant during one of the periods indicated in the seeding and grassing chart or as advised by the turf provider. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species:
 1. Quality: State-certified seed of grass species as listed.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.2 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 1. Organic Matter Content: 50 to 60 percent of dry weight.

2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

2.3 PESTICIDES

- A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.4 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.
- B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.
- C. Erosion-Control Mats: Cellular, nonbiodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of 3-inch nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Invisible Structures, Inc.
 - b. Presto Products Company.
 - c. Tenax Corporation - USA.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel,

- paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
- 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
- 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

- 1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
- 2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 32 91 13 "Soil Preparation."

B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade.

- 1. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Engineer's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Prepare area as specified in "Turf Area Preparation" Article.

B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.

C. Fill cells of erosion-control mat with planting soil and compact before planting.

- D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
 - 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 2. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 3 to 4 lb/1000 sq. ft. or as indicated by the SCDOT guidelines.
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.
- F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
- G. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch planting soil within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

3.6 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, commercial fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
 - 1. Mix slurry with fiber-mulch manufacturer's recommended tackifier.
 - 2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

3.7 SODDING

- A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Engineer prior to delivery time. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - 1. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.8 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - 2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
- C. Owner shall mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.
- D. Turf Postfertilization: Apply commercial fertilizer after initial mowing and when grass is dry.
 - 1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.9 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Engineer:
 - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
 - 2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.10 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.11 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove non-degradable erosion-control measures after grass establishment period.

END OF SECTION 32 92 00

SECTION 40 05 06 - COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe penetrations.
2. Restrained joints.
3. Braided flexible connections.
4. Expansion joints.
5. Expansion loops.
6. Sleeve-type couplings.
7. Wall sleeves.

B. Related Requirements:

1. Section 05 50 00 - Metal Fabrications
2. Section 09 96 00 – High-Performance Coatings
3. Division 40 – Process Interconnections

C. Conform to the requirements of Section 40 05 13 – Common Requirements for Process Piping

1.2 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe.
2. AWWA C227 Bolted, Split-Sleeve Restrained and Nonrestrained Couplings for Plain-End Pipe.

B. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

C. ASME International:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.
2. ASME B31.3 - Process Piping.
3. ASME B31.9 - Building Services Piping.
4. ASME Boiler and Pressure Vessel Code (BPVC), Section IX - Welding, Brazing, and Fusing Qualifications.

D. ASTM International:

1. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.

2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 3. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 4. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
 5. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- E. Expansion Joint Manufacturers Association, Inc.:
1. EJMA Standards.
- F. NSF International:
1. NSF 61 - Drinking Water System Components - Health Effects.
 2. NSF 372 - Drinking Water System Components - Lead Content.
- G. UL:
1. UL 263 - Fire Tests of Building Construction and Materials.
 2. UL 1479 - Fire Tests of Through-Penetration Firestops.
 3. UL 2079 - Tests for Fire Resistance of Building Joint Systems.

PART 2 - PRODUCTS

2.1 PIPE PENETRATIONS

- A. Flashing:
1. Metal Flashing:
 - a. Material: 304 stainless steel.
 - b. Thickness: 26 gage.
 2. Metal Counterflashing:
 - a. Material: 304 stainless steel.
 - b. Thickness: 22 gage.
 3. Flexible Flashing Materials:
 - a. Material: Butyl sheet, PVC sheet, or Compatible with service conditions.
 - b. Thickness: 47 mils.
 4. Caps:
 - a. Material: 304 stainless steel.
 - b. Minimum Thickness: 22 gage, and 16 gage at fire-resistive elements.
- B. Sleeves:

1. Sleeves for Pipes through Non-fire-rated Floors:
 - a. Material: 304 stainless steel.
 - b. Thickness: 0.0625 inch minimum
2. Sealant:
 - a. As specified in Section 07 92 00 - Joint Sealants.

C. Mechanical Sleeve Seals:

1. Manufacturers:
 - a. Flexicraft Industries, PipeSeal
 - b. GPT (Link-Seal)
 - c. Or Approval Equal
2. Description:
 - a. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve.
 - b. Connection: Bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.2 RESTRAINED JOINTS

A. Flange Adapter (Set Screws)

1. Manufacturer:
 - a. EZ Flange Adapter (EBAA Iron, Inc.)
 - b. Uni-Flange, series 400 (OR series 420)
 - c. Ford Meter Box Company, Inc. (Nappco, Inc.)
 - d. Star Pipe Series 400
 - e. Or Approved Equal.
2. Description:
 - a. The uniflange assembly shall be used only in instances shown on the drawings. If the Contractor proposes to use uniflanges at other locations, he shall first obtain approval from the Engineer.
 - b. The uniflange shall consist of a Ductile Iron ASTM A536 Grade 65-45-12 flange with ANSI B16.1 Class 125 & 250 or ANSI B16.5 Class 150 & 300 drillings.
 - c. The standard gasket of Buna S for water and wastewater shall be supplied.
 - d. The uniflange class shall be suitable for the pressure service. (2"-12" = 250 psi, 14"-24" = 150psi, >24" = 100 psi)

B. Flange Adapter-Restrained

1. Manufacturer:

- a. SERIES 2100 MEGAFLANGE adapter, as produced by EBAA Iron, Inc.,
 - b. StarFlange Series 3200
 - c. Or Approved Equal.
2. Description:
- a. Restrained flange adapters may be used in lieu of threaded, or welded, flanged spool pieces. Flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10.
 - b. Restraint for the flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.
 - c. The flange adapter shall be capable of deflection during assembly, or permit lengths of pipe to be field cut, to allow a minimum of 0.6" gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
 - d. Flange Adapters shall be fully restrained and shall incorporate a wedge style grip.
 - e. Allowable working pressures shall have a minimum as follows: 3"-16" = 350 psi, 18"-24" = 250 psi, 30"-48" = 150 psi.

C. Adapter with Wedge Restraints for Mechanical Joint pipe.

1. Manufacturer:
- a. Uni-Flange Series 1400, by Ford Meter Box Company
 - b. StarGrip 3000 by Star Pipe Products
 - c. Megalug Series 1100 by EBBA Iron Sales, Inc.
 - d. Or Approved Equal.
2. Description:
- a. Restraint for standardized mechanical joints shall be incorporated into the design of the follower gland and shall impart multiple points of wedge action against the pipe, increasing its resistance as the pressure increases.
 - b. The restrained joint shall incorporate a wedge style restraint system. Restraints with set screws will not be acceptable.
 - c. The assembled joint shall maintain its flexibility after burial and shall maintain its integrity by a controlled and limited expansion of each joint during the wedging action.
 - d. Restraining glands shall be manufactured of high strength ductile iron conforming to the requirements of ASTM A536, Grade 65-45-12.
 - e. Wedges shall be contoured to properly fit on the pipe, and shall be manufactured of ductile iron, heat treated to a minimum hardness of 370 BHN. Dimensions of the glands shall be such that they can be used with the standardized mechanical joint bell and tee head bolts conforming to the requirements of ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 of latest revision.
 - f. Twist-off heads shall be incorporated in the design of the wedge actuating screws to ensure proper torque.
 - g. The mechanical joint restraining device shall have a water working pressure rating of 250 psi minimum with a safety factor of at least 2:1 against separation when tested in a dead-end situation

- h. Allowable working pressures shall be as follows: 3"-16" = 350 psi, 18"-36" = 250 psi.

2.3 BRAIDED FLEXIBLE CONNECTIONS

A. Manufacturers:

- 1. Flexicraft Industries
- 2. Flex-Weld, Inc.
- 3. Hyspan Precision Products, Inc.
- 4. Or Approved Equal.

B. Steel or Stainless Steel Piping:

- 1. Inner Hose: Corrugated stainless steel as indicated.
- 2. Exterior Sleeve: Braided or stainless steel as indicated.
- 3. Pressure Rating: Minimum 150 psig at 50 °F and sufficient for service condition.
- 4. Fittings: Flanged, unless otherwise noted.
- 5. Size: Use pipe-sized units.
- 6. Maximum Offset: 3/4inch on each side of installed center line.

C. Copper Piping:

- 1. Inner Hose: Corrugated Bronze.
- 2. Exterior Sleeve: Braided bronze.
- 3. Pressure Rating: Minimum 150 psig at 70 °F and sufficient for service condition.
- 4. Fittings: Threaded with union, Soldered, or as specified for pipe joints.
- 5. Size: Use pipe-sized units.
- 6. Maximum Offset: 3/4 inch on each side of installed center line.

2.4 EXPANSION JOINTS

A. Manufacturers:

- 1. Flexicraft Industries
- 2. Flex-Weld, Inc.
- 3. Hyspan Precision Products, Inc.
- 4. Or Approved Equal

B. Performance and Design Criteria:

- 1. Bellow Design: According to Section C of EJMA Standards.

C. Stainless-Steel Compensator Type:

- 1. Pressure Rating: 50 psig WOG at 250 °F for aeration air piping, all others shall be 200 psig WOG at 250 °F.
- 2. Maximum Compression: 1-3/4 inches.
- 3. Maximum Extension: 1/4 inch.

4. Joint: Flanged, unless otherwise noted.
5. Size: Use pipe-sized units.
6. Application: Aeration air piping 4-inch and larger or steel piping 3 inches and smaller.

D. External Ring-Controlled Stainless-Steel Bellows Type:

1. Pressure Rating: 200 psig WOG at 250 °F.
2. Maximum Compression: 1-1/4 inches.
3. Maximum Extension: 3/8 inch.
4. Maximum Offset: 5/16 inch.
5. Joint: Flanged.
6. Size: Use pipe-sized units.
7. Accessories: Internal flow liner.
8. Application: Steel piping 3 inches and larger.

E. Single-Arch Rubber Type:

1. Body: Neoprene with nylon fabric reinforcement.
2. Working Pressure: 150 psig.
3. Maximum Temperature: 200 °F.
4. Maximum Compression: 1 inch.
5. Maximum Elongation: 5/8 inch.
6. Maximum Offset: 1/2 inch.
7. Maximum Angular Movement: 30 degrees.
8. Joint: 304 stainless steel tapped backing rings.
9. Size: Use pipe-sized units.
10. Accessories: Control rods.
11. Application: Steel piping 2 inches and larger.

F. Bronze Compensator Type:

1. Description: Bronze with anti-torque device, limit stops, and internal guides.
2. Pressure Rating: 200 psig WOG at 250 °F.
3. Maximum Compression: 3 inches.
4. Maximum Extension: 1/4 inch.
5. Size: Use pipe-sized units.
6. Application: Copper piping.

2.5 EXPANSION LOOPS

- A. Provide expansion loops as indicated on Shop Drawings.**

2.6 SLEEVE-TYPE COUPLINGS

A. Manufacturers:

1. Dresser Piping Specialties
2. The Macomb Group
3. US Pipe Fabrication

B. Description:

1. Comply with AWWA C219.
2. Middle Ring: Epoxy Coated Steel.
3. Followers: Epoxy Coated Steel.
4. Gaskets:
 - a. Material: Buna-N, EPDM, or Compatible with service conditions.
 - b. Comply with ASTM D2000.
5. Bolts: AWWA C111, Epoxy Coated Steel.

2.7 WALL SLEEVE

A. Manufacturers:

1. Sigma – Omni-Sleeve.
2. American
3. Or Approved Equal.

B. Description:

1. Wall and floor pipe penetrations of ductile iron piping systems shall be made by means of a sleeve capable of being bolted directly to the formwork to prevent misalignment. Seal of annular space shall be by means of a confined rubber gasket, so as not to be affected by vibration and capable of withstanding up to 100 psig. Sleeve shall be manufactured from Ductile Iron with an integrally cast water stop.

2.8 FINISHES

- A. Prepare ferrous metal piping appurtenances for field finishes as specified in Section 09 96 00 – High-Performance Coatings.

2.9 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

1. Provide shop inspection and testing of completed assemblies.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that field dimensions are as indicated on Shop Drawings.
- C. Inspect existing flanges for nonstandard bolthole configurations or design and verify that new pipe and flanges mate properly.
- D. Verify that openings are ready to receive sleeves.
- E. Verify that pipe plain ends to receive sleeve-type couplings or flange adapters are smooth and round for 12 inches from pipe ends.
- F. Verify that pipe outside diameter conforms to sleeve manufacturer's requirements.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Cleaning: Thoroughly clean end connections before installation.
- C. Close pipe and equipment openings with caps or plugs during installation.
- D. Surface Preparation: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

- A. According to ASME B31.3 for process piping and ASME B31.9 for building services piping.
- B. Coating: Finish ferrous metal piping appurtenances as specified in Section 09 96 00 – High-Performance Coatings for service conditions.
- C. Pipe Penetrations:
 - 1. Flashing:
 - a. Provide flexible flashing and metal counterflashing where piping penetrates weatherproofed or waterproofed walls, floors, and roofs.
 - b. Flash floor drains with topping over finished areas with lead, 10 inches clear on sides, with minimum 36-by-36-inch sheet size.
 - c. Fasten flashing to drain clamp device.
 - 2. Sleeves:

- a. Exterior Watertight Entries: Seal with mechanical sleeve seals.
- b. Set sleeves in position in forms and provide reinforcement around sleeves.
- c. Size sleeves large enough to allow for movement due to expansion and contraction and provide for continuous insulation wrapping.
- d. Extend sleeves through floors 1/2 inches above finished floor level and calk sleeves.
- e. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent Work with insulation and calk airtight.
- f. Provide close-fitting metal collar or escutcheon covers at both sides of penetration.
- g. Install stainless-steel escutcheons at finished surfaces.

D. Firestopping:

1. Placement: Place intumescent coating in sufficient coats to achieve rating required.
2. Fire-Rated Surfaces:
 - a. Seal opening at floor, wall, partition, ceiling and roof.
 - b. Install sleeve through opening and extend beyond minimum of 1 inch on both sides of building element.
 - c. Size sleeve, allowing minimum of 1 inch void between sleeve and building element.
 - d. Pack void with backing material.
 - e. Seal ends of sleeve with UL-listed, fire-resistive silicone compound to meet fire rating of structure penetrated.
3. Non-rated Surfaces:
 - a. Seal opening through non-fire-rated floor, wall, partition, ceiling and roof.
 - b. Install sleeve through opening and extend beyond minimum of 1 inch on both sides of building element.
 - c. Size sleeve to allow minimum of 1 inch void between sleeve and building element.
 - d. Install type of firestopping material recommended by manufacturer.
 - e. Occupied Spaces:
 - 1) Install escutcheons, floor plates, or ceiling plates where conduit penetrates non-fire-rated surfaces in occupied spaces.
 - 2) Occupied spaces include rooms with finished ceilings and rooms where penetration occurs below finished ceiling.
 - f. Exterior Wall Openings below Grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place according to manufacturer instructions.
 - g. Interior Partitions:
 - 1) Seal pipe penetrations at where indicated.
 - 2) Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

- E. Flexible Connections: Install flexible couplings at connections to equipment and where indicated on Shop Drawings.

F. Expansion Joints:

1. Install flexible couplings and expansion joints at connections to equipment and where indicated on Drawings.
2. If expansion joint is supplied with internal sleeve, indicate flow direction on outside of joint.

G. Air Release and Vacuum Breakers: Provide vacuum breakers on all tanks and process equipment.

H. Backflow Preventers:

1. Install with nameplate and test cock accessible.
2. Install according to local code requirements.
3. Do not install in vertical position.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. After installation, inspect for proper supports and interferences.
- D. Repair damaged coatings with material equal to original coating.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Keep equipment interior clean as installation progresses.

END OF SECTION 40 05 06

SECTION 40 05 07 - HANGERS AND SUPPORTS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Structural attachments.
4. Pipe guides.
5. Guides
6. Anchors
7. Elbow and Flange Supports

B. Related Requirements:

1. Section 03 30 00 - Cast-in-Place Concrete
2. Division 05 – Metals
3. Section 07 92 00 – Joint Sealants
4. Section 09 96 00 – High-Performance Coatings
5. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.9 - Building Services Piping.

B. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A47 - Standard Specification for Ferritic Malleable Iron Castings.
3. ASTM A576 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
4. ASTM A181 - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code Steel - Reference Manual.

D. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacturer, Selection, Application, and Installation.

1.3 COORDINATION

- A. Section 01 31 00 – Project Management and Coordination
- B. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's catalog data including load capacity.
- C. Shop Drawings: Indicate system layout with location - including critical dimensions, sizes, and pipe hanger and support locations - and detail of trapeze hangers, anchors, and guides.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Welders' Certificate: Submit welders' certification of compliance with ASME Section IX or AWS D1.1, verifying qualification within previous 12 months.
- F. Delegated Design Submittals:
 - 1. Submit signed and sealed Shop Drawings with design calculations and assumptions for load carrying capacity of trapeze, multiple pipe, and riser support hangers.
 - 2. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
 - 3. Submit sizing methods or calculations sealed by a registered professional engineer.
- G. Manufacturers' Instructions: Submit special procedures and assembly of components.
- H. Qualifications Statements:
 - 1. Submit qualifications for manufacturer, fabricator, installer, and licensed professional.
 - 2. Submit manufacturer's approval of installer.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
 - 1. Furnish one set of manufacturer's recommended spare parts.

1.6 QUALITY ASSURANCE

- A. Perform Work according to applicable authority and/or AWS D1.1 for welding hanger and support attachments to building structure.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum five (5) years' documented experience.
- B. Fabricator: Company specializing in fabricating products specified in this Section with minimum five (5) years' documented experience.
- C. Installer: Company specializing in performing Work of this Section with minimum five (5) years' documented experience and approved by manufacturer.
- D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State in which the project is located.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on-Site in original factory packaging, labeled with manufacturer's identification.
- C. Protect products from weather and construction traffic, dirt, water, chemical, and damage by storing in original packaging.

1.9 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls
- B. Provide ventilation in areas receiving solvent-cured materials.

1.10 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Description:

1. Horizontal Piping Hangers and Supports

- a. General: Except as otherwise indicated, provide factory-fabricated horizontal piping hangers and supports of MSS type and size indicated, bolts (if any) and washers; comply with MSS SP-58 and manufacturer's published product information. Where MSS type or size is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with MSS SP-69 and manufacturer's published product information; size hangers and supports properly for piping including insulation (if any). Provide copper-plated hangers and supports for uninsulated copper-piping systems. Provide 304 stainless steel supports and hangers for stainless steel piping systems.

2. Vertical Piping Clamps

- a. General: Except as otherwise indicated, provide factory-fabricated vertical piping clamps of MSS type and size indicated; comply with MSS SP-58 and manufacturer's published product information. Where MSS type or size is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with MSS SP-69 and manufacturer's published product information. Size clamps properly for piping, including insulation (if any). Provide copper-plated clamps for copper-piping systems. Provide 304 stainless steel supports and hangers for stainless steel piping systems.

3. Hanger Rod Attachments

- a. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments of MSS type and size indicated; comply with MSS SP-58 and manufacturer's published product information. Where MSS type or size is not indicated, provide proper selection determined by Installer for installation requirements, and comply with MSS SP-69 and manufacturer's published product information. Size attachments properly for piping, including insulation (if any). Provide copper-plated hanger-rod attachments for uninsulated copper-piping systems. Provide 304 stainless steel supports and hangers for stainless steel piping systems.

4. Structural Attachments

- a. General: Except as otherwise indicated, provide factory-fabricated building attachments of MSS type and load-rating indicated; comply with MSS SP-58 and manufacturer's published product information. Where MSS type or load-rating is not indicated, provide proper selection determined by Installer for installation requirements, and comply with MSS SP-69 and manufacturer's published product information. Size units properly for the piping loading.

B. Performance and Design Criteria:

1. General:

- a. Design, size and locate piping support systems throughout facility, whether shown or not.
 - b. Piping smaller than 30 inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required.
 - c. Piping 30 inches and Larger: Supports for large diameter piping shall be specifically designed by pipe support Manufacturer and shown on the drawings.
 - d. Meet requirements of MSS SP 58 and ASME B31.1 or as modified by this Section.
2. Pipe Support Systems
- a. Design pipe support systems for gravity and thrust loads imposed by weight of pipes or internal pressures, including insulation and weight of fluid in pipes.
 - b. Maximum Support Spacing and Minimum Rod Size: In accordance MSS SP 58 Table 3 and Table 4.
3. Anchoring Devices: Design, size and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.
4. Vertical Sway Bracing: 10-foot maximum centers or as shown.
5. Existing Support Systems: Use existing supports systems to support new piping only if Contractor can show they are adequate for additional load, or if they are strengthened to support additional load. Allow for expansion and contraction of piping while eliminating undue stress on piping appurtenances and equipment.
6. Provide linkage to permit lateral or axial movement where anticipated.
7. Where horizontal pipe movement is greater than ½ inch, or where hanger rod deflection from the vertical is greater than 4 degrees from cold to hot position of pipe, hanger rod and structural attachment shall be offset to maintain rod vertical in hot position.
8. Heat Transmission: Design supports, hangers, anchors, and guides to prevent excessive heat from being transmitted to building structure, equipment, or piping appurtenances.
9. Riser Supports: Support risers on each floor with riser clamps and lugs, independent of connected horizontal piping.
10. Point Loads:
- a. Support plastic piping containing meters, valves, appurtenances, and other point loads on both sides.
 - b. Avoid point loads on plastic piping by providing extra wide pipe saddles or galvanized steel shields.

2.2 HANGERS

A. Clevis: MSS SP 58, Type 1

1. Shall be used for the suspension of non-insulated pipe or insulated with B3151 shield or Anvil ISS
 - a. Shall be used for the suspension of non-insulated pipe or insulated with B3151 shield or Anvil ISS
 - 1) B-Line; Figure B3100, 1/2 inch to 30 inches
 - 2) Anvil: Figure 260 for steel pipe and Figure 590, 1/2 inch to 30 inches
 - 3) Insulated Steel Pipe; B-Line; Figure B3100 with B3151 shield, ½ inch through 16 inches
 - 4) Insulated Steel Pipe; Anvil; Figure 260 with insulated saddle system (ISS), ½ inch through 12 inches

- 5) Or Approved Equal
- b. Adjustable Swivel Split-Ring Pipe Clamp: MSS SP 58, Type 6
 - 1) Shall be used for suspension of non-insulated stationary pipe
 - a) B-Line; Figure B3171, : ¾ inch through 8 inches
 - b) Anvil; Figure 104, : ¾ inch through 8 inches
 - c) Or Approved Equal
- c. Steel Yoke Pipe Rolls and Roller Supports: MSS SP 58, Type 41 or Type 43
 - 1) Shall be used to support pipe where movement may occur due to thermal expansion
 - a) B-Line; Figure B3110 for sizes 2 inches through 24 inches and Figure B3114 for 30 inches.
 - b) Anvil; Figure 181 for sizes 2-1/2 inches through 24 inches and Figure 171 for sizes 1 inch through 30 inches
 - c) Or Approved Equal
- d. Pipe Rollers and Supports: MSS SP 58, Type 44
 - 1) Shall be used to support pipe where movement may occur due to thermal expansion when ceiling suspension is impractical
 - a) B-Line; Figure B3120, sizes 2 inches through 24 inches
 - b) Anvil; Figure 175, sizes 2 inches through 30 inches
 - c) Or Approved Equal

2.2 HANGER RODS

A. Hanger Rods:

- 1. ASTM A576, steel.
- 2. Threaded both ends or Threaded one end or All-thread.
- 3. Diameter: ASME B31.1; as indicated on Drawings.

2.3 STRUCTURAL ATTACHMENTS

A. Welded Steel Wall Bracket: MSS SP 58, Type 33 (heavy duty)

- 1. Anvil; Figure 199, 3,000-pound rating.
- 2. B-Line; Figure B3067, 3,000-pound rating.
- 3. Or Approved Equal

B. Adjustable “J” hanger MSS SP 58, Type 5:

- 1. Anvil; Figure 67, sizes ½ inch through 8 inches.
- 2. B-Line; Figure B3690, sizes ½ inch through 8 inches.
- 3. Or Approved Equal

C. Channel Type:

1. General Use
 - a. Unistrut
 - b. Anvil: Power Strut
 - c. B-Line; Strut System
 - d. Or Approved Equal

2.4 PIPE SADDLES

- A. Provide 90-degree to 120-degree pipe saddle for pipe 6 inches and larger with baseplates drilled for anchors bolts.
 1. Sizes 20 inches through 60 inches, Piping Technology & Products, Inc.; Figure 2000.
 2. Or Approved Equal
- B. Saddle Supports, Pedestal Type
 1. Minimum standard weight pipe stanchion, saddle, and anchoring flange.
 2. Nonadjustable Saddle: MSS SP, Type 37 with U-bolt
 - a. B-Line; Figure B3090, sizes 3/4 inch through 36 inches with B3088S base
 - b. Anvil: Figure 259; sizes 4 inch through 36 inches with Figure 63C base
 - c. Or Approved Equal
 3. Adjustable Saddle: MSS SP 58, Type 38 without clamp
 - a. B-Line; Figure B3093, sizes 1 inch through 36 inches with Figure B3088S base.
 - b. Anvil: Figure 264, sizes 2-1/2 inch through 36 inches with Figure 62C base.
 - c. Or Approved Equal

2.5 CHANNEL TYPE SUPPORT SYSTEMS

- A. Channel Size: 12-gauge, 1-5/8-inch wide minimum steel, or 1-1/2-inch wide, minimum FRP.
- B. Members and Connections: Design for loads using one-half of manufacturer's allowable loads.
- C. Fasteners: Vinyl ester fiber, polyurethane base composite nuts and bolts, or encapsulated steel fasteners.
- D. Manufacturers and Products:
 1. General Use
 - a. B-Line; Strut System.
 - b. Unistrut
 - c. Anvil; Power-Strut.
 - d. Or Approved Equal

2.6 CLAMPS AND BEAM ATTACHMENTS

- A. Beam Clamps:

1. Shall be used for suspending hanger rod from flanged beam and shall distribute the load equally on both sides of the beam.
2. MSS SP-58 Type 21, Type 28, Type 30
3. ASTM A36, steel or ASTM A181, forged steel.
4. Clamp Size: Based on load to be supported and load configuration.
5. Anchoring: Locknuts and cup-point set screws.
6. Reversible top or bottom flange.
7. Manufacturers:
 - a. B-Line;
 - b. Anvil;
 - c. Or Approved Equal

B. Offset Clamps:

1. Shall be used to support pipe offset from the floor or wall.
2. Double leg, two-piece.
 - a. B-Line; B3148; sizes ¾ inch through 12 inches
 - b. Anvil; Figure 103; sizes ¾ inch through 8 inches
 - c. Or Approved Equal

C. Welded Beam Attachment: MSS SP 58, Type 22

1. B-Line; Figure B3083, sizes 3/8"-16 through 2"-4 ½ rod
2. Anvil: Figure 66, sizes 3/8 inch through 3-1/2 inch

2.7 ELBOW AND FLANGE SUPPORTS

- A. Elbow and Adjustable Stanchion: Sizes 2 inches through 18 inches, Anvil; Figure 62C base or approved equal
- B. Elbow with Nonadjustable Stanchion: Sizes 2-1/2 inches through 42 inches, Anvil; Figure 63A or 63B base or approved equal.
- C. Flange Support with Adjustable Base: Sizes 2 inches through 24 inches, Standon; Model S89 or approved equal.

2.8 PIPE GUIDES

A. Intermediate Guides:

1. Type: Hold down pipe guide
 - a. Shall prevent longitudinal or lateral movement of pipe
 - 1) B-Line; Figure B3256 sizes 2 inch through 30 inches
 - 2) Or Approved Equal
2. Type: U-bolts with 4 hex nuts to provide nominal 1/8 inch to ¼ inch clearance around pipe; MSS SP 58 Type 24

- a. Shall be used for support, anchor, or guide of pipe
 - 1) B-Line; Figure B3188 and Figure B3188NS, sizes ½ inch through 30 inches
 - 2) Anvil; Figure 137 and Figure 137S, sizes ½ inch through 36 inches
 - 3) Or Approved Equal

B. Alignment Guides:

- 1. Type: Spider
 - a. Shall direct thermal expansion of insulated or non-insulated pipe in direction permitted by expansion joints or loops
 - b. Two or more guides shall be used on both sides of expansion joint or loop
 - 1) B-Line; Figure B3281 through B 3287, sizes 1-1/2 inch through 24 inches
 - 2) Anvil; Figure 255, sizes ½ inch through 24 inches
 - 3) Or Approved Equal

2.9 PIPE ANCHORS

A. Type: Anchor chair with U-bolt strap

- 1. Shall be used to anchor pipe to structure
 - a. B-Line; Figure 3147A and 3147B, sizes ½ inch through 24 inches
 - b. Or Approved Equal

2.10 ACCESSORIES

A. Anchor Bolts:

- 1. Size and Material: ½-inch minimum diameter, and as specified in Section 0 55 00, Metal Fabrications.
- 2. Bolt Length (Extension Above Top of Nut):
 - a. Minimum Length: Flush with top of nut preferred. If not flush, shall be no more than one thread recessed below top of nut.
 - b. Maximum Length: No more than a full nut depth above top of nut.

B. Dielectric Barriers:

- 1. Plastic coated hangers, isolation cushion, or tape.
- 2. Manufacturer:
 - a. B-Line; B1999 Vibra Cushion.
 - b. B-Line; Iso Pipe, Isolation Tape.
 - c. Or Approved Equal

C. Insulation Shields:

- 1. Type: Galvanized steel or stainless steel, MSS SP 58, Type 40.
- 2. Manufacturers:

- a. B-Line; Figure B3151, sizes ½ inch through 24 inch.
 - b. Anvil; Figure 167, sizes ½ inch through 24 inches.
 - c. Or Approved Equal
- D. Welding Insulation Saddles:
 - 1. Type: MSS SP 58, Type 39.
 - 2. Manufacturers:
 - a. B-Line; Figure Series B3160, sizes ½ inch through 24 inches.
 - b. Anvil; Figure Series 160, sizes 1 inch through 36 inches.
 - c. Or Approved Equal
- E. Plastic Pipe Support Channel:
 - 1. Type: Continuous support for plastic pipe and to increase support spacing
 - 2. Manufacturer:
 - a. B-Line; Figure Series B3106V, sizes ½ inch through 6 inches with Figure B3106 Vee bottom hanger.
 - b. Or Approved Equal
- F. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.
- G. Attachments:
 - 1. Concrete Insert: MSS SP 58, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.
 - 2. Concrete Attachment Plates:
 - a. B-Line; Figure B3084, Figure B3085, or Figure B3086 with B3201 to attach center lug.
 - b. Anvil: Figure 47, Figure 49, or Figure 52.
 - c. Or Approved Equal

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 31 00 – Project Management and Coordination.
- B. Verify field dimensions as indicated on Drawings.

3.2 INSTALLATION

- A. Obtain permission from Engineer before using powder-actuated anchors.
- B. Obtain permission from Engineer before drilling or cutting structural members.
- C. Inserts:

1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 in and larger.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of or recessed into and grouted flush with slab.

D. Pipe Hangers and Supports:

1. Install according to: MSS SP 58.
2. Support horizontal piping as indicated on Drawings.
3. Install hangers with minimum 1/2 in space between finished covering and adjacent Work.
4. Place hangers within 12 in of each horizontal elbow.
5. Use hangers with 1-1/2 in minimum vertical adjustment.
6. Support horizontal cast iron pipe adjacent to each hub, with 5 ft maximum spacing between hangers.
7. Support vertical piping at every other floor. Support vertical cast iron pipe at each floor at hub.
8. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
9. Support riser piping independently of connected horizontal piping.
10. Provide copper-plated hangers and supports for copper piping or sheet lead packing between hanger or support and piping.
11. Design hangers for pipe movement without disengagement of supported pipe.
12. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
13. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
14. Support no pipe from pipe above it.
15. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
16. Provide welded steel brackets where piping is to be run adjacent to building walls or columns.
17. Do not use adhesive anchors for attachment of supports to ceiling or walls.
18. Use beam clamps where piping is to be suspended from building steel.
19. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
20. Install lateral supports for seismic loads at changes in direction.
21. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
22. Insulated Piping: Provide two bolted clamps designed to accommodate insulated piping.
23. Use offset clamps where pipes are indicated as offset from wall surfaces.
24. Repair mounting surfaces to original condition after attachments are completed.

E. Insulation:

1. Provide clearance in hangers and from structure and other equipment for installation of insulation.

2. Conform to 40 42 13 - Process Piping Insulation.

F. Equipment Bases and Supports:

1. Provide housekeeping pads as detailed on Drawings.
2. Using templates furnished with equipment, install anchor bolts and accessories for mounting and anchoring equipment.
3. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.
4. Provide rigid anchors for pipes after vibration isolation components are installed. Comply with

G. Prime Coat:

1. Prime coat exposed steel hangers and supports.
2. Conform to Section 09 96 00 – High-Performance Coatings.
3. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.3 ATTACHMENTS

A. Standard Pipe Supports

1. Horizontal Suspended Piping:
 - a. Single Pipes: Clevis hangers or adjustable swivel split-ring.
 - b. Grouped Pipes: Trapeze hanger system.
 - c. Suspended piping shall only be supported by hanger systems if the vertical distance between piping and floor is larger than 4 ft or it is not feasible to support piping from floor. Alternative application of hangers and supports shall be considered by Engineer with submittal and request.
2. Horizontal Piping Supported from Walls:
 - a. Single Pipes: Wall brackets, or attached to wall, or to wall mounted framing with anchors.
 - b. Stacked Piping: Wall mounted framing system and “J” hangers acceptable for pipe smaller than 3-inch.
 - c. Pipe clamp that resists axial movement of pipe through support is not acceptable. Use pipe rollers supported from wall bracket.
3. Horizontal Piping Supported from Floors/Roof:
 - a. Supports from floor shall be used for piping 4 ft or less above floor only. Exceptions shall be allowed if it is infeasible to install pipe support from floor.
 - b. Saddle Supports:
 - 1) Pedestal type, elbow and flange.
 - 2) Provide minimum 1-1/2-inch grout beneath baseplate.
 - c. Stanchion:
 - 1) Baseplate and stanchion shall be manufactured from steel.
 - 2) Stanchion shall be shop welded to baseplate.

- 3) Stanchion size shall be selected based on pipe diameter and in accordance with the table below.

Pipe or Elbow Size (in)	Stanchion Size (in)													
	1 1/2	2	2 1/2	3	4	5	6	8	10	12	14	16	20	24
2 1/2	X	X												
3	X	X	X											
4	X	X	X	X										
6			X	X	X	X								
8				X	X	X	X							
10					X	X	X	X						
12						X	X	X	X					
14							X	X	X	X	X			
16							X	X	X	X	X	X		
18								X	X	X	X	X	X	
20									X	X	X	X	X	
24									X	X	X	X	X	X
30											X	X	X	X
36											X	X	X	X
42												X	X	X

- 4) Baseplate shall be sized based on stanchion size and in accordance with the table below.

Stanchion Size (in)	Baseplate (in)
1 1/2	3/8 x 6 x 6
2	
2 1/2	3/8 x 8 x 8
3	
4	
5	3/8 x 10 x 10
6	
8	3/8 x 14 x 14
10	1/2 x 18 x 18
12	
14	1/2 x 20 x 20
16	1/2 x 22 x 22
20	1/2 x 24 x 24
24	1/2 x 30 x 30

- d. Floor Mounted Channel Supports:

- Use for pipe smaller than 3-inch running along floors and in trenches at pipe elevations lower than can be accommodated using pedestal pipe supports.
- Attach channel framing to floors with baseplate on minimum 1-1/2-inch non-shrink grout and with anchor bolts.

- 3) Attach pipe to channel with clips or pipe clamps.
 - e. Concrete Cradles: Use for pipe larger than 3 inches along floor and in trenches at pipe elevations lower than can be accommodated using stanchion type.
 4. Vertical Pipe: Support with wall bracket and elbow support, or riser clamp on floor penetration
- B. Standard Attachments:
1. New Concrete Ceilings: Concrete inserts, concrete attachment plates, or concrete anchors as limited below:
 - a. Single point attachment to ceiling allowed for only $\frac{3}{4}$ -inch rod and smaller (8 inches and smaller pipe).
 - b. Where there is vibration or bending considerations, do not connect a single pipe support hanger rod directly to a drilled concrete anchor (single point attachment) regardless of size.
 2. Existing Concrete Ceilings: Channel type support with minimum of two anchor points, concrete attachment plates or concrete anchors as limited below:
 - a. Single point attachment to ceiling is allowed only for $\frac{3}{4}$ -inch rod and smaller (8 inches and smaller pipe).
 - b. Where there is a vibration or bending considerations do not connect a single pipe support hanger rod directly to a drilled concrete anchor (single point attachment) regardless of size.
- 1) These lines include air operated diagram pumps and other lines.
 - c. Steel Beams: I-beam clamp or welded attachments.
 - d. Wooden Beams: Lag screws and angel clips to members not less than 2-1/2 inches thick
 - e. Concrete Walls: Concrete inserts or brackets or clip angles with concrete anchors.
 - f. Concrete Beams: Concrete inserts, or if inserts are not used attach to vertical surface similar to concrete wall. Do not drill into beam bottom.
- C. Saddles for Steel or Concrete Pipe: Provide 90-degree to 120-degree pipe saddle for pipe sizes 6 inches and larger when installed on top of steel or concrete beam or structure, pipe rack, trapeze, or where similar concentrated point supports would be encountered.
- D. Intermediate and Pipe Alignment Guides:
1. Provide pipe alignment guides, or pipe supports that provide same function, at expansion joints and loops.
 2. Guide pipe on each side of expansion joint or loop at 4 pipe and 14 pipe diameters from each joint or loop.
 3. Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.
- E. Accessories:
1. Insulation Shield: Install on insulated piping with oversize rollers and supports.
 2. Welding Insulation Saddle: Install on insulated steel pipe with oversize rollers and supports.

3. Dielectric Barrier:
 - a. Provide between painted and galvanized carbon steel members and copper or stainless-steel pipe or between stainless steel supports and nonstainless steel ferrous metal piping.
 - b. Install rubber wrap between submerged metal pipe and oversized clamps.
- F. Pipe Hanger Spacing:
 1. Pipe Material: Ductile Iron Pipe
 - a. Size: 8 Inches and Under
 - b. Maximum Hanger Spacing: Maximum span limited to that for standard weight steel pipe for water service.
 - 1) MSS SP 58 Table 3
 - c. Hanger Rod Diameter: MSS SP 58 Table 4
 2. Pipe Material: Ductile Iron Pipe
 - a. Size: 10 Inches and Larger
 - b. Maximum Hanger Spacing: Maximum span limited to 20 feet.
 - 1) MSS SP 58 Table 3
 - c. Hanger Rod Diameter: MSS SP 58 Table 4
 3. Pipe Material: ABS.
 - a. Maximum Hanger Spacing: 4 feet.
 - b. Hanger Rod Diameter: 3/8 inch.
 4. Pipe Material: Aluminum.
 - a. Maximum Hanger Spacing: 10 feet.
 - b. Hanger Rod Diameter: 1/2 inch.
 5. Pipe Material: Cast iron.
 - a. Maximum Hanger Spacing: 5 feet.
 - b. Hanger Rod Diameter: 5/8 inch.
 6. Pipe Material: Cast Iron, with 10-foot length of pipe.
 - a. Maximum Hanger Spacing: 10 feet.
 - b. Hanger Rod Diameter: 5/8 inch.
 7. Pipe Material: CPVC.
 - a. Size: 1 inch and smaller.
 - b. Maximum Hanger Spacing: 3 feet.
 - c. Hanger Rod Diameter: 1/2 inch.
 8. Pipe Material: CPVC.
 - a. Size: 1-1/4 inches and larger.
 - b. Maximum Hanger Spacing: 4 feet.
 - c. Hanger Rod Diameter: 1/2 inch.
 9. Pipe Material: Copper tube.

- a. Size: 1-1/4 inches and smaller.
 - b. Maximum Hanger Spacing: 6 feet.
 - c. Hanger Rod Diameter: 1/2 inch.
10. Pipe Material: Copper tube.
- a. Size: 1-1/2 inches and larger.
 - b. Maximum Hanger Spacing: 10 feet.
 - c. Hanger Rod Diameter: 1/2 inch.
11. Pipe Material: Fiberglass:
- a. Maximum Hanger Spacing: 4 feet.
 - b. Hanger Rod Diameter: 1/2 inch.
12. Pipe Material: Polybutylene.
- a. Maximum Hanger Spacing: 2.7 feet.
 - b. Hanger Rod Diameter: 3/8 inch.
13. Pipe Material: Polypropylene.
- a. Maximum Hanger Spacing: 4 feet.
 - b. Hanger Rod Diameter: 3/8 inch.
14. Pipe Material: PVC.
- a. Maximum Hanger Spacing: 4 feet.
 - b. Hanger Rod Diameter: 3/8 inch.
15. Pipe Material: Steel or Stainless Steel.
- a. Size: 3 inches and smaller.
 - b. Maximum Hanger Spacing: 12 feet.
 - c. Hanger Rod Diameter: 1/2 inch.
16. Pipe Material: Steel or Stainless Steel.
- a. Size: 4 inches and larger.
 - b. Maximum Hanger Spacing: 12 feet.
 - c. Hanger Rod Diameter: 5/8 inch.

END OF SECTION 40 05 07

SECTION 40 05 13 - COMMON REQUIREMENTS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Requirements common to pipe and tube of all material types used on the Project.
2. Accessories.

B. Related Requirements:

1. Section 09 96 00 – High-Performance Coatings
2. Division 31 – Earthwork.
3. Division 40 – Process Interconnections

1.2 COORDINATION

A. Section 01 31 00 – Project Management and Coordination.

B. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer's catalog information on pipe materials and fittings.

C. Shop Drawings: Indicate layout of piping systems, including equipment, fittings, critical dimensions, sizes, and material lists.

D. Submit manufacturer's certification and certified test reports that the pipe and linings and coatings were manufactured and tested in accordance with the ASTM and ANSI/AWWA Standards specified. Submittal shall be at least 7 days prior to each shipment of pipe.

E. Material Certificates

F. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for pipe sizing methods and calculations used.

G. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, invert and centerline elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

- A. Perform Work according to all applicable Federal, State and Local standards and these specifications.
- B. Permanently mark each length of pipe with manufacturer's name or trademark and indicate conformance to standards.
- C. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

1.6 QUALIFICATIONS

- A. Manufacturer: For each pipe material type, a company specializing in manufacturing products of the material shall be used. The manufacturer shall have successfully manufactured and delivered products of the diameters used in this project for a minimum of 15 projects over the past 5 years.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver materials in manufacturer's packaging; include handling instructions.
- C. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe or coatings. Under no circumstances shall the pipe be dropped or skidded against each other. Slings, hooks, or pipe tongs shall be padded and used in a manner as to prevent damage to the exterior surface or internal coating or lining of the pipe. If any part of the coating or lining is damaged, the repair shall be made by the Contractor.
- D. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- E. Store piping and appurtenances according to manufacturer instructions.
- F. Protect piping and appurtenances from oxidation by storing off ground.

- G. Stored pipe shall be kept safe from damage and away from traveled ways. The interior of all pipe, fittings and other appurtenances shall be kept free from water, dirt, or foreign matter at all times.

1.8 EXISTING CONDITIONS

A. Field Measurements:

- 1. Verify field measurements prior to fabrication.
- 2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 ACCESSORIES

- 1. Couplings, Adapters, Specials for Process Piping: As specified in Section 40 05 06 - Couplings, Adapters, Specials for Process Piping.
- 2. Hangers and Supports for Process Piping: As specified in Section 40 05 07 - Hangers and Supports for Process Piping.
- 3. Process Piping Insulation: As specified in Section 40 42 13 - Process Piping Insulation.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. All pipe and fittings to be installed under this Contract shall be of new manufacture.
- C. The manufacturer is responsible for the performance of all inspection requirements as specified.
- D. Owner Inspection:
 - 1. The manufacturer is responsible for performance of all inspection requirements as specified. All pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with these Specifications by the Owner, by an independent testing laboratory selected by the Owner, or by other representative of the Owner.
- E. Certificate of Compliance:
 - 1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 - 2. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that field dimensions are as indicated on the Drawings.
- C. Inspect existing flanges for nonstandard bolt hole configurations or design, and verify that new pipe and flange mate properly.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Ream ends of threaded pipes and file smooth.
- C. Cleaning: Thoroughly clean pipe and fittings before installation.
- D. Surface Preparation:
 - 1. Touch up shop-primed surfaces with primer as specified in Section 09 96 00 - High-Performance Coatings.
 - 2. Solvent-clean surfaces that are not shop primed.
 - 3. Clean surfaces of metallic pipe to remove loose rust, mill scale, and other foreign substances by power wire brushing or commercial sand blasting; SSPC SP 6/NACE No. 3. Do not sand blast or power wire brush thermoplastic pipe.
 - 4. Prime surface as specified in Section 09 96 00 – High-Performance Coating.

3.3 INSTALLATION

- A. Buried Service: Install pipe as specified in the Section appropriate to the pipe material.
- B. Exposed Service - Install according to ASME B31.3.
- C. Provide required upstream and downstream clearances from devices as indicated.
- D. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.
- E. Support piping as specified in Section 40 05 07 - Hangers and Supports for Process Piping.
- F. Provide expansion joints as specified in Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping and pipe guides as specified in Section 40 05 07 - Hangers and Supports for Process Piping to compensate for pipe expansion due to temperature differences.
- G. Dielectric Fittings: Provide between dissimilar metals.

- H. Field Cuts: According to pipe manufacturer's recommendations.
- I. Finish primed surfaces according to Section 09 96 00 – High-Performance Coating.
- J. Run pipelines straight and true, parallel to building lines with a minimum use of offsets and couplings. Provide only such offsets as may be required to provide necessary headroom or clearance and to provide necessary flexibility in pipe lines.
- K. Changes in direction of pipelines shall be made only with fittings or pipe bends. Changes in size shall be made only with fittings. Miter fittings, face or flush bushings, or street elbows shall not be used. All fittings shall be of the long radius type, unless otherwise shown on the drawings or specified.
- L. Provide flanges or unions at all final connections to equipment, traps and valves to facilitate dismantling. Arrange piping and piping connections so that equipment being served may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.
- M. Use full and double lengths of pipe wherever possible.
- N. Unless otherwise indicated, install all supply piping, including shut off valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at inlet to control valve or pump. Install supply piping from outlet of control valve at full size to connection of equipment served.
- O. All pipe shall be cut to exact measurement and installed without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings. Particular care shall be taken to avoid creating, even temporarily, undue loads, forces or strains on valves, equipment, or building elements with piping connections or piping supports.

3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Laying Tolerances: Unless otherwise specified, laying tolerances will be within 5/8”.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Inspection:
 - 1. Inspect for damage to pipe lining or coating and for other defects that may be detrimental as determined by Architect/Engineer.
 - 2. Repair damaged piping or provide new, undamaged pipe.
 - 3. After installation, inspect for proper supports and interferences.

D. Damage:

1. Inspect for damage to pipe lining or coating, or other defects that may be detrimental as determined by Engineer.
2. Repair damaged piping or provide new undamaged pipe.

E. Pressure Testing:

1. Unless otherwise specified or indicated on the drawings, all pipe shall be pressure tested prior to acceptance.
2. Conduct pressure testing in according to AWWA C600 and following:
 - a. Test Pressure: Not less than 200 psig or 50 psi in excess of maximum static pressure, whichever is greater.
 - b. Conduct hydrostatic test for at least two hours.
 - c. Slowly fill with water section to be tested; expel air from piping at high points. Install corporation cocks at high points. Close air vents and corporation cocks after air is expelled. Raise pressure to specified test pressure.
 - d. Observe joints, fittings, and valves under test. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage. Retest.
 - e. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate. Maintain pressure within plus or minus 5 psi of test pressure. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
 - f. Compute maximum allowable leakage by following formula:
 - 1) $L = SD \times \sqrt{P}/C$.
 - 2) L = testing allowance, in gph.
 - 3) S = length of pipe tested, in feet.
 - 4) D = nominal diameter of pipe, in inches.
 - 5) P = average test pressure during hydrostatic test, in psig.
 - 6) C = 148,000.
 - 7) When pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.
 - g. When test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.
 - h. Correct visible leaks regardless of quantity of leakage.

F. After installation, inspect for proper supports and interferences.

3.6 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Keep pipe interior clean as installation progresses.
- C. All piping shall be cleaned, flushed, and tested prior to use.
- D. All water lines shall be flushed out under full treated water pressure; potable water piping shall be flushed with potable water; air piping shall be thoroughly blown out with air. All filters, control valves and gages shall be removed from lines or bypassed during the blowout period.

- E. Following the blow through, all dirt legs and other low points in lines shall be disassembled and all residual material thoroughly removed. All stop valves shall be removed and cleaned.
- F. The Contractor shall provide all water required for cleaning, and flushing at no additional cost to the Owner.

END OF SECTION 40 05 13

SECTION 40 05 19 - DUCTILE IRON PROCESS PIPE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ductile-iron pipe and fittings.
 - 2. Accessories.
- B. Conform to the requirements of Section 40 05 13 – Common Requirements for Process Piping
- C. Related Requirements:
 - 1. Section 09 96 00 – High-Performance Coating
 - 2. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

- A. American Water Works Association:
 - 1. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - 2. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - 3. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings.
 - 4. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 5. AWWA C150/A21.50 - Thickness Design of Ductile-Iron Pipe.
 - 6. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast.
 - 7. AWWA C153/A21.53 - Ductile-Iron Compact Fittings.
 - 8. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
- B. ASME International:
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. ASME B31.3 - Process Piping.
- C. ASTM International:
 - 1. ASTM A48 - Standard Specification for Gray Iron Castings.
- D. SSPC - The Society for Protective Coatings:
 - 1. SSPC SP 6/NACE No. 3 - Commercial Blast Cleaning.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Manufacturers:

1. US Pipe.
2. American.
3. Or Approved Equal.

B. Piping:

1. Comply with AWWA C151.
2. Diameter and Class: As indicated below:

Pipe Size (in)	Pressure Class
12" and Smaller	350
14" – 24"	250
30" and Larger	150

C. Joints:

1. Pressure Rating: Same as that of connected piping.
2. Mechanical:
 - a. Comply with AWWA C110 and AWWA C111.
 - b. Glands: Ductile iron with asphaltic coating.
 - c. Use Tee-head or non-hex head bolts and head nuts for joint makeup and gasket seating. Bolts & Nuts shall be carbon steel coated with corrosion inhibiting fluoropolymer composite material.
 - d. Mechanical joint fittings shall be furnished with sufficient quantities of accessories as required for each joint.
 - e. All mechanical joints shall be restrained.
3. Push On: Comply with AWWA C111.
4. Flanged: Comply with AWWA C115 with gaskets and bolts conforming to AWWA C115, Appendix A.
5. Gaskets for mechanical and push-on type joints shall conform to ANSI A21.11 and AWWA C111, Gaskets shall be SBR, neoprene, or EPDM.
6. Gaskets for flange joints shall conform to ANSI A21.15 and AWWA C115. Gaskets shall be neoprene or EPDM.
7. Gaskets for air piping shall be high temperature compressed gasketing consisting of organic fibers (Aramid) with SBR binder, Garlock "BLUE-GARD" Style 3200 or equal.
8. Gaskets for joints above 250 psi shall be Toruseal gaskets as manufactured by American specially designed for a working pressure of 350 psi.

D. Fittings:

1. Comply with AWWA C153, ductile iron.
2. Pressure Rating, Pipes 12 Inches and Smaller: 250 psig.

2.2 FINISHES

A. Interior Coating

1. Cement-mortar lining, AWWA C104; standard thickness.
2. Glass-lined SR-14 or equal for grit and scum piping.
3. Ceramic epoxy for gravity and pumped raw wastewater.
4. Ductile Iron Pipe and Fittings used for air service shall be unlined pipe

B. Outside Coating:

1. Buried: Asphaltic; 1-mil thick, minimum, in accordance with AWWA C151 / ANSO A21.51.
2. Exposed: As specified in Section 09 96 00 - High-Performance Coatings.

2.3 ACCESSORIES

A. Jackets:

1. AWWA C105, polyethylene jacket.
2. All buried ductile iron pipe shall receive polyethylene jacketing.

B. Dielectric Fittings: Provide between dissimilar metals.

C. Pipe Identification Labels

1. Identification for Process Piping: As specified in Section 40 05 53 - Identification for Process Piping.

PART 3 - EXECUTION

3.1 EXAMINATION

- ### A. As specified in Section 40 05 13 – Common Requirements for Process Piping

3.2 INSTALLATION

A. Buried Service: Install pipe as specified in:

1. Section 40 05 13 – Common Requirements for Process Piping.
2. AWWA C600 – Installation of Ductile Iron Water Mains and their Appurtenances.

B. Exposed Service: Install pipe as specified in:

1. Section 40 05 13 – Common Requirements for Process Piping.
2. Install according to ASME B31.3.

3. Fittings:

- a. Clean gasket seats thoroughly and wipe gaskets clean prior to installation.
- b. Install fittings according to manufacturer instructions.
- c. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to manufacturer recommendations.

4. Provide required upstream and downstream clearances from devices as indicated.

- C. Tap ductile-iron piping only with service saddle, tapping boss of a fitting or valve body, or equipment casting.
- D. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means acceptable to the Engineer.
- E. The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining so as to leave a smooth end at right angles to the axis of the pipe.
- F. Where pipe is laid on a grade of ten (10) percent or greater, the laying shall start at the bottom and shall proceed upward with the bell ends of the pipe upgrade.

3.3 JOINING OF PIPE

A. Flanged Joints

1. Flanges conforming to AWWA C110 can be joined with Class 125 B16.1 flanges shown in ANSI B16.1 but not with Class 250 B16.1 flanges.
2. Flange joints should be fitted so that the contact faces bear uniformly on the gasket. The joint should be made with relatively uniform bolt stress.
3. Set flange bolts beyond finger tightness with an indicating torque wrench to insure equal tension in all bolts. Tighten bolts such that those 180 degrees apart or directly opposite are torqued in sequence.

B. Push-On Joint

1. Push-on joints shall be made in strict accordance with the manufacturer's instructions. Pipe shall be laid with bell ends upstream.
2. Pipe 8 inches in diameter and larger shall be socketed by fork tools or jacks.
3. Pipe cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. The spigot ends of field cut pipe shall be tapered back 1/8 inch at an angle of about 30 degrees to the barrel of the pipe with a coarse file or portable grinder. All sharp or rough edges that may injure the rubber gasket shall be removed in this operation.
4. Whenever it is desirable to deflect push-on joint pipe, the amount of deflection shall not exceed the maximum limits according to Table 4 in AWWA C600.

C. Mechanical Joints:

1. Mechanical joints shall be in accordance with AWWA C600 and the manufacturer's instructions.
2. Bell ends shall be laid upstream.
3. Bolts shall be tightened to the specified torque. Under no condition shall extension wrenches or pipe over handle of ordinary ratchet wrench be used to obtain greater leverage.
4. Final tightening of bolts shall be with a torque wrench to insure equal tension in all bolts.
5. Bolts shall not be over-stressed to compensate for poor assembly.

3.4 PLACEMENT OF FITTINGS

1. Pipeline fittings, plugs, and caps shall be furnished and installed of the type indicated and at the location shown on the Drawings or as directed by the Engineer. It shall be the responsibility of the Contractor to furnish and install all proper size pipe bends for both horizontal and vertical deflections that are required to construct the pipeline to the line and grade as shown on the construction drawings or as set by the Engineer.

3.5 POLYETHYLENE ENCASEMENT

- A. The Contractor shall use Method A of ANSI/AWWA A21.5/C105 to install polyethylene encasement.

3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Test Pipe (other than air lines) per Section 40 05 13 – Common Requirements for Process Piping.
- C. Pressure Testing - Air
 1. All pressure pipelines conveying process air, flume air or primary air shall be tested by the Contractor in a manner satisfactory to and witnessed by the Engineer.
 2. The section under test shall be isolated by airtight plugs or valves from the air blowers and the diffuser headers which shall be tested separately.
 3. The pressure and leakage test shall first consist of filling the test section with compressed air to a pressure of 12 psig. The air inlet point shall be sealed and with no further introduction of air, the pipeline shall maintain a pressure of 12 psig for one hour. A pressure gage supplied by the Contractor and scaled to twice the test pressure shall be used to indicate the pressure.
 4. If the pipeline fails the above test, the Contractor shall locate and correct all leaks and retest the pipe section until it satisfactorily passes the test.

3.7 DISINFECTION OF POTABLE WATERLINES

- A. Following the testing procedure and after all corrections and adjustments have been made, all potable waterlines, both hot and cold water systems, shall be disinfected in strict accordance with the following procedure:
1. Water shall be introduced with a chlorine concentration of at least 50 mg/L. Chlorine shall be added with either a solution feed chlorinator or a hypochlorite feeder. Chlorine application shall continue until the system is filled with the chlorine solution.
 2. The chlorinated water shall remain in the system for a minimum of 24 hr while all valves along the system are operated to insure their disinfection. Following the 24 hr period, a residual chlorine test shall be conducted on a fresh sample taken at a point farthest from the point the solution was introduced. If less than 25 mg/L of chlorine is indicated, the system shall be drained and the disinfection procedure repeated.
 3. After a chlorine residual of at least 25 mg/L is obtained, the system shall be flushed until the chlorine concentration is equal to or less than 1 mg/L.
 4. Disinfection shall conform to ANSI/AWWA C-651, latest revision. The Engineer and Owner shall be notified 48 hr in advance of the disinfection procedure. Also, the flushed solution shall be disposed of as directed by the Engineer and Owner.

END OF SECTION 40 05 19

SECTION 40 05 23 - STAINLESS STEEL PROCESS PIPE AND TUBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stainless-steel pipe, tube, and fittings.
2. Stainless-steel cam and groove couplings.
3. Accessories.

B. Conform to the requirements of Section 40 05 13 – Common Requirements for Process Piping.

C. Related Requirements:

1. Section 09 96 00 - High-Performance Coatings: Finishes as specified by this Section.
2. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

A. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

B. ASME International:

1. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
3. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings.
4. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.
5. ASME B16.20 - Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed.
6. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.
7. ASME B31.3 - Process Piping.
8. ASME Boiler and Pressure Vessel Code (BPVC), Section IX - Welding and Brazing Qualifications.

C. ASTM International:

1. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
2. ASTM A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
3. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

4. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
5. ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
6. ASTM A632 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small Diameter) for General Service.
7. ASTM A778 – Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
8. ASTM A789 - Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service.
9. ASTM D3308 - Standard Specification for PTFE Resin Skived Tape

D. AWWA

1. AWWA C220 – Stainless-Steel Pipe, ½ In. and Larger
2. AWWA C223 – Fabricated Steel and Stainless Steel Tapping Sleeves
3. AWWA C226 – Stainless-Steel Fittings for Waterworks Service, ½ In. Through 72 In.
4. AWWA C228 – Stainless-Steel Pipe Flanges for Water Service – Sizes 2 in. through 72 in.

E. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

F. The Society for Protective Coatings:

1. SSPC SP-6 - Commercial Blast Cleaning.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Felker Brothers.
- B. Brismet.
- C. TW Metals.
- D. Or Approved Equal.
- E. All cam and groove couplings shall be as manufactured by PT Coupling, USA.

2.2 STAINLESS-STEEL PIPE, TUBE AND FITTINGS

- A. All materials shall be new and unused.
- B. Unless otherwise indicated on the drawings, stainless steel pipe shall be Type 304 stainless steel, schedule 10 conforming to AWWA C220.
- C. Stainless steel tube shall be Seamless Type 304 stainless steel conforming to ASTM A269.

1. In the event plans/schedule indicate Type 304, the requirements for Type 316 shall be interchangeable with Type 304.
- D. All welded pieces shall be shop fabricated.
- E. Pipe shall be field assembled using flanges and gaskets where necessary. Field welding will not be allowed without written approval from the Engineer.
- F. Fittings shall conform to AWWA C226. Shop-fabricated fittings made from flat-rolled stock, in accordance with ASTM A240 shall be in a solution-annealed condition. Shop fabricated fittings made from pipe shall be in accordance with AWWA C220, ASTM A312 and ASTM A778.
- G. Flanges shall conform to AWWA C228.
 1. Flanges shall be made from castings, seamless forgings, rolled and welded bar rings, segmented and welded plates, or cut from plate as a single piece.
 2. Flanged joints shall be made with bolts, bolt studs with nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same Standard as the flanges.
 3. Flanges shall be grade 316, Slip on type, minimum Class D. If service pressure is greater than 150 psi, class shall be rated for the same service pressure as the pipe.
 4. Flange faces shall be raised except when bolted to flat face cast iron flanges.
 5. Bolting:
 - a. Bolts and nuts shall be Type 316 stainless steel.
 - b. Bolts: Comply with ASTM A193, Grade B8M; square head.
 - c. Nuts: ASTM A194, Grade 8M; hex head.
 - d. Bolt studs and studs shall be of the same quality as machine bolts.
 - e. Washers on mating flanges or equipment connections: Same material as bolt

2.3 ACCESSORIES

- A. Pipe-Thread Tape:
 1. Material: PTFE.
 2. Comply with ASTM D3308.
- B. O-Ring Seals: EPDM.
- C. Flange Gaskets:
 1. Gaskets for flat face flanges shall be full face type. Gaskets for raised face flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Gaskets shall be 1/8 in. thick minimum and of following types:
 - a. Water, Sewage, Sludges (up to 175°F): Red rubber, heavy duty type, by John Crane Co., Morton Grove, IL, - Style 555.
 - b. Air: High temperature compressed gasketing consisting of organic fibers (Aramid) with SBR binder, Garlock "BLUE-GARD" Style 3200 or equal.

D. Connections with Dissimilar Pipes

1. For stainless steel to ductile iron connections, a weld neck flange can be used on the stainless steel and a megaflange may be used on the ductile iron side. Sufficient gaskets should be used between the nuts or bolts and stainless steel in order to protect the stainless steel.
2. End welding of longitudinal seams shall be performed by manual welding in accordance with AWWA C220-12 Section 4.4.3.4 and 4.4.3.4.1.

2.4 CAM AND GROOVE COUPLING

- A. All cam and groove couplings shall be 316 stainless steel and designed for lightweight strength and long lasting durability.
- B. Cam and groove couplings shall allow for hose connection without the need for threading tools, lugs, twisting, springs or snaps.
- C. Locking arms shall be provided to prevent couplers from leaking or pulling apart during operation.
- D. Gaskets and materials shall be selected based on the manufacturer's recommendation and the material being conveyed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASME B31.3.
- B. Comply with Section 40 05 13 - Common Requirements for Process Piping.
- C. Field Cuts: According to pipe manufacturer instructions.
- D. Field welding of stainless steel is **not** permitted, without written permission from the Engineer.

3.2 TOLERANCES

- A. Piping tolerances shall be per AWWA C220.

3.3 TESTING

- A. Test installed components Per Section 40 05 13 – Common Requirements for Process Piping.

END OF SECTION 40 05 23

SECTION 40 05 31 - THERMOPLASTIC PROCESS PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. PVC pipe, tube, and fittings.
2. Chlorinated polyvinyl chloride (CPVC) pipe and fittings.
3. Acrylonitrile-butadiene-styrene (ABS) pipe and fittings.
4. High Density Polyethylene (HDPE) pipe, tube, and fittings.
5. Accessories for plastic piping and fittings.

B. Related Requirements:

1. Section 40 05 07 – Hangers and Supports for Process Piping
2. Section 40 05 13 – Common Requirements for Process Piping
3. Section 40 05 51 – Common Requirements for Process Valves

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers:

1. ASME B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form).
2. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
3. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800
4. ASME B16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.
5. ASME B16.20 - Metallic Gaskets for Pipe Flanges.
6. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.
7. ASME B31.3 - Process Piping Guide.

B. ASTM International:

1. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
2. ASTM A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
3. ASTM D1527 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80.
4. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
5. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
6. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

7. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
8. ASTM D2321 – Standard Practice for Underground installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
9. ASTM D2464 - Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
10. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
11. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
12. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
13. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
14. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
15. ASTM D2737 - Standard Specification for Polyethylene (PE) Plastic Tubing.
16. ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
17. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
18. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
19. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
20. ASTM D3222 - Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
21. ASTM D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
22. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
23. ASTM D3892 - Standard Practice for Packaging/Packing of Plastics.
24. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
25. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
26. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
27. ASTM F441 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
28. ASTM F442 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
29. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
30. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
31. ASTM F656 - Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
32. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.
33. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.

34. ASTM F1055 - Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing.
35. ASTM F1290 - Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings.
36. ASTM F2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.

C. American Water Works Association:

1. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.
2. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service.
3. AWWA C905 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In.
4. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission.

D. NSF

1. NSF / ANSI 14 – Plastic Piping and Components and Related Materials
2. NSF/ANSI 61 – Drinking Water System Components – Health Effects.

E. PVC Pipe Association

1. UNI-B-06-Recommended Low-Pressure Air Testing of Installed Sewer Pipe.

1.3 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Temperature: Do not install pipe when temperature is below 40 degrees F (4.4 degrees C) or above 90 degrees F (32.2 degrees C) if pipe is exposed to direct sunlight.
- C. Ultraviolet (UV) Protection: Provide pipe installed above ground or outside with UV protection.

PART 2 - PRODUCTS

2.1 PVC PIPE, TUBE, AND FITTINGS

A. Manufacturers:

1. Eslon Thermoplastics; Charlotte, NC
2. R&G Sloane, Sun Valley, CA
3. Harvel Plastics, Easton, PA
4. LCP Chemicals & Plastics, Colfax, NC
5. Bristol Corp., Bristol, IN
6. Or Approved Equal.

B. PVC Pipe and Fittings (for non-potable service):

1. PVC Pipe shall be ASTM D2241, SDR-21 for pressure service and SDR-26 for gravity service, calculated according to ASTM D2837.
2. Fittings: ASTM D2466, Schedule 40 for gravity service and ASTM D2467, Schedule 80 for pressure service.
3. Joints:
 - a. Above ground service will be solvent-welded per ASTM D2855 or threaded or flanged if later removal is required.
 - b. Below ground service will be gasketed joint per ASTM D-3139, and the gasket shall be per ASTM F477.
4. Materials: ASTM D1784, minimum cell classification 12545-C.

C. PVC Pipe and Fittings (for potable water service)

1. Pipe: AWWA C900 / AWWA C905, Class 235.
2. Fittings: AWWA C111, cast iron.
3. Joints: ASTM D3139, compression gasket ring.
4. Materials: ASTM D1784, minimum cell classification 12454-C per ASTM D1784.

D. PVC Tube and Fittings:

1. Tube:
 - a. Clear.
 - b. Size and Wall Thickness: schedule 80.
2. Fittings: Compression type; materials suitable for application.
3. Threads: Straight; ASME B1.1.

E. Pipe shall be colored based on applications as follows:

1. Purple – Reclaimed Water
2. Green – Sanitary Sewer Force Main and Gravity Lines
3. White – Non-potable Water
4. Blue – Potable Water

2.2 CPVC PIPE AND FITTINGS

A. Manufacturers:

1. Eslon Thermoplastics; Charlotte, NC
2. R&G Sloane, Sun Valley, CA
3. Harvel Plastics, Easton, PA
4. LCP Chemicals & Plastics, Colfax, NC
5. Bristol Corp., Bristol, IN
6. Or Approved Equal.

B. CPVC Pipe and Fittings:

1. Pipe: ASTM F442, SDR 13.5 minimum.
2. Fittings:
 - a. Flanged: ASME B16.1, ASME B16.5, Class 125.
 - b. Socket Welded: ASTM F439, Schedule 80.
 - c. Threaded: ASTM F437, Schedule 80; ASME B1.20.1.
3. Joints: Flanged for above ground service, Push-on for below ground service; threaded or flanged if later removal is required.
4. Materials: ASTM D1784, minimum cell classification 23447.

2.3 ABS PIPE AND FITTINGS

A. Manufacturers:

1. Mueller Industries
2. NIBCO Inc.
3. Or Approved Equal.

B. ABS Pipe and Fittings:

1. Pipe: ASTM D1527, Schedule 40 for up to 4" and Schedule 80 for diameters greater than 4".
2. Fittings:
 - a. ASTM D2661; molded; solvent cemented.
 - b. Flanged Fittings: ASME B16.1, ASME B16.5, Class 125.
 - c. Threaded Fittings: ASME B1.1.
3. Joints: Solvent welded; flanged if later removal is required.
4. Materials: ASTM D3965, minimum cell classification 42222.

2.4 PE PIPE, TUBE, AND FITTINGS

A. Manufacturers:

1. Performance Pipe
2. United States Plastic Corporation
3. Or Approved Equal

B. Polyethylene Pipe and Fittings (for non-potable service):

1. Pipe: ASTM D2447, SDR 9, calculated according to ASTM D3035.
2. Fittings: Molded; ASTM D3261, butt welded or ASTM D2683, F1056, socket welded.
3. Joints: Socket heat fusion or Butt fusion; threaded or flanged if later removal is required.
4. Materials: ASTM D3350, manufactured from virgin resins with minimum cell classification 324433-C. No recycled compound shall be used except that generated in the manufacturer's own plant from resin of the same specification from the same raw material supplier.

C. Polyethylene Pipe and Fittings (for Potable Water Service):

1. Pipe: AWWA C901 /AWWA C906, DR 13.5 for 160 psig pressure rating.
2. Fittings: AWWA C901, AWWA C906, molded or fabricated.
3. Joints: Butt fusion; threaded or flanged if later removal is required.
4. Materials: ASTM D3350, minimum cell classification 324433-C.

D. Polyethylene Tube and Fittings:

1. Tube:
 - a. AWWA C901.
 - b. Size and Wall Thickness: ASTM D2737 or; as indicated on piping schedule.
 - c. Pressure Rating: As indicated on Drawings or piping schedule.
2. Fittings: Compression type; materials suitable for application.
3. Threads: Straight; ASME B1.1.

2.5 HDPE PIPE, AND FITTINGS

A. Manufacturers:

1. ISCO
2. JM Eagle
3. Or Approved Equal

B. HDPE Pipe and Fittings:

1. Pipe: ASTM F714 or ASTM D3035. DR as shown on the Drawings.
2. Fittings: ASTM D3261, butt welded and fully pressure rated for the same service condition as the pipe.
3. Joints: Butt fusion per ASTM F2620; threaded or flanged if later removal is required.
4. Materials: ASTM D3350, manufactured from virgin resins PE4710 cell classification PC445474C.
5. All HDPE pipe and fittings for potable water service shall be of nominal DIPS (ductile iron pipe size) outside diameter per AWWA C900/C905. The nominal size and DR shall be as shown on the Drawings.

2.6 ACCESSORIES

- A. Flange Bolting: Stainless steel, ASTM A193 Grade 8B hex head bolts and ASTM A194 Grade 8 hex head nuts.
- B. Flange Gaskets: Full faced, ethylene propylene diene monomer (EPDM), according to ASME B16.21.
- C. Push-On Joint Seals:
- D. Solvent Cement:
 1. PVC Piping: ASTM D2564.
 2. CPVC Piping: ASTM F493.
 3. ABS Piping: ASTM D2235

- E. Insert Fittings for PE Piping: ASTM D2609.
- F. Couplings for PE Piping: ASTM F1055.
- G. Tracer Wire: #12 AWG copper clad steel insulated wire, insulation color per pipe service.
- H. Detectable Underground Marking Tape: underground marking tape shall be a minimum 3" width, detectable marking tape, with a minimum 5.0 mil overall thickness. Tape shall be manufactured using a 0.8 mil clear virgin polypropylene film, reverse printed and laminated to a 0.35 mil solid aluminum foil core, and then laminated to a 3.75 mil clear virgin polyethylene film. Tape shall be printed using a diagonally striped design for maximum visibility, and meet the APWA Color-Code standard for identification of buried utilities. Detectable marking tape shall be Pro-Line Safety Products or approved equal and made in the USA.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install piping and components according to the following:
 - 1. Section 40 05 13 – Common Work Results For Process Piping
 - 2. ASME B31.3 for above ground service
 - 3. AWWA C605 for potable water service
 - 4. ASTM D2774 for non-potable underground pressure service
 - 5. ASTM D2321 for non-potable underground gravity service
- B. Joining:
 - 1. HDPE pipe sections shall be joined on the jobsite above ground into continuous lengths by the Butt-Fusion Method in accordance with ASTM F2620, and in strict accordance with the Manufacturer's Recommendations. Maximum joined drag length is 600-ft.
 - 2. HDPE pipe shall be joined to ductile iron valves and fittings with a DIPS size MJ Adapter Kit. Pipe Stiffeners shall be used to maintain roundness of the pipe. MJ adapter and stiffeners shall be installed in strict accordance with the manufacturer's instructions.
 - 3. Perform heat joining according to ASTM D2657.
 - 4. Perform electrofusion joining according to ASTM F 1290.
 - 5. Primers and Cleaners: ASTM F402.
 - 6. PVC Solvent-Cemented Joints: ASTM D2855.
- C. Tracer Wire shall be installed on all non-metallic lines. The contractor shall perform a continuity test on all tracer wire in the presence of the engineer. Tracer wire shall be run along the top of the pipe and secured at intervals of 10' with wire or tape. The tracer wire shall be brought up into all valve and meter boxes so as to be readily accessible to system operators. All wire splices and connections shall be tied and tightly taped with insulated electrical tape.

- 3.2 A detectable marking tape shall be installed over all nonmetallic lines by the CONTRACTOR. Care will be taken to insure that the buried marking tape will bear the words "CAUTION-PIPE

LINE BURIED BELOW." The detectable marking tape will be buried 4 to 6 in. below finish grade. The tape should be placed into backfill and allowed to settle into place in the backfill.

3.3 TESTING:

- A. Clean lines by flushing or other means before testing begins.
- B. Testing may be dangerous if a line is improperly prepared. The Contractor shall develop and put in place proper safety procedures when performing testing.
- C. PE and HDPE pipe for pressure service will be tested in accordance with ASTM F2164-13.
- D. PVC pipe for pressure service will be tested in accordance with AWWA C600.
- E. Tests for Gravity Service shall include:
 - 1. Infiltration Test:
 - a. All lines below the water table shall be checked for infiltration
 - b. If at any time prior to expiration of the correction period stipulated in the General Condition, infiltration exists, that is any inflow, and the pipe fails.
 - c. The Contractor shall locate the leaks and make repairs as necessary to remove the infiltration.
 - 2. Deflection Testing
 - a. Conduct deflection test prior to low-pressure air test.
 - b. Perform deflection testing after the final backfill and compaction has been in place at least thirty (30) calendar days and prior to placing lines into operation.
 - c. Each reach of pipe shall be checked for excessive deflection by pulling a mandrel through the pipe. The mandrel shall be cylindrical in shape and constructed with 9 evenly spaced arms. The critical dimensions of the mandrel shall have a +/- 0.01 inch tolerance.
 - d. Deflection shall not exceed 5% of initial diameter
 - e. Pipe failing the deflection test shall be uncovered, and the bedding and backfill replaced to prevent excessive deflection. Repaired pipe shall be retested.
 - 3. Low Pressure Air Testing
 - a. Test each reach with maximum 5 psi
 - b. The time elapsed for a 0.5 psi drop in air pressure shall be not less than 10 minutes or as specified in ASTM F1417 or UNI B-6-90 whichever is greater.
 - 4. Joint Testing
 - a. For pipes large enough to enter (27" in diameter or larger), individual joints may be pressure tested with a portable tester to 5 psi maximum, with air or water in lieu of low pressure air testing.
 - b. Joint Testing shall be performed in accordance with ASTM C1103.

END OF SECTION 40 05 31

40 05 51 - COMMON REQUIREMENTS FOR PROCESS VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Valves.
 - 2. Valve actuators.
- B. Conform to the requirements of Section 40 05 51 - Common Requirements for Process Valves.
- C. Related Requirements:
 - 1. Section 03 30 00 – Cast-in-Place Concrete
 - 2. Section 05 50 00 – Metal Fabrications
 - 3. Section 09 96 00 – High-Performance Coatings
 - 4. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

- A. American Water Works Association:
 - 1. AWWA C541 - Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
 - 2. AWWA C542 - Electric Motor Actuators for Valves and Slide Gates.
 - 3. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.
- B. ASTM International:
 - 1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - 2. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
- C. Manufacturers Standardization Society:
 - 1. MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges, and Unions.
- D. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. NFPA:
 - 1. NFPA 70 - National Electrical Code (NEC).
- F. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

G. UL:

1. Equipment Directory.

1.3 COORDINATION

- A. Section 01 31 00 – Project Management and Coordination.
- B. Coordinate Work of this Section with piping, equipment, and appurtenances.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 1. Submit manufacturer information for actuator with model number and size indicated.
 2. Submit valve cavitation limits.
- C. Shop Drawings: Indicate parts list, materials, sizes, position indicators, limit switches, control system, actuator mounting, wiring diagrams, and control system schematics.
- D. Valve Schedule: Indicating the service, size, and connections, make, model number and any special features such as chain wheel operators, etc.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Certification of Valves Larger than 12 Inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.
- G. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for sizing of control valves.
- H. Manufacturer Instructions: Submit installation instructions and special requirements.
- I. Source Quality-Control Submittals: Indicate results of shop/factory tests and inspections.
- J. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections, including factory-applied coatings.
- K. Qualifications Statement:
 1. Submit qualifications for manufacturer and licensed professional.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of valves and actuators.

1.6 QUALITY ASSURANCE

- A. Maintain clearances as indicated on Drawings and Shop Drawings.
- B. Ensure that materials of construction of wetted parts are compatible with process liquid.
- C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.
- D. The manufacturer shall be required to furnish at the time of delivery an affidavit of compliance stating the valve and all materials used conform in every respect to the applicable performance of the appropriate AWWA Standard, and these supplementary specifications and that all tests have been performed with test requirements having been met. Test requirements shall be performed and test records furnished to the engineer prior to shipment.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum twenty (20) years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Prepare valves and accessories for shipment according to latest edition of AWWA C500, Section 31 and:
 - 1. Seal valve ends to prevent entry of foreign matter into valve body.
 - 2. Box, crate, completely enclose, and protect valves and accessories from accumulations of foreign matter.
- D. Store materials according to manufacturer instructions.
- E. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
 - 3. Provide additional protection according to manufacturer instructions.

1.9 TOOLS AND SPARE PARTS

- A. Provide to the OWNER, one operating wrench for every 10 valves of each type (but not less than 2 wrenches per type), not equipped with hand wheels or levers.
- B. The manufacturer shall furnish any special tools necessary to disassemble, service, repair, and adjust the equipment.

1.10 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. The Manufacturer and Contractor shall furnish a warranty extending twelve (12) months after substantial completion date.

PART 2 - PRODUCTS

2.1 VALVES

- A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required.
- B. General:
 - 1. All packing, gaskets, discs, seats, diaphragms, lubricants, etc., shall conform to recommendations of the valve manufacturer for the intended service.
 - 2. All valves shall be manufacturer's standard of the design which the manufacturer recommends for the service intended.
 - 3. Each valve shall bear the maker's name or trademark or reference symbol to indicate the service conditions for which it is guaranteed.
 - 4. All valves for use with copper tubing shall have solder type connections.
 - 5. All screw end valves shall be threaded according to the American Standard for Pipe Threads No. B2.1.
 - 6. Flange end valves shall have connecting end flanges in accordance with the B16.1, Class 125 Series of the American Standards Association for type valves covered in the Standard, and in accordance with the Manufacturer's Standardization Society Standard Practice for bronze valves corresponding to the maximum pressure and service for which the valve is to be used.
- C. Valve Ends: Compatible with adjacent piping system.

D. Operation:

1. Open by turning counterclockwise; close by turning clockwise.
2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.

E. Valve Marking and Labeling:

1. Marking: Comply with MSS SP-25.
2. Labeling: As specified in Section 40 05 53 - Identification for Process Piping.

F. Valve Construction:

1. Bodies: Rated for maximum temperature and pressure to which valve will be subjected as specified in valve Sections.
2. Bonnets:
 - a. Flanged to body and of same material and pressure rating as body.
 - b. Furnish glands, packing nuts, or yokes as specified in valve Sections.
3. Stems and Stem Guides:
 - a. Materials and Seals: As specified in valve Sections.
 - b. Bronze Valve Stems: According to ASTM B584.
 - c. Space stem guides 10 feet o.c.
 - d. Submerged Stem Guides: Type 304 stainless steel.
4. Nuts and Bolts: As specified in Section 05 50 00 - Metal Fabrications.

G. Valve Type:

1. Plug Valves: As specified in Section 40 05 62 – Plug Valves.
2. Ball Valves: As specified in Section 40 05 63 – Ball Valves.
3. Butterfly Valves: As specified in Section 40 05 64 – Butterfly Valves.
4. Swing and Disc Check Valves: As specified in Section 40 05 65 – Swing Check Valves.
5. Pressure-Regulating Valves: As specified in Section 40 05 66 – Pressure-Regulating Valves.
6. Pressure-Relief Valves: As specified in Section 40 05 67 – Pressure-Relief Valves.
7. Telescoping Valves: As specified in Section 40 05 71 – Telescoping Valves.
8. Mud Valves: As specified in Section 40 05 72 – Mud Valves.
9. Combination Air Valves for Wastewater Service: As specified in Section 40 05 78 – Combination Air Valves for Wastewater Service.

2.2 VALVE ACTUATORS

- A. Description: Manual, pneumatic and electric motor actuators.
- B. Provide actuators per specification Section 40 05 57 – Actuators for Process Valves and Gates

2.3 INSULATION

- A. As specified in Section 40 42 13 - Process Piping Insulation or as indicated on Drawings.

2.4 FINISHES

- A. Valve lining and coating: Comply with AWWA C550.
- B. Exposed Valves: As specified in Section 09 96 00 – High-Performance Coatings.
- C. Do not coat flange faces of valves unless otherwise specified.

2.5 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Testing: Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.
- C. Certificate of Compliance:
 - 1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
 - 2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 31 00 – Project Management and Coordination: Requirements for installation examination
- B. Verify that piping system is ready for valve installation.

3.2 INSTALLATION

- A. Install valves, actuators, extensions, valve boxes, and accessories according to manufacturer instructions.
- B. Firmly support valves to avoid undue stresses on piping.
- C. Valves shall be installed with the stems positioned in the horizontal or above the centerline of the pipe unless otherwise shown on the Drawings.
- D. Operators shall be positioned so that they do not interfere with pedestrian traffic.

- E. Valve operators which are 7 ft 0 in. or more above the operating floor or platform shall be chain wheel operated.
- F. Where necessary for operations as described above, valves shall be bevel or spur gear operated. Plug valve 6 in. and larger shall be gear operated.
- G. Coat studs, bolts and nuts with anti-seizing lubricant.
- H. Clean field welds of slag and splatter to provide a smooth surface.
- I. Install valves with stems upright or horizontal, not inverted.
- J. Install brass male adapters on each side of valves in copper-piped system and solder adapters to pipe.
- K. All buried valves shall have a 2" operating nut and handwheels for all exposed valves.
- L. Install 3/4-inch ball valves with cap for drains at main shutoff valves, low points of piping, bases of vertical risers, and equipment.
- M. Install valves with clearance for installation of insulation and to allow access.
- N. Provide access where valves and fittings are not accessible.
- O. Pipe Hangers and Supports: As specified in Section 40 05 07 - Hangers and Supports for Process Piping.
- P. Comply with Division 40 - Process Interconnections for piping materials applying to various system types.
- Q. Install insulation as specified in Section 40 42 13 - Process Piping Insulation and as indicated on Drawings.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Valve Field Testing:
 - 1. Test for proper alignment.
 - 2. If specified by valve Section, field test equipment to demonstrate operation without undue noise, vibration, or overheating.
 - 3. Architect/Engineer will witness field testing.

END OF SECTION 40 05 51

SECTION 40 05 53 - IDENTIFICATION FOR PROCESS PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.

B. Related Requirements:

1. Section 09 96 00 – High-Performance Coatings
2. Division 40 – Process Interconnections
3. Division 43- Process Gas and Liquid Handling, Purification and Storage Equipment
4. Division 46 – Water and Wastewater Equipment

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer's catalog literature for each product required.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color-coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Samples: Submit one tag, label, and pipe markers for each size used on Project.

E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirement.

G. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Extra Stock Materials: Furnish one container of spray-on adhesive.
- C. Tools: Furnish special tools and other devices required for Owner to reinstall tags.

1.6 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' documented experience.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 1. Craftmark Pipe Markers
 2. Kolbi Pipe Marker Co.
 3. Seton Identification Products
 4. Or Approved Equal
- B. Description: Equipment nameplates shall be engraved or stamped on stainless steel and fastened to the equipment in an accessible location with oval head stainless steel screws or drive pins. Nameplates shall at a minimum contain manufacturers name and address, year of manufacture, serial number, speed (if applicable) and other applicable information.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:

- a. Brady ID
- b. Craftmark Pipe Markers
- c. Kolbi Pipe Marker Co.
- d. Seton Identification Products
- e. Or Approved Equal

2. Description:

- a. Laminated three-layer plastic with engraved black letters on light, contrasting background color.
- b. Minimum Tag Size and Configuration: 1-1/2 inches; diameter or square.

B. Metal Tags:

1. Manufacturers:

- a. Brady ID
- b. Craftmark Pipe Markers
- c. Kolbi Pipe Marker Co.
- d. Seton Identification Products
- e. Or Approved Equal

2. Description:

- a. Aluminum or Stainless-steel construction; stamped letters.
- b. Minimum Tag Size and Configuration: 1-1/2 inches; diameter or square with finished edges.

C. Information Tags:

1. Manufacturers:

- a. Brady ID
- b. Craftmark Pipe Markers
- c. Kolbi Pipe Marker Co.
- d. Seton Identification Products
- e. Or Approved Equal

2. Description:

- a. Clear plastic with printed DANGER, CAUTION, WARNING, and message.
- b. Minimum Tag Size: 3-1/4 by 5-5/8 inch.
- c. Furnish grommet and self-locking nylon ties.

3. Tag Chart: Typewritten, letter-size list of applied tags and location, in anodized aluminum frame.

2.3 STENCILS

- A. Manufacturers:
 - a. Kolbi Pipe Marker Co.
 - b. Seton Identification Products
 - c. Or Approved Equal
- B. Description:
 - 1. Clean-cut symbols.
 - 2. Letters:
 - a. Up to 2-inch Outside Diameter of Insulation or Pipe: 1/2-inch-high letters.
 - b. 2-1/2- to 6-inch Outside Diameter of Insulation or Pipe: 1-inch-high letters.
 - c. Over 6-inch Outside Diameter of Insulation or Pipe: 1-3/4-inch-high letters
- C. Stencil Paint: As specified in 09 96 00 - High-Performance Coatings; semigloss enamel.
- D. Color-Coding and Lettering Size: Conform to ASME A13.1.

2.4 PIPE MARKERS

- A. Color-Coding and Lettering Size: Conform to ASME A13.1.
- B. Plastic Pipe Markers:
 - 1. Manufacturers:
 - a. Brady ID
 - b. Craftmark Pipe Markers
 - c. Seton Identification Products
 - d. Or Approved Equal
 - 2. Description:
 - a. Factory-fabricated, flexible, semirigid plastic.
 - b. Preformed to fit around pipe or pipe covering.
 - c. Larger sizes may have maximum sheet size with spring fastener.
- C. Plastic Tape Pipe Markers:
 - 1. Manufacturers:
 - a. Brady ID
 - b. Craftmark Pipe Markers
 - c. Kolbi Pipe Marker Co.
 - d. Seton Identification Products
 - e. Or Approved Equal

2. Description: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

D. Plastic Underground Pipe Markers:

1. Manufacturers:
 - a. Kolbi Pipe Marker Co.
 - b. Seton Identification Products
 - c. Or Approved Equal
2. Description:
 - a. Brightly colored, continuously printed plastic ribbon tape.
 - b. Minimum 6 inches wide by 4 mil thick.
 - c. Manufactured for direct burial service.

2.5 LABELS

A. Manufacturers:

1. Brady ID
2. Seton Identification Products
3. Or Approved Equal

B. Description:

1. Aluminum or Laminated Mylar construction.
2. Minimum Size: 1.9 by 0.75 inches.
3. Adhesive backed, with printed identification and bar code.

2.6 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers:
 - a. Brady ID
 - b. Master Lock Company, LLC
 - c. Or Approved Equal
2. Description:
 - a. Anodized aluminum or reinforced nylon construction.
 - b. Furnish hasp with erasable label surface.
 - c. Minimum Size: 7-1/4 by 3 inches.

B. Valve Lockout Devices:

1. Manufacturers:

- a. Brady ID
 - b. Master Lock Company, LLC
 - c. Or Approved Equal
2. Description:
 - a. Nylon or Steel construction.
 - b. Furnish device preventing access to valve operator and accepting lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Prepare surfaces as specified in Section 09 96 00 – High-Performance Coatings for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting as specified in Section 09 96 00 - High-Performance Coatings.
- B. Install identifying devices after completion of coverings and painting.
- C. Identify equipment with nameplates.
- D. Identify inline pumps and other small devices with tags.
- E. Identify control panels and major control components outside panels with plastic nameplates.
- F. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.
- G. Labels:
 1. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
 2. For unfinished covering, apply paint primer before applying labels.
- H. Tags:
 1. Install tags using corrosion-resistant chain.
 2. Number tags consecutively by location.
- I. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- J. Identify valves in main and branch piping with tags.

K. Piping:

1. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers and/or stenciled painting.
2. Use tags on piping 3/4-inch diameter and smaller.
3. Identify service, flow direction, and pressure.
4. Install in clear view and align with axis of piping.
5. Locate identification not to exceed 20 feet on straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

L. Ceiling Tacks:

1. Provide ceiling tacks to locate valves above T-bar-type panel ceilings.
2. Locate in corner of ceiling panel closest to equipment.

END OF SECTION 40 05 53

SECTION 40 05 57 - ACTUATORS FOR PROCESS VALVES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manual actuators
 - 2. Electric motor actuators
- B. Related Requirements:
 - 1. Section 05 50 00 - Metal Fabrications
 - 2. Section 09 96 00 - High-Performance Coatings
 - 3. Division 40 - Process Interconnections
- C. This specification shall NOT cover actuators included in biological nutrient removal (BNR) system package. Actuators in BNR package shall be specified in Section 46 53 54 - Biological Wastewater Treatment System.

1.2 REFERENCE STANDARDS

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings
 - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings
- B. American Water Works Association:
 - 1. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service
 - 2. AWWA C542 - Electric Motor Actuators for Valves and Slide Gates
- C. NFPA:
 - 1. NFPA 70 - National Electrical Code

1.3 COORDINATION

- A. Section 01 31 00 - Project Management and Coordination: Requirements for coordination
- B. Coordinate Work of this Section with installation of valves and accessories.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals

- B. Product Data: Submit manufacturer information for actuator with model number and size indicated.
- C. Shop Drawings:
 - 1. Indicate parts list, materials, sizes, position indicators, limit switches, actuator mounting, wiring diagrams, control system, and control system schematics on assembly drawings.
 - 2. Submit actuator Shop Drawings with valve and gate submittal.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit special procedures and placement requirements.
- F. Source Quality-Control Submittals: Indicate results of shop/factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Qualifications Statements:
 - 1. Submit qualifications for manufacturer and installer.
 - 2. Submit manufacturer's approval of installer.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations and types of actuators.

1.6 QUALITY ASSURANCE

- A. Valve Actuators in NEC Class I, Group D, Division 1 for areas where flammable gases, vapors or liquids can exist all of the time or some of the time under normal operating conditions.
- B. Valve Actuators in NEC Class I, Group D, Division 2 for areas where flammable gases, vapors or liquids are not likely to exist under normal operating conditions.
- C. Locations: Comply with NFPA 70.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
 - 3. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. The Manufacturer and Contractor shall furnish a warranty extending twelve (12) months after substantial completion date.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. Furnish gear and power actuators with position indicators.

2.2 MANUAL ACTUATORS

- A. Gate Valves: Gate valves shall be fitted with cast iron hand wheels of suitable size or gear and hand wheel operators in accordance with AWWA C500.
- B. Butterfly Valves: Butterfly valves 3 inches and smaller shall be lever and locking ratchet operated. Butterfly valves 4 inches and larger shall be equipped with gear and hand wheel operators. The operators shall be furnished by the manufacturer of the valve, in accordance with AWWA C504, who shall be responsible for the compatibility and adequacy of both the valve

and operator. Valve operator shall be sized for the maximum torque developed by the maximum pressure in the pipeline in which the valve is to be used.

- C. Plug and Ball Valves: Plug and ball valves 3 inches and smaller shall be lever and locking ratchet operated. Plug and ball valves 4 inches and larger shall be provided with gear and hand wheel operators.
- D. Provide gear and power actuators with position indicators.
- E. Gear-Assisted Manual Actuators:
 - 1. Drive Type: Worm gear except where otherwise shown or specified
 - 2. Provide totally enclosed gears.
 - 3. Gearing: Designed for 100 percent overload.
 - 4. Bearings:
 - a. Type: Ball or Roller; comply with ABMA 9 or ABMA 11.
 - b. Permanently lubricated bronze.
 - c. Minimum L10 Life: 100,000 hours.
 - 5. Maximum Operating Force: 60 lbf.
 - 6. Handwheel: Minimum 12-inch diameter.
 - 7. Packing: Accessible for adjustment without requiring removal of actuator from valve.
- F. Chain Actuators:
 - 1. Description:
 - a. Chain actuators for shutoff valves mounted 7 feet and greater above operating floor level.
 - b. Chain guides and hot-dip galvanized operating chain extending to 5-1/2 feet above operating floor level.
 - 2. Chain Wheels: Sprocket rim type.
 - 3. Furnish chain storage if chains may interfere with pedestrian traffic.
- G. Buried Valves:
 - 1. Comply with AWWA C500.
 - 2. Floors:
 - a. Furnish extension stems to grade, and square nuts or floor stands with position indicators.
 - b. Cast-iron/Steel pipe extensions with valve boxes, covers, and operating keys.
 - c. Floor Boxes: Hot-dip galvanized cast iron or steel, with bronze cover.
 - d. Lid Inscription: An arrow at least 2" long showing direction of opening. The word OPEN shall also be cast on the flange.
 - 3. Valve Boxes:
 - a. Material: Cast iron.

- b. 12 Inch Diameter Valves and Smaller: Two-piece, screw type.
- c. Valves larger than 12 Inch Diameter: Three-piece, screw type.
- d. Lid Inscription: An arrow at least 2" long showing direction of opening. The word OPEN shall also be cast on the flange.

2.3 ELECTRIC MOTOR ACTUATORS

A. Manufacturers:

- 1. Auma Actuators, Inc.; Canonsburg, PA
- 2. Limitorque
- 3. Or Approved Equivalent

B. Description:

- 1. Motor, reduction gearing, torque switches, limit switches, auxiliary hand wheel, starter, mechanical position indicator, and accessories.
- 2. Comply with AWWA C542.
- 3. Open-close operation or modulation, as specified, or as shown on the Drawings.
- 4. Valve closing time will be 60 seconds, unless otherwise noted.
- 5. Actuators will be capable of operating in an ambient temperature range of -20 to +175 °F.
- 6. All actuators in open/close service will be furnished with integral, motor controls consisting of reversing starters, control transformer, phase discriminator, monitor relay, positioner, "open-stop-close" pushbuttons, "local-off-remote" selector switch in addition to red and green indicating lights. The positioner shall be capable of accepting a 4~20 mADC signal from the controller and positioning the valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer mounted inside the actuator. The positioner shall be field adjustable to fail in the "open", "closed" or "last" position on loss of 4~20 mADC command signal.

C. Enclosure:

- 1. Minimum NEMA 250 Type 4. When specified, motor and all electrical enclosure shall be available to meet NEMA 6 submersible, or NEMA 7 hazardous requirements.
- 2. Mounting: Attached actuator housing using flanged motor adapter.

D. Motors:

- 1. As specified in Section 26 05 93 - Common Motor Requirements for Process Equipment.
- 2. Type:
 - a. Reversing or modulating, as specified, or as shown on the Drawings.
 - b. Totally enclosed, non-ventilated, high starting torque, low starting current.
 - c. Full-voltage starting.
- 3. Electrical Characteristics:
 - a. Connections: As specified in Division 26 – Electrical.
 - b. Torque: A running torque per valve manufacturer's recommendation.

- c. Sufficient horsepower to open or close a valve against the maximum specified differential pressure when voltage to the motor is $\pm 10\%$ of nominal voltage with a factor of safety of 1.5.
- d. Voltage: 480 V, three phase, 60 Hz.
- e. Lubrication: Pre-lubricated.
- f. Bearings Type: Anti-friction
- g. Motor Rating: 30 minute duty.

E. Reduction Gearing:

- 1. Description: Single- or double-reduction unit of spur or helical gears and worm-gearing.
- 2. Lubrication: Grease or oil.
- 3. Bearings:
 - a. Type: Ball or Roller; comply with ABMA 9 or ABMA 11.
 - b. Minimum L10 Life: 100,000 hours.

F. Limit Switches:

- 1. Type: Heavy duty, open contact.
- 2. Actuation: Rotor cam.
- 3. Compartment: Totally enclosed and equipped with a heater and thermostat to prevent build-up of moisture and contamination.
- 4. Switches shall be SPDT and rated 10A at 120 VAC or as specified.
- 5. Actuating Point: Adjustable at any point of valve between fully open and fully closed.
- 6. Adjustment: Capable of quick adjustment requiring no more than five (5) turns of the adjustment spindle.
- 7. Contacts: One set of normally open and one set of normally closed contacts will be furnished and available for use by the plant control system at each end of travel where indicated. Contact shall be of silver and capable of reliably switching a low voltage DC source from the control system furnished by other.

G. Torque Limiting Switches:

- 1. Torque limiting switches shall be provided.
- 2. Torque limiting switches shall be responsive to the mechanical torque developed in seating, backseating, or by obstruction.
- 3. Accuracy: Within $\pm 5\%$
- 4. Calibration: The use of torque wrenches for calibration shall not be required. Calibrated by use of a dynamometer in order to accurately predict the output of the actuator.
- 5. A calibration tag stating the maximum torque output of each torque switch at 100% setting shall be permanently affixed to the torque switch dial.

H. Extended Shafts

- 1. Bonnets/shaft enclosures for valve shafts that extend through grating shall be connected to the valve body. No force shall be applied to the grating to actuate the valve.

I. Hand Wheel Operation:

- 1. A permanently attached hand wheel shall be provided for emergency manual operation.

2. A seized or inoperable motor shall not prevent manual operation.
3. The hand wheel shall not rotate during electrical operation.
4. Maximum Torque Required: 60 lb-ft.
5. Maximum Force Required: 60 lbs.
6. Inscription: An arrow and either the work OPEN or CLOSE shall be cast in the hand wheel to indicate the direction to turn hand wheel.
7. Minimum Diameter: 8 inches.

2.4 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assemblies.
- C. Certificate of Compliance:
 1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
 2. Specified shop tests are not required for Work performed by approved Manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that field dimensions are as indicated on Shop Drawings.

3.2 INSTALLATION

- A. Securely mount actuators using brackets or hardware specifically designed for attachment to valves.
- B. Extend chain actuators to 5-1/2 feet above operating floor level.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. After installation, inspect for proper supports and interferences.

- D. Repair damaged coatings with material equal to original coating as specified in Section 09 96 00 - High-Performance Coatings.

END OF SECTION 40 05 57

SECTION 40 05 59 - STAINLESS STEEL SLIDE GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Stainless-steel slide gates.
- B. Related Requirements:
 - 1. Section 03 30 00 – Cast-In-Place Concrete.
 - 2. Section 05 50 00 – Metal Fabrications.
 - 3. Division 40 – Process Interconnections.

1.2 REFERENCE STANDARDS

- A. American Water Works Association:
 - 1. AWWA C542 - Electric Motor Operators for Valves and Slide Gates.
 - 2. AWWA C561 - Fabricated Stainless Steel Slide Gates.
- B. National Sanitation Foundation:
 - 1. NSF Standard 61 - Drinking Water System Components - Health Effects.
 - 2. NSF Standard 372 - Drinking Water System Components - Lead Content.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with Work of other Sections.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's product information for system materials and component equipment.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
 - 2. Submit installation and anchoring requirements, fasteners, and other details.
 - 3. Indicate gate identification number, location, service, type, size, design pressure, operator details, stem details, and loads.

- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 1. Certify that installation is completed according to manufacturer's instructions.
- E. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Manufacturer Reports:
 - 1. Certify that equipment has been installed according to manufacturer's instructions.
 - 2. Indicate activities on Site, adverse findings, and recommendations.
- I. Qualifications Statements:
 - 1. Submit qualifications for manufacturer and licensed professional.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations of installed slide gates and components.
- C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
 - 1. Furnish one set of manufacturer's recommended spare parts.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store and protect materials according to manufacturer's instructions.

1.8 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. The Manufacturer and Contractor shall furnish a warranty extending twelve (12) months after substantial completion date.
- C. Furnish five year manufacturer's warranty that clear plastic stem covers will not crack, discolor, or become opaque.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Seating/Unseating Pressure:

1. Measurement: From maximum water surface to centerline of gate.

B. Minimum Vertical Loading: 50 percent of force on the gate from operating head acting on horizontal centerline of gate, multiplied by effective gate area, plus weight of slide and stem.

C. Gate Reinforcement: As required for deflection not greater than 1/360 of span.

D. Operating Head:

1. Safety Factor: Design gate to operate under specified operating head with safety factory of three.

2.2 STAINLESS-STEEL SLIDE GATES

A. Manufacturers:

1. Halliday Products
2. Waterman Industries
3. RW Gate Company
4. Whipps Inc
5. Golden Harvest, Inc
6. Rodney Hunt
7. Or Approved Equal

B. Description:

1. Comply with AWWA C561.
2. Self-contained stainless-steel slide gate, with extended frame, yoke, lifting stem attached to yoke, lift and lift support, stem, stem guide, and stem block.
3. Size: As indicated on Drawings.
4. Operating Head: As indicated on Drawings.
5. Closure: As indicated on Drawings.
6. Opening: As indicated on Drawings.

C. Gates:

1. Material:
 - a. Type 304 stainless steel.
2. Minimum Thickness: 3/16 inch.
3. Configuration: Removable.

D. Yokes:

1. Material: Stainless Steel.
2. Mounting: Bolted to gate frame.

E. Seats:

1. Impacted into dovetail slots and held in position without use of screws or other fasteners.
2. Maximum Clearance between Seating Faces: 0.004 inch when gate is fully closed.

F. Wedges:

1. Description: Machined brass blocks with angled faces and secured with a stud bolt to prevent slippage during operation.
2. Provide side, top, and bottom wedges.

G. Frames:

1. Configuration: One piece.
2. Mounting: As indicated on Drawings.
3. Material: Type 304 stainless steel.
4. Thickness: 1/4 inch.
5. Seats: Ultra-high-molecular-weight polymer.
6. Bottom Flush Closure: Resilient seal securely attached to frame along invert.

H. Lifting Devices:

1. Description: Stem, lifting nut, supports, bushings, stem cover, position indicator, and gear-assisted crank or electric-motor actuator as indicated in Gate Schedule.
2. Powered Lift Devices:
 - a. As specified in Section 40 05 23 - Common Work Results for Process Valves.
 - b. Comply with AWWA C542.

I. Lifting Nut:

1. Material: Brass.
2. Furnish grease fitting.
3. Furnish polymer bearing pads above and below lifting nut.

J. Lifting Stem:

1. Material: Type 304 stainless steel.
2. Configuration:
 - a. Rising.
 - b. Removable.
3. Thread:
 - a. Acme, double lead.
 - b. Cut threads are not acceptable.
4. Diameter: 1-1/8 inch (minimum).
5. Fully lubricated.
6. Maximum Number of Turns: 16 per foot of travel.
7. Stem Covers: Provide rising stem gates with clear polycarbonate covers, capped, vented, and of a length to allow full travel of gate.

2.3 FINISHES

- A. Stainless-Steel Surfaces: Mill finish.

2.4 ACCESSORIES

- A. Hardware: Type 316 stainless steel.
- B. Nameplates: As specified in Section 46 05 53- Identification for Water and Wastewater Equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that facilities are ready to receive slide gates.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Clean surfaces according to manufacturer's instructions.

3.3 INSTALLATION

- A. Install slide gates according to manufacturer's instructions.
- B. Ensure that products are installed plumb, true, and free of warp or twist.
- C. Locate operators to avoid interference with handrails and other Work.
- D. Guides:
 - 1. Surface and Flange Mounted:
 - a. Install guides with expansion anchors.
 - b. Position guides at elevation as indicated on Drawings.
 - 2. Recessed:
 - a. Position guides at elevation as indicated on Drawings.
 - b. Grout guides in place according to manufacturer's instructions.
- E. Sealant:
 - 1. Apply 1/8-inch -thick layer of elastomeric sealant to back of frame.
 - 2. Tighten nuts snug until sealant begins to flow beyond frame.
 - 3. Remove excess sealant.
 - 4. Cure sealant for minimum seven days.
 - 5. Tighten nuts to their final positions.
- F. Lubricants: Provide oil and grease as required for initial operation.

3.4 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Inspection:
 - 1. Verify alignment of gate and components.
 - 2. Verify that gate operates smoothly and does not bind or scrape.
- C. Testing:
 - 1. Comply with AWWA C561.
 - 2. Leakage: Not exceeding 0.1 gpm/ft. of seating perimeter under 20 feet of seating head and not exceeding 0.21 gpm/ft. under 20 feet of unseating head.
- D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 2 days on Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.
- E. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and re-inspect.
 2. Make final adjustments to equipment under direction of manufacturer's representative.
- F. Furnish installation certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

3.5 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Adjust slide gates to provide smooth operation.

3.6 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment operation, routine maintenance, and emergency repair procedures to Owner's personnel.

3.7 ATTACHMENTS

- A. Gate Schedule (see Drawings)

END OF SECTION 40 05 59

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SECTION 40 05 61 - GATE VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient-seated gate valves.
 - 2. Solid wedge, metal-seated gate valves.
 - 3. General duty gate valves smaller than 3 inches.
- B. As specified in Section 40 05 51 - Common Requirements for Process Valves
- C. Related Requirements:
 - 1. Division 40 - Process Interconnections

1.2 REFERENCE STANDARDS

- A. American Water Works Association:
 - 1. AWWA C515 Ductile Iron
 - 2. AWWA C550 Fusion-bonded epoxy coatings
- B. ASME International:
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. ASME B16.5 - Pipe flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard.
 - 3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
- C. ASTM International:
 - 1. ASTM A536 - Standard Specification for Ductile Iron Castings

PART 2 - PRODUCTS

2.1 RESILIENT-SEATED GATE VALVES

- A. Manufacturers:
 - 1. M&H Valve Co., Anniston, AL
 - 2. Henry Pratt Co., Aurora, IL
 - 3. Or approved equal

B. Description:

1. As specified in Section 40 05 51 - Common Requirements for Process Valves.
2. Comply with AWWA C509; NSF Standard 61.
3. Minimum Working Pressure: 250 psig.
4. End Connections: ASME B16.1 Flanged, ANSI A21.11 Mechanical joint.
5. Gear Actuators for Manual Valves: Comply with AWWA C509.

C. Operation:

1. As specified in Section 40 05 51 - Common Requirements for Process Valves.
2. Stem: Non-rising.
3. Handwheel.
4. Furnish gear operators for valves 24 inches and larger, and chainwheel operators for valves mounted over 7 feet above operating floor.

D. Materials:

1. Wedge: Resilient ASTM A536, ductile iron, fully encapsulated with molded rubber per ASTM D429.
2. Body and Disc: ASTM A536, ductile iron, rubber Buna-N coated.
3. Stem, Stem Nuts, Glands, and Bushings: ASTM B584, bronze.
4. Connecting Hardware: Type 316 stainless steel.

2.2 SOLID WEDGE, METAL-SEATED GATE VALVES

A. Manufacturers:

1. M&H Valve Co., Anniston, AL
2. Henry Pratt Co., Aurora, IL
3. Or approved equal

B. Description:

1. As specified in Section 40 05 51 - Common Requirements for Process Valves.
2. Comply with AWWA C500.
3. Minimum Working Pressure: 250 psig .
4. Wedge: One piece, solid.
5. End Connections: ASME B16.1 Flanged, ANSI A21.11 Mechanical joint.

C. Operation:

1. As specified in Section 40 05 51 - Common Requirements for Process Valves.
2. Buried Service: Non-rising stem.
3. Interior and Exposed Service:
 - a. Outside screw and yoke (OS&Y).
 - b. Provide NRS valves with position indicators.
4. Gear Actuators for Manual Valves: Comply with AWWA C500.
5. Valves 24 Inches and Larger: Furnish bevel or spur gear operator.

D. Materials:

1. Comply with AWWA C500.
2. Body, Bonnet, Wedge, and Gland: ASTM A536, ductile iron.
3. Handwheel Nut: Ductile iron 2 inch.
4. Stem: Stainless steel 304.
5. Trim: Bronze B62.
6. Packing: Non-asbestos graphite.
7. Rollers and Tracks: Bronze.
8. Rubber Components: Buna-N.
9. Connecting Hardware: Type 316 stainless steel.

E. Finishes: As specified in Section 40 05 51 - Common Requirements for Process Valves.

2.3 GENERAL-DUTY GATE VALVES - 3 INCHES AND SMALLER

A. Manufacturers:

1. NIBCO Inc., Elkhart, IN
2. Watts Water Technologies, North Andover, MA
3. Or approved equal.

B. 3 Inches and Smaller:

1. Comply with MSS SP-80, Class 150.
2. Maximum Process Fluid Temperature: 366 °F.
3. Body and Trim: Bronze, ASTM B62.
4. Bonnet: Threaded.
5. Operation: Handwheel.
6. Inside screw with backseating stem.
7. Wedge Disc:
 - a. Type: Solid.
 - b. Bronze, ASTM B62.
8. Alloy seat rings.
9. End Connections: Soldered or threaded.

2.4 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly according to AWWA C509.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXECUTION, INSTALLATION AND FIELD QUALITY CONTROL

- A. As specified in Section 40 05 51 - Common Requirements for Process Valves: Submittal requirements for compliance with this Section.
- B. According to AWWA C500, C509.

END OF SECTION 40 05 61

SECTION 40 05 62 - PLUG VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Eccentric plug valves.
 - 1. This specification shall cover all plug valves except for those included in biological nutrient removal (BNR) equipment package. Plug valves in BNR package shall be specified in Section 46 53 54 – Biological Wastewater Treatment System.
- B. Conform to the requirements of Section 40 05 51 - Common Requirements for Process Valves.
- C. Related Requirements:
 - 1. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

- A. American Water Works Association:
 - 1. AWWA C517 - Resilient-Seated Cast-Iron Eccentric Plug Valves.
- B. ASME International:
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
 - 3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
 - 4. ASME B1.20.1 - Pipe Threads, General Purpose, Inch.
- C. ASTM International:
 - 1. ASTM A536 - Standard Specification for Ductile Iron Castings.
 - 2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

PART 2 - PRODUCTS

2.1 ECCENTRIC PLUG VALVES

- A. Manufacturers:
 - 1. Dezurik
 - 2. Milliken; Henry Pratt Company
 - 3. Or approved equal

B. Description:

1. Type:
 - a. Non-lubricated.
 - b. Eccentric.
 - c. 90 Degree Turn
 - d. Resilient faced Plug
2. Working Pressure: 175 psig for valves through 12" and 150 psig for valves for 14" through 72".
3. Ports:
 - a. Configuration: Rectangular
 - b. Minimum Port Area: 100 percent of nominal pipe area for valves.
4. Stem Bearings: Self-lubricating.
5. Stem Seals:
 - a. Type: V-ring.
 - b. Material: Buna-N
6. End Connections:
 - a. Flanged: Comply with ANSI 125/150 lb. Standard
 - b. Mechanical Joint

C. Operation:

1. As specified in Section 40 05 57 Actuators for Process Valves and Gates.

D. Materials:

1. Body:
 - a. Cast iron, ASTM A126 Class B.
 - b. Lining: As recommended by valve manufacturer for service conditions.
2. Plug:
 - a. Cast iron, ASTM A126 Class B.
 - b. Lining: Buna N
3. Seats: 1/8", welded, 90% pure nickel.
4. Stem Bearings: Type 316L stainless steel.
5. Seals: Buna-N.
6. Connecting Hardware: Type 316 stainless steel.

E. Finishes: As specified in Section 40 05 51 - Common Requirements for Process Valves.

F. Plug valves at biological nutrient removal basins shall be included in the scope of system supplier. For detailed scope of plug valves, refer to valve schedule in drawings.

2.2 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

- B. As specified in Section 40 05 51 - Common Requirements for Process Valves.
- C. Testing: Test gate valves according to AWWA C509.

PART 3 - EXECUTION

3.1 EXAMINATION, INSTALLATION AND FIELD QUALITY CONTROL

- A. As specified in Section 40 05 51 - Common Requirements for Process Valves
- B. According to AWWA C517.
- C. Horizontal Piping: Stem horizontal.
- D. Vertical Piping: Plug at top when closed.
- E. Plugs: On top when open and on pressure side when closed.

END OF SECTION 40 05 62

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SECTION 40 05 63 - BALL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal-seated ball valves.
2. Plastic ball valves.
3. Ball valves in biological treatment system and tertiary filters equipment package shall be provided by Manufacturers, and shall be governed by respective specifications in lieu of this specification.

B. Conform to requirements of Section 40 05 51 – Common Requirements for Process Valves

C. Related Requirements:

1. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C507 - Ball Valves, 6 In. Through 60 In.

B. ASME International:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

C. ASTM International:

1. ASTM D1784 - Standard Specification for Rigid PolyVinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.
2. ASTM D3222 - Standard Specification for Unmodified Poly Vinylidene Fluoride (PVDF) Molding Extrusion and Coating Materials.
3. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.

D. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

PART 2 - PRODUCTS

2.1 RUBBER-SEATED BALL VALVES

A. Manufacturers:

1. Henry Pratt Company
2. APCO
3. GA
4. Or Pre-Approved Equal

B. 4 Inches through 48 Inches:

1. AWWA C507, Class 150.
2. Body:
 - a. Material: Ductile iron, ASTM A536.
 - b. Seats: Rubber.
3. Ball:
 - a. Material: Cast iron, ASTM A126 or Ductile iron, ASTM A536.
 - b. Bearing Seal, O-Rings, and Packing: Buna-N.
4. Shaft and Attachment Pins: Type 316 stainless steel.
5. Bearings: PTFE-lined with fiberglass backing.
6. Shaft Seals: Self-lubricating and self-adjusting.
7. Connecting Hardware: Type 316 stainless steel.
8. End Connections:
 - a. Flanged: Comply with ASME B16.1.
9. Operator: Handwheel.

C. Smaller Than 4 Inches:

1. Comply with MSS SP 110.
2. Body:
 - a. Type: Two piece.
 - b. Material: Bronze.
3. Ball: Stainless steel.
4. Port: Full.
5. Seats: PTFE.
6. Stem: Blowout proof.
7. End Connections: Threaded, with union.
8. Operator: as scheduled
9. Finishes: As specified in Section 40 05 51 - Common Requirements for Process Valves.

2.2 PLASTIC BALL VALVES

A. Manufacturers:

1. Hayward
2. Or Pre-Approved Equal

B. Description:

1. Working Pressure: 232 psig at 68 °F.
2. Ports: Full size.
3. End Connections:
 - a. Socket Union
 - b. Threaded Pipe Union.

C. Operator: Manual unless otherwise specified or shown.

D. Materials:

1. Body and Ball: PVC, CPVC, PP as specified, shown on drawings, or recommended by the Manufacturer for the service conditions specified.
2. Seats: PTFE.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. As specified in Section 40 05 51 - Common Requirements for Process Valves.
- C. Testing: Test ball valves according to AWWA C507.

PART 3 - EXECUTION

3.1 EXAMINATION, INSTALLATION AND FIELD QUALITY CONTROL

- A. As specified in Section 40 05 51 - Common Requirements for Process Valves.
- B. According to AWWA C507.

END OF SECTION 40 05 63

SECTION 40 05 64 - BUTTERFLY VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rubber-seated butterfly valves.

B. Conform to the requirements of Section 40 05 51 - Common Requirements for Process Valves

C. Related Requirements:

1. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C504 - Rubber-Seated Butterfly Valves.

B. ASME International:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

C. ASTM International:

1. ASTM A536 - Standard Specification for Ductile Iron Castings.
2. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
3. ASTM D3222 - Standard Specification for Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
4. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.

PART 2 - PRODUCTS

2.1 RUBBER-SEATED BUTTERFLY VALVES

A. Manufacturers:

1. Milliken; Henry Pratt Company, Aurora, IL
2. DeZurik, Sartell, MN

3. Or Pre-Approved Equal

B. Description:

1. Comply with AWWA C504, Class 150.
2. Minimum Working Pressure: 150 psig.
3. Shaft: Bearings shall be non-metallic and permanently lubricated.
4. Seats:
 - a. Mounting: On body for valves 24 inches and smaller.
 - b. Type: Field replaceable for valves larger than 30 inches.
5. Packing: V-type packing with a minimum of 4 sealing rings.
6. End Connections: Flanged end valves of short body design with 125 lb. flanged ends faced and drilled per ANSI B16.1 standard for cast iron flanges.

C. Operator:

1. As specified in Section 40 05 57 – Actuators for Process Valves and Gates
2. Gear Actuators for Manual Valves: Comply with AWWA C504.

D. Materials:

1. Body: Cast iron, ASTM A126.
2. Stem: Stainless steel.
3. Disc: Cast iron, ASTM A48, Class 4C.
4. Seats:
 - a. Type: Resilient and replaceable.
 - b. Material: Buna N for water, or as required for other services
5. Seating Surfaces: Type 316 stainless steel.
6. Bearings: Aluminum Bronze, ASTM B148, C954
7. Connecting Hardware: Type 316 stainless steel.

E. Finishes: As specified in Section 09 96 00 – High-Performance Coatings.

2.2 BUTTERFLY VALVES FOR AIR SERVICE

A. Manufacturers:

1. M and H: Anniston, AL
2. Henry Pratt Company; Aurora, IL
3. DeZurik; Sartell, MN
4. Or Pre-Approved Equal

B. Description:

1. Comply with AWWA C504, Class 150.
2. Minimum Working Pressure: 175 psig.
3. Shaft: Bearings shall be non-metallic and permanently lubricated.
4. Seats:

- a. Mounting: On body for valves 24 inches and smaller.
 - b. Type: Field replaceable for valves larger than 30 inches.
- 5. Packing: V-type packing with a minimum of 4 sealing rings.
- 6. End Connections: Flanged end valves of short body design with 125 lb. flanged ends faced and drilled per ANSI B16.1 standard for cast iron flanges.
- C. Operator:
 - 1. As specified in Section 40 05 57 – Actuators for Process Valves and Gates.
 - 2. Gear Actuators for Manual Valves: Comply with AWWA C504.
- D. Materials:
 - 1. Body: Cast iron, ASTM A126.
 - 2. Stem: Stainless steel.
 - 3. Disc: Cast iron, ASTM A48, Class 4C with welded nickel edge.
 - 4. Seats:
 - a. Type: Resilient and replaceable.
 - b. Material: EPDM for air service.
 - 5. Seating Surfaces: Type 316 stainless steel.
 - 6. Bearings: Aluminum Bronze, ASTM B148, C954
 - 7. Connecting Hardware: Type 316 stainless steel.
- E. Finishes: As specified in Section 40 05 51 - Common Requirements for Process Valves.
- F. Butterfly valves for biological nutrient removal basins shall be included in Section 46 53 54 - Biological Wastewater Treatment System. Referenced butterfly valves shall be provided by BNR system supplier.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. As specified in Section 40 05 51 - Common Requirements for Process Valves.
- C. Testing: Test butterfly valves according to AWWA C504.

PART 3 - EXECUTION

3.1 EXAMINATION, INSTALLATION AND FIELD QUALITY CONTROL

- A. As specified in Section 40 05 51 - Common Requirements for Process Valves.
- B. According to AWWA C504.

END OF SECTION 40 05 64

SECTION 40 05 65.23 - SWING AND DISC CHECK VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Swing check valves three (3) inches and larger.

B. Conform to the requirements of Section 40 05 51 – Common Requirements for Process Valves.

C. Related Requirements:

1. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm through 600-mm) NPS.

B. ASME International:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
2. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.
3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

C. ASTM International:

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
2. ASTM A536 - Standard Specification for Ductile Iron Castings.
3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
4. ASTM B148 - Standard Specification for Aluminum-Bronze Sand Castings.

PART 2 - PRODUCTS

2.1 STANDARD SWING CHECK VALVES

A. Manufacturers:

1. DeZurik
2. Milliken
3. APCO

4. Or Pre-Approved Equal

B. Description:

1. Type: Swing, resilient seated with outside lever and adjustable weight.
2. Comply with AWWA C508.
3. Swing check valves shall be used for water and wastewater service.
4. Check valves used for air service shall be provided by the biological treatment system supplier. These valves shall be specified in Section 46 53 54 – Biological Wastewater Treatment System.
5. Minimum Working Pressure: 200 psig for 2” - 12” and 150 psig for 14” - 30”
6. Flow area: Full open, equal to connecting nominal pipe diameter.
7. Check valves 6 inches and larger: Furnish with adjustable air cushion chambers.
8. Mounting: Horizontal or vertical.
9. End Connections: Integral flange ends shall be ANSI B16.1 Class 125, suitable for horizontal or vertical installation.

C. Materials:

1. Body and Cover: Ductile iron, ASTM A536.
2. Disc, Disc Arm: Ductile iron, ASTM A536.
3. Body Seat: Replaceable, Type 316 ASTM A276 with Buna-N renewable seat ring.
4. Shaft: Type 303 Stainless Steel ASTM A582.
5. Disc Seat: Buna-N.
6. Lever and Counterweight: Ductile Iron, ASTM A536.
7. Hinge Pin and Key: Type 316 Stainless Steel.
8. Rubber Components: Buna-N.
9. Connecting Hardware: Type 304 Stainless Steel.

- D. Finishes:** As specified in Section 40 05 51 - Common Requirements for Process Valves.

2.2 SYNTHETIC DISC CHECK VALVE

A. Manufacturers:

1. Valmatic
2. APCO
3. Or Pre-Approved Equal

B. Description:

1. Comply with AWWA C508.
2. Minimum Working Pressure: 200 psig for 2” - 12” and 150 psig for 14” - 30”
3. Type: Swing, flexible disc check valve, full body flow type.
4. Mounting: Horizontal or vertical.
5. End Connections: Integral flange ends shall be ANSI B16.1 Class 125, suitable for horizontal or vertical installation

C. Materials:

1. Body and Cover: Ductile iron, ASTM A536
2. Disc: Precision molded Buna-N ASTM D2000
3. Epoxy Coated Interior.
4. Screw-Type Stainless Steel backflow actuator.
5. Mechanical Position indicator.
6. Open-Close position indicator limit switch (if required per P&ID drawings).

D. Finishes: As specified in Section 40 05 51 - Common Requirements for Process Valves.

2.3 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Testing:

1. Hydrostatically test check valves at twice rated pressure according to AWWA C508.
2. Permitted Leakage at Indicated Working Pressure: None.

PART 3 - EXECUTION

3.1 EXAMINATION, INSTALLATION AND FIELD QUALITY CONTROL

A. As specified in Section 40 05 51 - Common Requirements for Process Valves.

B. According to AWWA C508.

END OF SECTION 40 05 65.23

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SECTION 40 05 67.36 - PRESSURE-REGULATING VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pressure-reducing valves (PRV).

B. Conform to the requirements of Section 40 05 51 - Common Requirements for Process Valves

C. Related Requirements:

1. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C530-12 – Pilot-Operated Control Valves

B. ASME International:

1. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300.

C. ASTM International:

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
2. ASTM A216 - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
3. ASTM A536 - Standard Specification for Ductile Iron Castings.
4. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

D. American Water Works Association:

1. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.

PART 2 - PRODUCTS

2.1 PRESSURE-REDUCING VALVES (PILOT OPERATED)

A. Manufacturers:

1. Cla-Val.
2. Singer Valve.
3. Flomatic Corporation.
4. Or Pre-Approved Equal.

B. Description:

1. Normally open or closed valves to maintain constant downstream pressure regardless of changing flow rate or varying inlet pressure, and to prevent backflow.
2. Type: Pilot operated.
3. Furnish V-ports for pressure control at low flows.
4. Indicator Rod: Attached to piston for visual position indication.

C. Pilot Valves:

1. Type: Globe or Angle
2. Body: Cast iron, Ductile iron, Steel, or Stainless steel.

D. End Connections:

1. Flanged, ASME B16.5 or B16.42, Class 150.

E. Performance and Design Criteria:

1. Flow Rate: as shown on drawings.
2. Maximum Upstream Pressure: 200 psig
3. Set Point Downstream Pressure:
 - a. As indicated on Drawings.
 - b. Range: Field adjustable from near zero to 110 percent.

F. Materials:

1. Body: Cast iron, ASTM A126, Class B or Ductile iron, ASTM A536
2. Disc and Diaphragm:
 - a. Buna-N rubber.
 - b. Disc Retainer and Diaphragm Washer: Cast iron or Cast steel or Bronze.
3. Trim: Bronze or Stainless steel
4. Stem, Nut, and Spring: Stainless steel
5. Packing: PTFE
6. Control Piping: Brass or Bronze with stainless-steel wetted trim.

G. Interior Coating: Coat cast-iron and ductile-iron surfaces with epoxy coating according to AWWA C550.

H. Accessories:

1. Externally mounted strainer with cocks.
2. Isolation valve.
3. Check valves.
4. Low-flow bypass.
5. Position Indicator.
6. Inlet and Outlet Pressure Gauges.

2.2 PRESSURE REDCUING VALVES (1/2 thru 2 inch)

A. Manufacturers:

1. Watts.
2. Or Pre-Approved Equal.

B. Description:

1. Normally open or closed valves to maintain constant downstream pressure regardless of changing flow rate or varying inlet pressure, and to prevent backflow.
2. Type: Water pressure reducing valve with integral strainer.

C. Materials:

1. Body: Cast copper-silicon alloy.
2. Threaded female union inlet with threaded NPT outlet.
3. Trim: Bronze or Stainless steel.
4. Stem, Nut, and Spring: Stainless steel.
5. Packing: PTFE.

PART 3 - EXECUTION

3.1 EXAMINATION, INSTALLATION AND FIELD QUALITY CONTROL

- A. As specified in Section 40 05 51 - Common Requirements for Process Valves.
- B. According to AWWA C530-12.

END OF SECTION 40 05 67.36

SECTION 40 05 71.33 - TELESCOPING VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Telescoping valves.
- B. Related Requirements:
 - 1. Section 40 05 51 - Common Requirements for Process Valves: Basic materials and methods related to valves commonly used for process systems.

1.2 REFERENCE STANDARDS

- A. American Water Works Association:
 - 1. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information, indicating materials of construction and compliance with indicated standards.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Qualifications Statement:
 - 1. Submit qualifications for manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.5 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.6 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish one year manufacturer's warranty for telescoping valves.

PART 2 - PRODUCTS

2.1 TELESCOPING VALVES

- A. Manufacturers:
 - 1. Troy Valve
 - 2. Halliday Products
 - 3. Waterman Industries
 - 4. Trumbull Manufacturing
 - 5. Or Pre-Approved Equal
- B. Description:
 - 1. Type: Rack and pinion.
 - 2. Handwheel:
 - a. Comply with AWWA C500.
 - b. Cast opening direction arrow with word OPEN.
 - 3. Pedestal: Minimum 6-inch diameter.
- C. Additional Features:
 - 1. Scum baffle
 - 2. Handwheel extension of approximately 3 ft to extend handwheel past handrail around tank.

D. Materials:

1. Telescopic Tube and Bail:
 - a. Type 304 stainless steel.
 - b. Minimum Thickness: Schedule 10S.
2. Guide Collar: Type 304 stainless steel.
3. Stem: Type 304 stainless steel.
4. Stem Cover: Butyrate plastic.
5. Handwheel: Cast aluminum.
6. Pedestal: Type 304 stainless steel, Schedule not less than 20.
7. Mounting Bracket:
 - a. Type 304 stainless steel.
 - b. Anchor Bolts: Type 316 stainless steel.
8. Connecting Hardware: Type 316 stainless steel.
9. Scum Baffle: 304 stainless steel

E. Finishes: As specified in Section 40 05 51 - Common Requirements for Process Valves.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed valve assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. As specified in Section 40 05 51 - Common Requirements for Process Valves.

3.2 INSTALLATION

- A. Install according to manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

- A. As specified in Section 40 05 51 - Common Requirements for Process Valves.

END OF SECTION 40 05 71.33

SECTION 40 05 78 - COMBINATION AIR VALVES FOR WASTEWATER SERVICE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Combination air valves for wastewater treatment facilities.
- B. Related Requirements:
 - 1. Section 09 96 00 - High Performance Coatings
 - 2. Division 40 - Process Interconnections

1.2 REFERENCE STANDARDS

- A. American Water Works Association:
 - 1. AWWA C512 - Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
- B. ASME International:
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- C. ASTM International:
 - 1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. ASTM A536 - Standard Specification for Ductile Iron Castings.
- D. International Organization for Standardization:
 - 1. ISO 9001 - Quality Management Systems.

PART 2 - PRODUCTS

2.1 COMBINATION AIR VALVES FOR WASTEWATER SERVICE

- A. Manufacturers:
 - 1. A.R.I
 - 2. DeZurik.
 - 3. Valmatic
 - 4. H-TEC
 - 5. Or Pre-Approved Equal

B. Description:

1. Type:
 - a. Automatic, float operated.
 - b. Body: Single.
2. Comply with AWWA C512.
3. Size: As indicated on Drawings.
4. Suitable for sewage service.

C. Materials:

1. Body and Cover: Stainless steel with stainless steel screws, unless indicated in the plan set.
2. Float, Seat, and Trim: Stainless steel.
3. Seats: Buna-N.
4. Seals: Buna-N.

D. End Connections - Single Body:

1. Size 4 Inches and Smaller:
 - a. Threaded, NPT.
 - b. 1-Inch Valves: Furnish 2-inch inlet.
2. Backwash Accessories: NPT connections.

E. Valve Body Connections:

1. Threaded, NPT.
2. Cleanout: 2 inches.
3. Drain: 1 inch.

F. Accessories:

1. Backwash accessories, including inlet shutoff valve, blowoff valve, rubber supply hose, and quick-disconnect couplings.

2.2 INSULATION

- A. As specified in Section 40 42 13 - Process Piping Insulation.

2.3 FINISHES

- A. Prepare piping appurtenances for field finishes as specified in Section 09 96 00 - High-Performance Coatings.

2.4 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

- B. Provide shop inspection and testing of completed assembly.
- C. Certificate of Compliance:
 - 1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 - 2. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that field dimensions are as indicated on Shop Drawings.
- C. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flanges mate properly.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Thoroughly clean end connections before installation.
- C. Close pipe and equipment openings with caps or plugs during installation.
- D. Cleaning: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

- A. According to manufacturer instructions.
- B. Provide access for operation, removal, and maintenance, and to avoid discharge to occupied areas or other equipment.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Inspect for interferences and proper supports.

D. Testing:

1. As specified in Section 40 05 51 - Common Requirements for Process Valves.
2. Demonstrate operation without undue noise or vibration.

E. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.
3. Repair damaged coatings with material equal to original coating.

F. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Keep interior of air release valves clean as installation progresses.

END OF SECTION 40 05 78

SECTION 40 05 82 - SOLENOID VALVES FOR PROCESS SERVICE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Solenoid valves for process applications.
- B. Related Requirements:
 - 1. Section 40 05 51 - Common Requirements for Process Valves: Basic materials and methods related to valves commonly used for process systems.

1.2 REFERENCE STANDARDS

- A. ASTM International:
 - 1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information, indicating materials of construction and compliance with indicated standards.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.5 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.6 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.**

PART 2 - PRODUCTS

2.1 SOLENOID VALVES

A. Manufacturers:

1. Asco; Florham Park, NJ
2. Or Pre-Approved Equal

B. Description:

1. Type: As indicated on Drawings.
2. Working Pressure: 120 psig at 180 degrees F.
3. Coil: Continuous duty.
4. Operation: Fail close, energize to open unless noted otherwise.
5. Enclosures: NEMA 250 rated according to area designation.
6. Electrical Characteristics: As indicated on Drawings.
7. End Connections: Screwed.
8. Conduit Connection: Threaded.

C. Materials:

1. Body: Brass.
2. Trim and Spring: Stainless steel.
3. Seals: Resilient, PTFE.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. As specified in Section 40 05 51 - Common Requirements for Process Valves.

3.2 INSTALLATION

- A. As specified in Section 40 05 51 - Common Requirements for Process Valves.

3.3 FIELD QUALITY CONTROL

- A. As specified in Section 40 05 51 - Common Requirements for Process Valves.

END OF SECTION 40 05 82

SECTION 40 23 19 - NON-POTABLE PLANT WATER PROCESS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes and tubes for conveying non-potable process water.
2. Valves for conveying non-potable process water.
3. Connect new pipe to existing reuse water loop at the facility.
4. Extend existing reuse water piping as indicated on drawings.

B. Related Requirements:

1. Section 05 50 00 - Metal Fabrications: Miscellaneous metalwork and fasteners as required by this Section.
2. Section 40 05 51 - Common Work Results for Process Valves: Execution requirements for valves specified by this Section.
3. Section 40 05 61 - Gate Valves: Execution requirements for gate valves as required by this Section.
4. Section 40 05 63 - Ball Valves: Execution requirements for ball valves as required by this Section.
5. Section 40 05 64 - Butterfly Valves: Execution requirements for butterfly valves as required by this Section.

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers:

1. ASME B31.3 - Process Piping Design.

B. ASTM International:

1. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
2. ASTM B75 - Standard Specification for Seamless Copper Tube.

C. American Water Works Association:

1. AWWA C950 - Fiberglass Pressure Pipe.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Spare Parts:

1. Furnish one (1) set of manufacturer's recommended spare parts.
 2. Furnish a complete list of manufacturer's recommended spare parts.
- C. Tools: Furnish special wrenches and other devices required for Owner to maintain completed installation.

PART 2 - PRODUCTS

2.1 PIPES AND TUBES FOR CONVEYING NON-POTABLE PROCESS WATER

- A. Manufacturers:
1. Eslon Thermoplastics; Charlotte, NC
 2. R&G Sloane, Sun Valley, CA
 3. Harvel Plastics, Easton, PA
 4. LCP Chemicals & Plastics, Colfax, NC
 5. Bristol Corp., Bristol, IN
 6. Or Pre-Approved Equal
- B. Furnish pipes and tubes, fittings, appurtenances, and accessories as specified in Section 40 05 13 - Common Work Results for Process Piping, as indicated on pipe schedule, and as specified by pipe material in Division 40 - Process Integration.
- C. Piping Material:
1. Piping < 4"
 - a. Piping shall be PVC pipe shall be rigid, Type I, Grade I, ANSI/ASTM D-1784, D-1785 polyvinyl chloride Schedule 80 pipe.
 - b. Pipe shall contain less than 10% inert fillers
 - c. All pipe shall be joined utilizing socket couplings or fittings by first applying a primer such as that equal to IPS Weld-on P-70, then applying a solvent cement. Flanged fittings may be used. Where threaded pipe must be used, it shall be threaded with new threading dies which shall not be used for the threading of iron or other metal pipe
 2. Piping > 4"
 - a. All pipe shall meet the requirements of ASTM D-2241
 - b. Pipe supplied with solvent cement joint shall meet the requirements of ASTM D-2672.
 - c. Pipe supplied with a gasketed joint shall meet the requirements of ASTM D-3139, and the joint gasket shall conform to the requirements of ASTM F-477.
 - d. Pipe shall be colored based on applications as follows:
 - 1) Purple - Reclaimed Water
 - 2) White - Non-potable Water
 3. Buried pipe shall have both marking tape and wrapped with locating wire.
 4. Unless otherwise shown on drawings or specified, pipe shall be as follows:
 - a. Pressure force mains: SDR 21

- b. Gravity Drain Lines: SDR 26

2.2 VALVES FOR CONVEYING NON-POTABLE PROCESS WATER

- A. Furnish valves, appurtenances, and accessories as specified in Section 40 05 23 - Common Work Results for Process Valves, as indicated on pipe schedule, and as specified by valve type in Division 40 - Process Integration.
 - 1. Furnish shutoff and drain valves at locations as indicated on Drawings, according to this Section.
 - 2. Install shutoff and isolation valves; isolate equipment, part of systems, or vertical risers as indicated on Drawings.
 - 3. Install valves for throttling, bypass, or manual flow-control services as indicated on Drawings.
 - 4. Install ball, butterfly, and gate valves in process potable water systems for shutoff service.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify conditions as specified in Section 40 05 13 - Common Work Results for Process Piping and Section 40 05 51 - Common Work Results for Process Valves.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Comply with requirements as specified in Section 40 05 13 - Common Work Results for Process Piping.
- C. Protect equipment from damage and intrusion of water and other materials.
- D. Repair damaged coatings with material equal to the original coating as specified in Section 09 96 00 – High-Performance Coatings.

3.3 INSTALLATION

- A. Install piping and appurtenances as indicated on Drawings using minimum number of joints and according to manufacturer's instructions and ASME B31.3.
- B. In locations where pipe expansion joints are indicated, install pipe alignment guides adjacent to and within four pipe diameters of joint.

- C. Field Fabrication: Fabricate fittings according to manufacturer's instructions.
- D. Provide thrust restraints as required.
- E. Provide flexible couplings and expansion joints at connections to equipment and where indicated on Shop Drawings.
- F. Install couplings, service saddles, and anchors according to manufacturer's instructions.
- G. Provide upstream and downstream clearances according to component manufacturer's recommendations.
- H. Local Indicators:
 - 1. Install direct-reading indicator devices such as thermometers and pressure gages, to be read from floor level and accessible for maintenance and service.
 - 2. Install according to manufacturer's instructions.
- I. Orientate valves to permit operation and maintenance access to the valve operator and to avoid interferences with other equipment.

3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Field calibrate local indicators at time of piping installation.

END OF SECTION 40 23 19

SECTION 40 41 13 - PROCESS PIPING ELECTRICAL RESISTANCE HEAT TRACING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Self-regulating cables.
2. Heat-tracing controls.

B. Related Requirements:

1. Section 26 00 00 - Electrical: Execution requirements for electrical connections to equipment specified by this Section.
2. Section 40 05 13 - Common Work Results for Process Piping: Piping components, appurtenances, and identification requirements common to process piping systems.
3. Section 40 05 53 - Identification for Process Piping: Labels as required by this Section.

1.2 DEFINITIONS

- A. Self-Regulating Index (SRI):** The rate of change of power output in Watts per degree F, as measured between the temperatures of 50 degrees F and 100 degrees F.

1.3 REFERENCE STANDARDS

A. ASTM International:

1. ASTM B193 - Standard Test Method for Resistivity of Electrical Conductor Materials.
2. ASTM D2633 - Standard Test Methods for Thermoplastic Insulations and Jackets for Wire and Cable.

B. FM Global:

1. FM Approval Guide.

C. International Electrotechnical Commission:

1. IEC 216-1 - Guide for the Determination of Thermal Endurance Properties of Electrical Insulating Materials - Part 1: General Procedures for the Determination of Thermal Endurance Properties, Temperature Indices and Thermal Endurance Profiles.
2. IEC 60800 - Heating cables with a rated voltage of 300/500 V for comfort heating and prevention of ice formation.

D. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 V Maximum).

- E. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code (NEC).

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's product data for system materials and component equipment, including thermal properties, electrical characteristics, and connection requirements.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
 - 2. Submit wiring and control diagrams, installation and anchoring requirements, fasteners, and other details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 1. Certify installation is completed according to manufacturer's instructions.
- E. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Manufacturer Reports: Indicate that equipment has been installed according to manufacturer's instructions.
- H. Qualifications Statement:
 - 1. Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations of piping receiving heat tracing and locations of source power and controls.
- C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

- B. Deliver materials in manufacturer's packaging, including application instructions.
- C. Inspection: Accept heat tracing on-Site in original packaging. Inspect for damage.
- D. Store heat tracing and components according to manufacturer's instructions.
- E. Protect heat tracing from water and wet weather.

1.7 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.8 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five (5) year manufacturer's warranty for heat tracing and components.

PART 2 - PRODUCTS

2.1 SELF-REGULATING CABLE

- A. Manufacturers:
 - 1. RayChem; Spring, TX
 - 2. Thermon; San Marcos, TX
 - 3. Or Pre-Approved Equal
- B. Description:
 - 1. Bus Wires: Two, parallel; nickel-coated copper; minimum size 16 AWG.
 - 2. Heating Element: Self-regulating polymeric core.
 - 3. Jacketing:
 - a. Tinned copper braid with resistance less than cable bus wire resistance, as determined by ASTM B193.
 - b. Fluoropolymer insulating jacket.
 - 4. Cable Temperature Identification Number (T-Rating): T6, without use of thermostats; according to NEC.
 - 5. Output: As indicated on Drawings; minimum 3 W/ft.
- C. Performance and Design Criteria:
 - 1. Power output varies relative to the temperature of surface of pipe or appurtenance.
 - 2. Cable can be crossed over itself and cut to length at Site.
 - 3. Minimum SRI:

- a. Cable Rating 3 W/ft.:
 - 1) SRI: 0.038 W/degree F.

D. Operation:

- 1. Electrical Characteristics: According to Section 26 05 03 - Equipment Wiring Connections and following:
 - a. Voltage: 120V, single phase, 60 Hz.
 - b. Furnish ground-fault protection device set at 30 mA, with nominal 100-ms response time, to protect each circuit.
- 2. Disconnect Switch: Factory mounted in control panel.

E. Accessories:

- 1. Approved for the respective area classification and approved as a system with the particular type of heating cable in use.
- 2. Splicing connectors.
- 3. End terminations.
- 4. T-connectors.
- 5. Power termination kits.

2.2 HEAT-TRACING CONTROLS

A. Control and Monitoring Panel:

- 1. Materials: Nonmetallic.
- 2. Rating: NEMA 4X.
- 3. Configuration: Wall or Pedestal mounted.
- 4. Temperature Controller: Microprocessor based; diagnostic self-testing capability.
- 5. Communications Port: Modbus ASCII via RS 485.
- 6. ON-OFF Control: Soft start.
- 7. Real-Time Data Indication:
 - a. Temperature.
 - b. Heater current.
 - c. Ground leakage current.
- 8. Stored Data:
 - a. Highest temperature encountered.
 - b. Lowest temperature encountered.
- 9. Alarms:
 - a. LOW TEMPERATURE.
 - b. HIGH TEMPERATURE.
 - c. LOW HEATER CURRENT.
 - d. HIGH HEATER CURRENT.
 - e. GROUND LEAKAGE CURRENT.
 - f. DAMAGED RTD SENSOR.

B. Single Thermostat:

1. Description: Stainless-steel remote bulb with 6-foot capillary encased in flexible stainless-steel armor.
2. Housing: FM-approved, NEMA 4X.
3. Set-Point Range: 35 to 235 degrees F

2.3 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Testing:

1. Conform to IEC 216-1 for following:
 - a. Retain at least 75 percent of rated power after 20 years of operation at maximum published continuous exposure (maintain) temperature.
 - b. Retain at least 90 percent of rated power after 1,000 hours of operation at maximum published intermittent exposure temperature.
2. Cable Dielectric Test: Passing 2.5 kV dielectric test for one minute according to ASTM D2633 after undergoing a 0.5 kg-m impact according to IEC 60800.
3. Before shipment, demonstrate cable insulation resistance of 20 megohms minimum bus to braid using a 2,500-V DC megger, and demonstrate tolerance for one minute at voltage equal to twice rated plus 1,000 V applied bus to braid.
4. Thermal Runaway:
 - a. Ensure that cable produces less than 0.5 W/ft. when energized and heated to 350 degrees F for 30 minutes.
 - b. After testing and reenergizing, demonstrate that cable does not have an increasing power output leading to thermal runaway.

C. Certificate of Compliance: When fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that surfaces of pipes, valves, and fittings are clean and dry.
- C. Verify that piping has been inspected and is ready for insulation.

3.2 INSTALLATION

- A. Install heat tracing before insulation is installed.
- B. Install equipment according to manufacturer's instructions.
- C. If required, spiral heat-trace cable around piping to obtain proper heating per length of piping.
- D. Do not overlay cable over cable.
- E. Cover installed heating cable with thermal insulation and waterproof jacketing as soon as possible.
- F. Affix following label, as specified in Section 40 05 53 - Identification for Process Piping, to exterior of thermal insulation every 15 feet and readily visible from ground level: ELECTRIC HEAT TRACING: CAUTION.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. After installation, inspect for proper operation.

3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Adjust and check control module functions.
- C. Check thermostat and wiring connections to heater cable.

3.5 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 40 41 13

SECTION 40 42 13 - PROCESS PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Process piping insulation.
2. Jacketing.
3. Accessories.

B. Related Requirements:

1. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

A. ASTM International:

1. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
2. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
3. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
4. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
5. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
6. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
7. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
8. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
9. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
10. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
11. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
12. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.
13. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
14. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
15. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

16. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
17. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
18. ASTM D1785 - Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe, Schedule 40, 80, and 120.
19. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
20. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

B. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit product description, thermal characteristics, list of materials, and thickness for each service and location.
- C. Manufacturer's Instructions: Submit manufacturer's published literature indicating recommended installation procedures.

1.4 QUALITY ASSURANCE

- A. Comply with ASTM C585 for inner and outer diameters of pipe insulation.
- B. Factory-fabricated fitting covers according to ASTM C450.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on-Site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Inspection: Accept insulation on-Site in manufacturer's packaging. Inspect for damage.
- D. Store insulation according to manufacturer's instructions.
- E. Protect insulation from weather and construction traffic, dirt, water, chemicals, and damage by storing in original wrapping.

1.6 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Install insulation only when ambient temperature and humidity conditions are within ranges as recommended by manufacturer.
- C. Maintain recommended temperature and humidity before, during, and after installation for minimum of 24 hours.

1.7 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.8 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

PART 2 - PRODUCTS

2.1 PIPE INSULATION

- A. Type P-1:
 - 1. Description: Molded glass fiber.
 - 2. Comply with ASTM C547. Comply with ASTM C795 for application on austenitic stainless steel.
 - 3. Thermal Conductivity: 0.23 Btu-in./h-ft.-°F at 75°F.
 - 4. Operating Temperature Range: 0 to 850 °F.
 - 5. Vapor Barrier Jacket:
 - a. Description: Factory-applied, reinforced foil kraft with self-sealing adhesive joints.
 - b. Comply with ASTM C1136, Type I.
 - 6. Jacket Temperature Limits: -20 to 150 °F.
- B. Type P-5:
 - 1. Description:
 - a. Flexible, closed-cell elastomeric.
 - b. Tubular.
 - 2. Comply with ASTM C534, Type I.

3. Thermal Conductivity: 0.27 Btu-in./h.-ft.-°F at 75°F.
4. Operating Temperature Range: -70 to 180 °F.

2.2 PIPE INSULATION JACKETS

A. PVC Plastic Pipe Jacket:

1. Description:
 - a. One-piece, molded-type fitting covers and sheet material.
 - b. Color: Off-white.
2. ASTM D1785.
3. Thickness: 15 mils.
4. Connections: Brush-on welding adhesive.

B. Acrylonitrile Butadiene Styrene (ABS) Plastic Pipe Jacket:

1. Description:
 - a. One-piece, molded-type fitting covers and sheet material.
 - b. Color: Off-white.
2. Minimum Service Temperature: Minus 40°F.
3. Maximum Service Temperature: 180°F.
4. Water Vapor Permeance:
 - a. ASTM E96.
 - b. 0.02 perms.
5. Thickness: 30 mils.
6. Connection: Brush-on welding adhesive.

C. Stainless-Steel Pipe Jacket:

1. Comply with ASTM A240 or ASTM A666.
2. Material: Type 304 stainless steel.
3. Thickness: 0.016 inch.
4. Finish: Smooth.
5. Metal Jacket Bands:
 - a. Width: 3/8 inch.
 - b. Thickness and Material: 0.020 inch, stainless steel.

2.3 PIPE INSULATION ACCESSORIES

A. Closed-Cell Elastomeric Insulation Pipe Hangers:

1. Description: Polyurethane insert with stainless-steel jacket single-piece construction and self-adhesive closure.
2. Thickness: Match pipe insulation.

B. Tie Wire: 0.048-inch stainless steel with twisted ends on maximum 12-inch centers.

- C. Adhesives: Compatible with insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that piping and equipment has been tested before applying insulation materials.
- C. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

- A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.
- B. Fire-Rated Penetrations:
 - 1. Continue insulation through penetrations of building assemblies or portions of assemblies having fire-resistance rating of one hour or less.
 - 2. Provide intumescent firestopping when continuing insulation through assembly.
 - 3. Finish at supports, protrusions, and interruptions.
- C. Piping Systems Conveying Fluids below Ambient Temperature:
 - 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies and expansion joints.
 - 2. Jacketing:
 - a. Furnish factory-applied or field-applied vapor-retarder jackets.
 - b. Secure factory-applied jackets with pressure-sensitive adhesive with self-sealing longitudinal laps and butt strips.
 - c. Secure field-applied jackets with outward-clinch expanding staples, and seal stapled penetrations with vapor-retarder mastic.
 - 3. Fittings, Joints, and Valves:
 - a. Insulate with molded insulation of like material and thickness as adjacent pipe.
 - b. Finish with glass cloth and vapor-retarder adhesive or PVC fitting covers.
- D. Glass-Fiber Board Insulation:
 - 1. Apply insulation close to equipment by grooving, scoring, and beveling insulation.
 - 2. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

3. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface; on cold equipment, use vapor-retarder cement.
 4. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.
- E. Inserts and Shields:
1. Piping 1-1/2 Inch Diameter and Smaller: Install stainless steel shield between pipe hanger and insulation.
 2. Piping 2-Inch Diameter and Larger:
 - a. Install insert between support shield and piping, and under finish jacket.
 - b. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - c. Insert Material: Compression-resistant insulating material suitable for planned temperature range and service.
 3. Piping Supported by Roller-Type Pipe Hangers: Install stainless steel shield between roller and inserts.
- F. Closed-Cell Elastomeric Insulation:
1. Push insulation onto piping.
 2. Miter joints at elbows.
 3. Seal seams and butt joints with manufacturer's recommended adhesive.
 4. If application requires multiple layers, apply with staggered joints.
 5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.
- G. High-Temperature Pipe Insulation:
1. Install in multiple layers to meet scheduled thickness.
 2. Attach each layer with bands, securing first layer with bands before installing next layer.
 3. Stagger joints between layers.
 4. Cover with stainless-steel jacket with seams located on bottom side of horizontal piping.
- H. Piping Exposed in Equipment Rooms or Finished Spaces (less than 10 feet above Finished Floor): Finish with PVC jacket and fitting covers or ABS jacket and fitting covers.
- I. Piping Exterior to Building:
1. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass-mesh-reinforced, vapor-retarder cement.
 2. Cover with stainless-steel jacket with seams located at 3- or 9-o'clock position on side of horizontal piping, with overlap facing down to shed water, or on bottom side of horizontal piping.
- J. Buried Piping:
1. Insulate only where insulation manufacturer recommends insulation product may be installed in trench or tunnel, or direct buried.
 2. Install factory-fabricated assembly with inner all-purpose service jacket, with self-sealing lap, and asphalt-impregnated open-mesh glass fabric with 1-mil-thick aluminum foil sandwiched between three layers of bituminous compound.

3. Face outer surface with polyester film.

K. Heat-Traced Piping Interior to Building:

1. Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe.
2. Size large enough to enclose pipe and heat tracing.

L. Heat-Traced Piping Exterior to Building:

1. Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe.
2. Size insulation large enough to enclose pipe and heat tracing.
3. Cover with stainless-steel jacket with seams located at 3- or 9-o'clock position on side of horizontal piping, with overlap facing down to shed water.

M. Prepare pipe insulation for finish painting as specified in Section 09 96 00 – High-Performance Coatings.

3.3 ATTACHMENTS

A. Process Piping Insulation Schedule:

1. Potable and Non-potable Water (where exposed):
2. Chemical Feed Piping (where exposed)
 - a. Type P-1 or P-5.
 - b. Thickness:
 - 1) Pipe Sizes 1-1/4 Inches and Smaller: 1/2 inch.
 - 2) Pipe Sizes 1-1/2 Inches and Larger: 1 inch.

END OF SECTION 40 42 13

SECTION 40 70 23 – PROCESS CONTROL NARRATIVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Process control narratives for multiple treatment facility processes.
- B. Related Requirements:
 - 1. Division 01 – General Requirement
 - 2. Division 26 – Electrical
 - 3. Division 40 – Process Interconnections
 - 4. Division 43 – Process Gas and Liquid Handling, Purification, and Storage Equipment
 - 5. Division 46 – Water and Wastewater Equipment

1.2 REFERENCES

- A. International Society of Automation (ISA)
- B. National Institute of Standards and Technology (NIST)

1.3 DEFINITIONS/ACRONYMS

- A. Definitions are defined as follows:
 - 1. AUTO vs MANUAL: The PLC will not attempt to control any device that is in the LOCAL MANUAL position. When in REMOTE, the device will be controlled through the PLC based on the automatic logic.
 - a. Local Manual – operator input at local device
 - b. Local Auto – algorithm input at local device
 - 2. ALARM: Indicate the alarm condition on appropriate HMI displays, and add to the HMI alarm summary display. Upon acknowledgement, indicate the alarm condition on appropriate HMI displays and the alarm summary display. Remove acknowledged alarms from the alarm summary once they are cleared. Log alarm occurrence, acknowledgement, and clearance in the alarm log file.
 - 3. ON (RUNNING): The equipment or adjustable speed motor is ON when the equipment or motor drive ON status contact is closed. A constant speed motor is ON when a motor normally open auxiliary contact (M-Contact) from the motor starter is closed.
 - 4. TREND: At intervals appropriate for the variable being trended (JCESD standard is one-minute intervals), place the current value of analog variable, along with a time and date stamp, into a historical trend file for that variable. Display the trend on selectable HMI screens with appropriate scaling and units.
 - 5. CLOSE FAIL: A valve is commanded-to-close, but is not confirmed closed within a preset time. Unless otherwise noted, a valve is confirmed closed by receiving Closed limit switch contact from the valve.

6. POSITION FAIL: A modulating valve is commanded to a set point position, but the valve is not confirmed to be within a preset percentage of set point within a preset time.
7. OPEN FAIL: A valve is commanded-to-open, but is not confirmed open within a preset time. Unless otherwise noted, a valve is confirmed open by receiving OPEN limit switch contact from the valve.
8. RUN FAIL: A motor is commanded-to-run, but is not confirmed running within a preset time. Unless otherwise noted, running is confirmed by receiving an ON-status M-contact from the starter's auxiliary contact.
9. START: Issue a maintained Run command.
10. STOP: Cease the maintained Run command.
11. TOTALIZE: Integrate flow type variable with respect to time. Unless otherwise noted, includes password protected operator reset that sets the totalized value to zero.
12. ELAPSED RUN TIME: Calculate the total time (in tenths of an hour) that a motor or piece of equipment has been in operation. For equipment and constant speed motors, use starter M-contacts to detect when the equipment or motor is running. For adjustable speed motors, use ON status contacts from the drive that close when the drive is in operation. For valves, calculate the time that the valve is open. Unless otherwise noted, include password protected operator reset that sets elapsed run times to zero.
13. CYCLE COUNT: Count the number of cycles a piece of equipment, valve, or motor undergoes. For equipment and motors, one cycle is defined as the transition from OFF to ON. For valves, one cycle is defined as the transition from CLOSED to OPEN.
14. INTERLOCKS: Safety interlocks are designed to prevent damage to equipment and injury to plant personnel. Hard-wired interlocks, such as high temperatures and pump overloads will stop the equipment and prevent it from running, until the alarm condition has been reset in the field. Software (PLC generated) interlocks, such as pump watchdogs or valve failure alarms, must be reset by the Operator at the HMI, before the equipment is allowed to be operated again in any REMOTE mode.

B. Acronyms are defined as follows:

- | | | |
|----|--------|--|
| 1. | HMI: | Human Machine Interface |
| 2. | FCP: | Factory Control Panel (supplied by equipment Manufacturer) |
| 3. | LCP: | Local Control Panel (supplied by system integrator) |
| 4. | MCC: | Motor Control Center |
| 5. | PID: | Proportional-Integral-Derivative |
| 6. | P&ID: | Process and Instrumentation Diagram |
| 7. | PLC: | Programmable Logic Controller |
| 8. | SCADA: | Supervisory Control and Data Acquisition |
| 9. | VFD: | Variable Frequency Drive |

1.4 SYSTEM DESCRIPTION

- A. The control loop descriptions provide the functional requirements of the control loops represented in the Contract Documents.
1. Descriptions are provided as follows:
 - a. Control system overview and general description.
 - b. Major equipment to be controlled.
 - c. Major field mounted instruments (does not include local gauges).
 - d. Manual control functions.

- e. Automatic control functions/interlocks.
 - f. Major indications provided at local control panels and motor starters/VFD's.
 - g. Remote indications and alarms.
- B. The control loop descriptions are not intended to be an inclusive listing of all elements and appurtenances required to execute loop functions but are rather intended to supplement and complement the Drawings and other Specification Sections.
 - 1. The control loop descriptions shall not be considered equal to a bill of materials.
- C. Provide instrumentation hardware and software as necessary to perform control function specified herein and shown on Drawings.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Control Strategy for Record Documents:
 - 1. Obtain this Section 40 70 23 – Process Control Narratives in electronic format (Microsoft Word) from Engineer at beginning of Project.
 - 2. Revise and update the file monthly during construction and start-up to reflect all changes that occur due to specific equipment and systems supplied on the Project.
 - a. Show all revisions in 'track change' mode.
 - b. Change Specification Section Title to read "Control Loop Descriptions – Contractor Record Document."
 - c. Reference all changes by Request for Information (RFI) number or Change Order Request (COR) number.
 - d. Submit revised file monthly to Engineer for review.
 - 3. Deliver the revised and updated file as a final control loop description Record Document in the Operation and Maintenance Manual described in Section 01 78 23 – Operation and Maintenance Data.
 - 4. Provide both paper copy and electronic copy (on a flash drive) of the Record Document control loop descriptions in the Operation and Maintenance Manual described in Section 01 78 23 – Operation and Maintenance Data.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. The Process & Instrumentation Diagrams (P&IDs) in the Drawings do not indicate all PLC and/or SCADA functions. Major requirements and elements are illustrated.
- B. Index for Process Control Narratives:
 - 1. Coarse Mechanical Screen (I-101)
 - 2. Influent Pump (I-101)
 - 3. Rotary Drum Screen (I-111)
 - 4. Vortex Grit Removal System (I-112)
 - 5. Surface Aerator (I-121)
 - 6. Flow Control Valve (I-201)
 - 7. Biological Nutrient Removal Basin (I-301, I-302, I-303)
 - 8. Level Correction Tank (I-311)
 - 9. Sludge Buffer Tank (I-312)
 - 10. BNR Blowers (I-321)
 - 11. Tertiary Filter (I-501, I-502)
 - 12. UV Disinfection (I-601)
 - 13. Aerobic Digester (I-701)
 - 14. Reuse Water System (I-801)
- C. Equipment/Communication Failure:
 - 1. In the event of a plant power failure, the SCADA will store the active setpoints and duty statuses, allowing the Operator to restart the plant with the prior configuration.
 - 2. In the event of a communication failure between a PLC and the HMI, the continued operation of the equipment will depend on the equipment control mode prior to the communications failure, as defined below:
 - a. If the equipment was operating in Remote Auto mode prior to the communications failure, the PLC will continue to operate the equipment based on the Operators defined process setpoints. The state of the equipment can be changed if the Operator switches the equipment to Local mode at the equipment's local control panel and start/stops equipment, using field mounted controls.
 - b. If the equipment was operating in Remote Manual mode prior to the communications failure, the equipment will revert to Remote Auto mode upon loss of communication continuing operation, using the last known setpoints.
 - c. If the equipment was operating in Local Manual mode, it is the Operator's responsibility to manually operate this device or place it back into Remote Auto or it will not function via PLC control.
 - d. When running in Local Manual mode, the device will continue operating in its current state (running/stopped) until a hard-wired interlock stops the equipment.
 - e. Any failed equipment will issue an alarm. Vendor package control panels that lose communication with their parent PLC (Remote Auto) will trigger a communication alarm, and continue to operate locally, if possible.
 - 3. An alarm will be displayed at the HMI, indicating the failed communication link.

3.2 PROCESS CONTROL NARRATIVES

A. Coarse Mechanical Screen (I-101)

1. General:

- a. Raw wastewater from the service area flows into the existing manhole upstream of new influent pump station (IPS) influent channel. Raw wastewater flows into the channel and through the coarse mechanical screen to remove large debris and trash from the liquid. Water level in the upstream of coarse mechanical screen is monitored via an ultrasonic level transducer. The call to run command is issued at a preset high water level, and the screen continues to run until the preset low water level is reached. The high and lower water level setpoints can be altered by operator input at FCP1000.
- b. Screenings are transported to the top of influent channel and discharged into the screening conveyor. The conveyor is called to run while the coarse mechanical screen is in operation and continues to run for one minute after the screen is turned off. The screening conveyor transports screenings into a dumpster for final disposal.
- c. If the coarse mechanical screen channel water level rises up during peak flow, raw wastewater will flow over the opening on the dividing wall and into the bypass channel. The overflow bypass channel has a manual bar screen. The bar screen can partially capture the large debris and trash, and will require operator to manually clean it and transport the trash to the top of channel for disposal.
- d. As raw wastewater flows through either the coarse mechanical screen or manual bar screen, it flows into the IPS wetwell and is pumped to the new headworks.

2. Major Equipment:

- a. Coarse mechanical screen (SCR1000)
- b. Coarse screening conveyor (SCY1001)
- c. Manual bar screen (SCR1002)
- d. Coarse mechanical screen factory control panel (FCP1000)

3. Major Instrumentation:

- a. Ultrasonic level transducer (LE/LIT1000)

4. Control Strategy:

a. Local Manual:

1) Coarse Mechanical Screen:

- a) Control shall be from Hand/Off/Auto and Forward/Reverse selector switches on LCP1000.
- b) In Hand, screen shall run continuously and cannot be called to cease operation by any other command.
- c) In Off, screen shall cease operation and remain off. No other command shall be able to call SCR1000 to run.
- d) In Forward or Reverse, the screen shall run in the corresponding direction if Hand/Off/Auto switch is in Hand.

2) Conveyor:

- a) Control shall be from Hand/Off/Auto selector switches on FCP1000.

- b) In Hand, SCY1001 shall run continuously and cannot be called to cease operation by any other command.
 - c) In Off, SCR1000 shall cease operation and/or remain off. No other command shall be able to call SCR1000 to run.
 - b. Local Auto:
 - 1) Coarse Mechanical Screen:
 - a) In Auto, the screen shall receive a call to run command from PLC in FCP1000.
 - b) In Auto, the screen shall be called to run when the preset upstream water level is reached as measured by LE/LIT1000. PLC in FCP1000 shall send a command and call the screen to run continuously. The PLC shall call the screen to cease operation when the low water level setpoint is reached.
 - 2) Conveyor:
 - a) In Auto, the conveyor shall receive a call to run command from PLC in FCP1000.
 - b) In Auto, the conveyor shall be called to run when coarse mechanical screen is running. PLC in FCP1000 shall send a command and call the conveyor to run continuously. The PLC shall call the conveyor to cease operation with a vendor preset delay after the screen ceases operation in order to ensure conveyer trough is fully emptied.
 - c. Interlocks:
 - 1) Software Interlocks:
 - a) Conveyor called to run by screen running.
 - d. Alarms:
 - 1) Operator adjustable high water level alarm (LAH1000)
 - 2) Screen fault (XA1000)
 - 3) Conveyor fault (XA1001)
 - e. FCP/LCP and SCADA:
 - 1) FCP1000 shall receive all information from the screen, conveyor and instrumentation. Control of all setpoints and controllable items shall be adjustable via both FCP1000.
 - 2) Plant SCADA system shall display items indicated on P&ID.
- B. Influent Pump (I-101)
 - 1. General:
 - a. Raw wastewater flows through the coarse mechanical screen and into the influent pump station wetwell. Five (5) influent pumps of two (2) different sizes transport raw wastewater to the headworks. The call to run command is issued at a preset water level to turn on the lead pump, and the pump continues to run until the preset low water level in wetwell is reached. If water level continues to increase, a call to run command is issued to a lag pump selected by operator. The preset water level setpoints can be adjusted by operator input at LCP1000.

2. Major Equipment:
 - a. Influent pumps (P1010, P1020, P1030, P1040, P1050)
 - b. Influent pumps local control panel (LCP1010)
3. Major Instrumentation:
 - a. Pressure differential level transducer (LE/LIT1010)
 - b. Low level float switch (LSL1010)
 - c. High level float switch (LSH1010)
4. Control Strategy:
 - a. Local Manual:
 - 1) Influent Pumps:
 - a) Control shall be from Hand/Off/Auto selector switches on LCP1010.
 - b) In Hand, the respective pump shall run continuously and cannot be called to cease operation by any other command.
 - c) In Off, the respective pump shall cease operation and remain off. No other command shall be able to call the pump to run.
 - b. Local Auto:
 - 1) Influent Pumps:
 - a) In Auto, control shall be transferred to the PLC in LCP1010.
 - b) In Auto, all pumps shall be controlled by wetwell water level as monitored by LE/LIT1010, LSL1010, and LSH1010. LSL1010 shall act as the low water level emergency shutoff, and shall cease operation of any pump running. Both LSL1010 and LSH1010 shall trigger alarm on LCP1000. Each pump shall have a status as Lead, Lag, LagLag, or Standby.
 - c) If water level reaches the setpoint for lead pump, the PLC in LCP1010 shall send a call to run command to lead pump. If water level further increases and reaches the setpoint for lag pump, LCP1010 shall send a call to run command to lag pump. If water level continues to increase and reaches the setpoint for laglag pump, LCP1010 shall send a call to run command to laglag pump. All pumps in operation shall continue to run until the pump off setpoint is reached.
 - c. Interlocks:
 - 1) Hardwired Interlocks:
 - a) LSL1010 signal shall cease operation in any pump running.
 - b) LSH1010 signal shall call all on duty pumps to run unless the pump is in Off position by manual control.
 - d. Alarms:
 - 1) Wetwell low water level alarm (LAL1010)
 - 2) Wetwell high water level alarm (LAH1010)
 - 3) Pump fault (XA1010, XA1020, XA1030, XA1040, XA1050)
 - e. FCP/LCP and SCADA:

- 1) LCP1010 shall read information from influent pumps and instrumentation in wetwell. Control of all setpoints and controllable items shall be adjustable via both LCP1010. Pump Lead/Lag/LagLag/Standby selection shall be controlled via LCP1010.
- 2) Plant SCADA system shall display items indicated on P&ID.

C. Rotary Drum Screen (I-111)

1. General:

- a. Raw wastewater is pumped to the headworks and is split between three (3) rotary drum screens. The rotary drum screens remove debris and trash that the coarse mechanical screen is not able to capture, and discharged screenings into a conveyor via discharge chute. Spray bars distribute washwater to clean the interior of screen basket. Each rotary drum screen has an internal overflow pipe. A sensor is located near the screen inlet to alert operator in case of overflow.
- b. Screenings from rotary drum screens are discharged into the screening conveyor. The conveyor is called to run while any of rotary drum screen is in operation and continues to run for a preset period of time by Manufacturer after the screen is turned off. The screening conveyor transports screenings into a washing compactor for final dewatering.
- c. Washing compactor receives screenings from conveyor via an inlet hopper. Washing compactor utilizes plant reuse water to flush organic materials out of screenings and drains the water to EQ Basin No.1. Dewatered screenings are discharged into a dumpster for final disposal.

2. Major Equipment:

- a. Rotary drum screens (SCR1110, SCR1120, SCR1130)
- b. Fine screening conveyor (SCY1111)
- c. Screening washing compactor (SWC1112)
- d. Rotary drum screen factory control panel (FCP1110)

3. Major Instrumentation: N/A

4. Control Strategy:

a. Local Manual:

1) Rotary Drum Screen:

- a) Control shall be from Hand/Off/Auto selector switches on FCP1110.
- b) In Hand, the respective screen shall run continuously and cannot be called to cease operation by any other command.
- c) In Off, the respective screen shall cease operation and remain off. No other command shall be able to call the unit to run.
- d) Washwater spray control shall be from Hand/Off/Auto selector switches on FCP1110.
- e) When HAND is selected, the solenoid valve shall open and spray shall be continuous.
- f) When OFF is selected, the solenoid valve shall close and the spray shall stop.

2) Fine Screening Conveyor:

- a) Control shall be from Hand/Off/Auto selector switches on FCP1110.

- b) In Hand, SCY1111 shall run continuously and cannot be called to cease operation by any other command.
 - c) In Off, SCY1111 shall cease operation and remain off. No other command shall be able to call SCY1111 to run.
 - 3) Screening Washing Compactor:
 - a) Control shall be from Hand/Off/Auto selector switches on FCP1110.
 - b) In Hand, SWC1112 shall run continuously and cannot be called to cease operation by any other command.
 - c) In Off, SWC1112 shall cease operation and remain off. No other command shall be able to call SWC1112 to run.
 - d) Washwater spray control shall be from Hand/Off/Auto selector switches on FCP1110.
 - e) When HAND is selected, the solenoid valve shall open and spray shall be continuous.
 - f) When OFF is selected, the solenoid valve shall close and the spray shall stop.
- b. Local Auto:
- 1) Rotary Drum Screen:
 - a) In Auto, the respective screen shall receive a call to run command from PLC in FCP1110.
 - b) In Auto, the respective screen shall start operating when a call to run signal is received from plant SCADA system. The call to run signal shall be sent when any influent pump starts to run. PLC in FCP1110 shall send a command and call the screen to run continuously. The PLC shall call the screen to cease operation when ALL influent pumps cease operation with a Manufacturer preset delay.
 - c) When Washwater solenoid valve control selector is in AUTO, the valve shall open when the screen starts to run for preset time. The solenoid valve shall cycle between open and closed based on a timer.
 - 2) Fine Screening Conveyor:
 - a) In Auto, the conveyor shall receive a call to run command from PLC in FCP1110.
 - b) In Auto, SCY1111 shall be called to run when any rotary drum screen starts to run. PLC in FCP1110 shall send a command and call the conveyor to run continuously. The PLC shall call the conveyor to cease operation with a Manufacturer preset delay when ALL rotary drum screens cease operation in order to fully empty conveyer trough.
 - 3) Screening Washing Compactor:
 - a) In Auto, the conveyor shall receive a call to run command from PLC in FCP1110.
 - b) In Auto, SWC1112 shall be called to run when SCY1111 starts to run. PLC in FCP1110 shall send a command and call the washing compactor to run continuously. The PLC shall call the washing compactor to cease operation with a Manufacturer preset delay after SCY1111 ceases operation.

- c) When washwater solenoid valve control selector is in AUTO, the valve shall open when washing compactor starts to run. The solenoid valve shall open and close based on a preset timer.
 - c. Interlocks:
 - 1) Software Interlocks:
 - a) Conveyor called to operate by any rotary drum screen running
 - b) Washing compactor called to operate by conveyor running
 - d. Alarms:
 - 1) Screen fault (XA1110A, XA1120A, XA1130A)
 - 2) Screen overflow (XA1110B, XA1120B, XA1130B)
 - 3) Screen motor overtorque/overload alarm (WAH1110, WAH1120, WAH1130)
 - 4) Conveyor fault (XA1111)
 - 5) Washing compactor fault (XA1112)
 - e. FCP/LCP and SCADA:
 - 1) FCP1110 shall receive all information from the screens, conveyor, washing compactor, and instrumentation. Control of all setpoints and controllable items shall be adjustable via FCP1110.
 - 2) Plant SCADA system shall display items as indicated on P&ID.
- D. Vortex Grit Removal System (I-112)
 - 1. General:
 - a. Screened raw wastewater flow into two (2) vortex grit chambers to remove grit and other inorganic materials. Each grit chamber is equipped with propeller drive, grit pump, and slide gates for isolation. The propeller slowly rotates to induce a vortex action in the chamber to assist settlement of heavy particles. The propeller is operated as On/Off unit. Grit is collected at the bottom.
 - b. Grit pump transports collected grit to a hydrocyclone to separate water and solids. The liquid and solid phase out of hydrocyclone is discharged back to main treatment process and grit classifier, respectively. Grit pump is controlled by a vacuum priming panel and pinch valve to ensure the pump is fully primed before withdrawing grit.
 - c. Grit classifier receives grit from hydrocyclone to further separate grit from water. Liquid phase is returned to main treatment process, and grit is discharged into a dumpster for final disposal.
 - 2. Major Equipment:
 - a. Vortex grit chambers (VGR1210, VGR1220)
 - b. Grit pumps (GP1211, GP1221)
 - c. Hydrocyclones (HC1211, HC1221)
 - d. Grit classifiers (GCL1213, GCL1223)
 - e. Grit removal equipment control panel (FCP1210)
 - 3. Major Instrumentation:
 - a. Parshall Flume Assembly (FE1230, LE/FIT1230)
 - 4. Control Strategy:

- a. Local Manual:
 - 1) Vortex Grit Chambers:
 - a) Control shall be from On/Off selector switches on FCP1210.
 - b) In On, the respective grit chamber propeller drive shall run continuously.
 - c) In Off, the respective propeller drive shall stop immediately.
 - 2) Grit Pumps:
 - a) Control shall be from Hand/Off/Auto selector switches on FCP1210.
 - b) In Hand, the respective grip pump shall run continuously and cannot be called to cease operation by any other command.
 - c) In Off, the respective grit pump shall cease operation and remain off. No other command shall be able to start the pump.
 - 3) Grit Classifiers:
 - a) Control shall be from Hand/Off/Auto selector switches on FCP1210.
 - b) In Hand, the respective classifier shall run continuously and cannot be called to cease operation by any other command.
 - c) In Off, the respective classifier shall cease operation and remain off. No other command shall be able to start the classifier.
- b. Local Auto:
 - 1) Grit Pumps:
 - a) In Auto, the grit pump shall receive a call to run command from PLC in FCP1210.
 - b) In Auto, the respective grit pump shall start and stop operating based on a timer set by operator. A vacuum priming system shall be supplied for each grit pump to ensure the pump is fully primed before actually starting to withdraw grit slurry.
 - 2) Grit Classifiers:
 - a) In Auto, the grit classifier shall receive a call to run command from PLC in FCP1210.
 - b) In Auto, the classifier shall be called to run when respective grit pump is running. PLC in FCP1210 shall send a command and call the classifier to run continuously. While the grit pump is operating, the classifier shall cycle on and off by the settings of a repeat cycle timer. The PLC shall call the classifier to stop with a Manufacturer preset delay after grit pump stops running.
- c. Interlocks:
 - 1) Software Interlocks:
 - a) Classifier called to operate by grip corresponding grit pump running.
- d. Alarms:
 - 1) Vortex chamber drive fault (XA1210, XA1220)
 - 2) Grit pump fault (XA1211, XA1221)
 - 3) Classifier fault (XA1213, XA1223)
- e. FCP and LCP/SCADA:

- 1) FCP1210 shall receive all information from the vortex chamber drives, grit pumps, grit classifiers, and instrumentation. Control of all setpoints and controllable items shall be adjustable via FCP1210.
- 2) Plant SCADA system shall display items as specified on P&ID.

E. Surface Aerator (I-121)

1. General:
 - a. Screen wastewater flows into EQ basins from headworks. Existing surface aerators keep wastewater aerated and well mixed as wastewater is temporarily stored in the EQ basins, which prevents wastewater from turning septic.
2. Major Equipment:
 - a. Six (6) existing surface aerators
 - b. Three (3) existing control panels; one (1) for EQ No.1 and two (2) for EQ No.2.
3. Major Instrumentation: N/A
4. Control Strategy:
 - a. Local Manual:
 - 1) Surface Aerators:
 - a) Control shall be from Hand /Off/Auto selector switches on existing control panels.
 - b) In Hand, the respective surface aerator shall run continuously.
 - c) In Off, the aerator shall stop immediately.
 - b. Local Auto:
 - 1) Surface Aerators:
 - a) In Auto, the respective surface aerator shall start and stop operating based on a timer set by operator.
 - c. Interlocks: N/A
 - d. Alarms:
 - 1) Aerator fault (XA1311, XA1312, XA1313, XA1314, XA1315, XA1316)
 - e. FCP/LCP and SCADA:
 - 1) Existing control panels shall receive all information from respective surface aerators.
 - 2) Plant SCADA system shall display items as specified on P&ID.

F. BNR Influent Flow Control Vault (I-201)

1. General:
 - a. New magnetic flow meter and flow control valve are located in a valve vault between EQ basins and BNR basins to control influent flow to each BNR basins. The flow control valve is electrically actuated. The Operator sets a desired flow to downstream unit processes, and the valve automatically adjusts its position to maintain the target flow based on real time flow measurement by the flow meter. Two (2) plug valves and bypass piping allow the flow control valve and magnetic flow meter to be taken offline for maintenance.

2. Major Equipment:
 - a. Flow control valve (V2005)
 - b. Valve control panel (LCP2010)
 3. Major Instrumentation:
 - a. Magnetic flow meter (FE/FIT2010)
 4. Control Strategy:
 - a. Local Manual:
 - 1) Flow Control Valve:
 - a) Control shall be from Open/Close and Local/Remote selector switches on LCP2010.
 - b) When Open is activated, the flow control valve shall fully open.
 - c) When Close is activated, the flow control valve shall fully close.
 - b. Remote:
 - 1) Flow Control Valve:
 - a) In Remote, the valve shall receive close and open command from LCP2010.
 - b) In Remote, the valve shall automatically adjust its position until the instantaneous flow measured by magnetic flow meter is equal to target flow preset by operator. Once the target flow is reached, the valve shall maintain the desired flow.
 - c. Interlocks:
 - 1) Hardware Interlocks:
 - a) Flow control valve adjusted based on readings from magnetic flow meter.
 - d. Alarms:
 - 1) XA2005 – Flow control valve actuator fault
 - e. FCP/LCP and SCADA:
 - 1) Valve control panel shall receive all information from flow meter and flow control valve. Desired flow setpoint shall be adjustable via LCP2010.
 - 2) Plant SCADA system shall display items as specified on P&ID.
- G. Biological Nutrient Removal Basin (I-301, I-302, I-303)
1. General:
 - a. Screened wastewater flows into biological nutrient removal (BNR) basins for BOD and nutrient removal. BNR basins operate in batches with three (3) phases, including simultaneous Fill/Decant, React, and Settle. Screened wastewater flows into each basin and pushes treated supernatant over the effluent weir during Fill/Decant phase for a Manufacturer preset period of time. Level correction valve opens and allow water level to drop below the effluent weir. Sludge valve opens to withdraw waste activated sludge (WAS) from basin. Next, aeration is turned on and React phase begins and lasts for a preset period of time. At the end of React

phase, air is turned off and Settle phase begins. Solids quickly settle and influent valve opens to receive next batch of influent. Influent raises water level above effluent weir to discharge treated effluent to downstream unit processes. A full treatment cycle is completed at this point.

- b. Air is supplied by blowers equipped with variable frequency drive (VFD) to control air flow. Air flow is further fine tuned with air throttling valve. Blower speed is adjusted based on measurements by multiple water quality parameter sensors in each basin.
2. Major Equipment:
 - a. BNR influent valves (V3103, V3203, V3303)
 - b. BNR air valves (V3112, V3212, V3312)
 - c. Level correction (LC) valves (V3106, V3206, V3306)
 - d. Sludge valves (V3108, V3208, V3308)
 - e. BNR blowers (BLR3610, BLR3620, BLR3630)
 - f. BNR basin master control panel (FCP3100)
 3. Major Instrumentation:
 - a. TSS sensors (AE3100A, AE3200A, AE3300A)
 - b. DO sensors (AE3100B, AE3200B, AE3300B)
 - c. ORP sensors (AE3100C, AE3200C, AE3300C)
 - d. Temperature/pH sensors (AE3100D, AE3200D, AE3300D)
 - e. NH₃ sensors and transmitters (AE/AIT3100E, AE/AIT3200E, AE/AIT3300E)
 - f. NO₃⁻ sensors (AE3100F, AE3200F, AE3300F)
 - g. P sensors (AE3100G, AE3200G, AE3300G)
 - h. Air flow meters (FE/FIT3110, FE/FIT3210, FE/FIT3310)
 - i. Level transducer (LE/LIT3100, LE/LIT3200, LE/LIT3300)
 - j. High water level float (LSH3100, LSH3200, LSH3300)
 4. Control Strategy:
 - a. Local Manual:
 - 1) Valves (influent, air, LC, sludge):
 - a) Valve controls shall be from Open/Close/Auto selector switches on BNR basin control panels. Valves shall fully open or close when controlled manually.
 - 2) BNR blowers:
 - a) Control shall be from Hand/Off/Auto selector switches on FCP3100.
 - b) In Hand, the respective blower shall run continuously.
 - c) In Off, the respective blower shall stop immediately and cannot be called to run by any other command.
 - d) Blower speed shall be controlled by manually adjusting frequency on VFD.
 - b. Local Auto:
 - 1) Valves (influent, air, LC, sludge):
 - a) In Auto, valves shall receive command to open or close from PLC in BNR basin control panels.
 - b) In Auto, all valves shall operate based on timer set properly for desired BNR cycle time.

- 2) BNR blowers:
 - a) In Auto, blowers shall receive a call to run command from PLC in FCP3100.
 - b) In Auto, the blowers shall be call to run and cease operation based on timer. The timer shall be set properly to operate BNR at desired cycle time.
 - c) Blowers shall run in constant speed or constant DO mode. In constant speed mode, blower shall run at set speed. In constant DO mode, blower shall automatically adjust speed to reach and maintain desired DO setpoint based on DO readings from respective DO sensor. DO setpoint shall be adjusted at BNR master control panel.
 - c. Interlocks:
 - 1) Software Interlocks:
 - a) Blower speed adjusted based on measured DO level.
 - d. Alarms:
 - 1) BNR control valve fault (XA3104, XA3106, XA3108, XA3112, XA3113, XA3114; XA3204, XA3206, XA3208, XA3212, XA3213, XA3214; XA3304, XA3306, XA3308, XA3312, XA3313, XA3314)
 - 2) BNR high water level (LAH3100, LAH3200, LAH3300)
 - 3) Blower fault (XA3610, XA3620, XA3630)
 - 4) Blower oil high temperature (TAH3610, TAH3620, TAH3630)
 - 5) Blower discharge high temperature (TAH3612, TAH3622, TAH3632)
 - 6) Blower discharge high pressure (PAH3614, PAH3624, PAH3634)
 - e. FCP/LCP and SCADA:
 - 1) BNR master control panel shall receive all information from control valves, water quality sensors, level transducers, and blowers. Control of all setpoints and controllable items shall be adjustable via BNR master control panel.
 - 2) Plant SCADA system shall display items as specified on P&ID.
- H. Level Correction Tank (I-341)
- 1. General:
 - a. As each BNR basin is filled with influent, the water level must be lowered to prevent untreated wastewater from entering the effluent weir. Level correction (LC) valve opens to lower the water level and discharge to level correction tank. Two (2) submersible pumps are installed in LC tank to return LC water back to EQ Basin No.1. LC pumps are controlled by water level in the tank, which is measured by a level transducer.
 - 2. Major Equipment:
 - a. LC pumps (P3410, P3420)
 - b. LC pump control panel (LCP3400)
 - 3. Major Instrumentation:
 - a. LC tank level transducer (LE/LIT3400)
 - b. LC tank high water level float (LSH3400)

4. Control Strategy:
 - a. Local Manual:
 - 1) LC Pumps:
 - a) Control shall be from Hand/Off/Auto selector switches on LCP3400.
 - b) In Hand, the respective LC pump shall run continuously.
 - c) In Off, the LC pump shall stop immediately and shall not be called to run by any other command.
 - b. Local Auto:
 - 1) LC Pumps:
 - a) In Auto, LC pumps shall receive a call to run command from PLC in LCP3400.
 - b) In Auto, LC pumps shall start operating when a preset Pump On water level is reached. LC pumps shall cease operation when water level is reduced to a Pump Off setpoint. Pump On and Off setpoints shall be adjusted at LCP3400 by operator.
 - c. Interlocks:
 - 1) Software Interlocks:
 - a) LC pumps called to run by tank water level measured by LE/LIT3400.
 - 2) Hardware Interlocks:
 - a) Both pumps called to run when high water level float is activated.
 - d. Alarms:
 - 1) LC pump fault (XA3410, XA3420)
 - 2) LC tank high water level (LAH3400)
 - e. FCP/LCP and SCADA:
 - 1) LCP3400 shall receive all information from LC pumps and level instruments. Control of all setpoints and controllable items shall be adjustable via LCP3400.
 - 2) Plant SCADA system shall display items as specified on P&ID.
- I. Sludge Buffer Tank (I-351)
 1. General:
 - a. At the end of Fill/React phase, sludge valve opens to withdraw waste activated sludge (WAS) and sludge is discharged to sludge buffer tank. Three (3) existing sludge pumps transfer WAS to existing Digester No.1. WAS pumps are controlled by water level in the tank, which is measured by a level transducer. Supernatant or overflow in sludge buffer tank flows into the adjacent level correction tank through a telescoping valve.
 2. Major Equipment:
 - a. Existing WAS pumps (P3510, P3520, P3530)
 - b. WAS pump control panel (LCP3500)

3. Major Instrumentation:
 - a. Sludge buffer tank level transducer (LE/LIT3500)
 - b. Sludge buffer tank high water level float (LSH3500)
 - c. Existing WAS magnetic flow meters (FE/FIT3510, FE/FIT3520, FE/FIT3530)
4. Control Strategy:
 - a. Local Manual:
 - 1) WAS Pumps:
 - a) Control shall be from Hand/Off/Auto selector switches on existing control panel LCP3500.
 - b) In Hand, the respective WAS pump shall run continuously.
 - c) In Off, the WAS pump shall stop immediately and shall not be called to run by any other command.
 - b. Local Auto:
 - 1) WAS Pumps:
 - a) In Auto, WAS pumps shall receive call to run command from PLC in LCP3500.
 - b) In Auto, WAS pumps shall start operating when a preset Pump On water level is reached. WAS pumps shall cease operation when water level is lowered to a Pump Off level. Pump On and Off setpoints shall be adjusted on LCP3500 by operator.
 - c. Interlocks:
 - 1) Software Interlocks:
 - a) WAS pumps called to run by tank water level measured by LE/LIT3500.
 - 2) Hardware Interlocks:
 - a) Both pumps called to run when LSH3500 is activated.
 - d. Alarms:
 - 1) WAS pump fault (XA3510, XA3520)
 - 2) Sludge buffer tank high water level (LAH3500)
 - e. FCP/LCP and SCADA:
 - 1) LCP3500 shall receive all information from WAS pumps and level instruments. Control of all setpoints and controllable items shall be adjustable via LCP3500.
 - 2) Plant SCADA system shall display items as specified on P&ID.
- J. Post EQ Flow Control Vault (I-401)
 1. General:
 - a. Existing 20" magnetic flow meter, flow control valve, and control panel are relocated to a new vault downstream of Post EQ basin. The flow control valve is electrically actuated. The Operator sets a desired flow from Post EQ basin, and the valve automatically adjusts its position to maintain the target flow based on real time flow measurement by the flow meter.

2. Major Equipment:
 - a. Existing flow control valve (V4006)
 - b. Existing valve control panel (LCP4010)
3. Major Instrumentation:
 - a. Existing magnetic flow meter (FE/FIT4010)
4. Control Strategy:
 - a. Local Manual:
 - 1) Flow Control Valve:
 - a) Control shall be from Open/Close and Local/Remote selector switches on LCP4010.
 - b) When Open is activated, the flow control valve shall fully open.
 - c) When Close is activated, the flow control valve shall fully close.
 - b. Remote:
 - 1) Flow Control Valve:
 - a) In Remote, the valve shall receive close and open command from LCP4010.
 - b) In Remote, the valve shall automatically adjust its position until the instantaneous flow measured by magnetic flow meter is equal to target flow preset by operator. Once the target flow is reached, the valve shall maintain the desired flow.
 - c. Interlocks:
 - 1) Hardware Interlocks:
 - a) Flow control valve adjusted based on readings from magnetic flow meter.
 - d. Alarms:
 - 1) XA4006 – Flow control valve actuator fault
 - e. FCP/LCP and SCADA:
 - 1) Valve control panel shall receive all information from flow meter and flow control valve. Desired flow setpoint shall be adjustable via LCP4010.
 - 2) Plant SCADA system shall display items as specified on P&ID.

K. Tertiary Filter (I-501, I-502)

1. General:
 - a. Secondary effluent from BNR basins flows through Post EQ basin and splits between three (3) tertiary filters, one (1) existing and two (2) new units. Water flows through filter disc from the outside towards inside, and the microfiber media catches fine suspended solids in the water. Filter effluent enters a center tube and flow over an effluent weir. Level instruments are installed inside the filter basin to monitor water level.
 - b. As solids accumulate on the surface of filter disc, the headloss increases and consequently water level in filter basin increases, too. When water level reaches a

setpoint, the disc units start rotating and backwash pumps start operating, removing solids from filter media. Backwash can be operated based on either water level or timer.

2. Major Equipment:
 - a. Tertiary filters (FTR5200, FTR5300)
 - b. Filter backwash pumps (P5210, P5220, P5310, P5320)
 - c. Filter control panels (FCP5020, FCP5030)
3. Major Instrumentation:
 - a. Level transducers (LE/LIT5200, LE/LIT5300)
 - b. High high water level floats (LSHH5200, LSHH5300)
4. Control Strategy:
 - a. Local Manual:
 - 1) Filter Discs:
 - a) Filter disc controls shall be from Hand/Off/Auto selector switches on filter control panels.
 - b) In Hand, filter discs shall rotate continuously.
 - c) In Off, filter discs shall stop rotating immediately and shall not be called to rotate by any other command.
 - 2) Backwash pumps:
 - a) Control shall be from Hand/Off/Auto selector switches on filter control panels.
 - b) In Hand, the respective backwash pump shall run continuously.
 - c) In Off, the backwash pump shall stop immediately and cannot be called to run by any other command.
 - b. Local Auto:
 - 1) Filter Discs:
 - a) In Auto, filter disc drive shall receive command to open or close from PLC in filter control panels.
 - b) In Auto, filter disc shall start rotating when backwash pumps are called to run. Filter rotation shall stop when backwash pumps stop operating.
 - 2) Backwash Pumps:
 - a) In Auto, backwash pumps shall receive a call to run command from PLC in filter control panels.
 - b) In Auto, the backwash pump shall be call to run in either timer or level mode. In timer mode, backwash pumps shall cycle between On and Off based on a timer in filter control panel. The timer shall be adjustable by operator. In level mode, backwash pumps shall start running when high water level is reached in filter basin. Backwash pumps shall continue to run until low water level setpoint is reached.
 - c. Interlocks:
 - 1) Software Interlocks:

- a) Backwash pump suction valves called to open by timer or water level.
 - b) Backwash pumps called to run by timer or water level.
 - c) Disc rotation drive called to run by backwash pump running.
 - d. Alarms:
 - 1) Disc drive overload (XA5200, XA5300)
 - 2) Backwash pump fault (XA5210, XA5220, XA5310, XA5320)
 - 3) Filter basin high water level (LAH5200, LAH5300)
 - 4) Filter basin high high water level (LAHH5200, LAHH5300)
 - e. FCP/LCP and SCADA:
 - 1) Filter control panels shall receive all information from filter disc drive, backwash pumps, suction valves, and level instruments. Control of all setpoints and controllable items shall be adjustable via filter control panels.
 - 2) Plant SCADA system shall display items as specified on P&ID.
- L. UV Disinfection (I-601)
 - 1. General:
 - a. Filter effluent enters UV channel for disinfection before discharging to cascade aerator. UV disinfection is the last treatment process at the facility. A new weir gate controls water level in UV channel in order to ensure that the UV banks stay submerged at all times. Weir gate elevation is adjusted manually by operator. Existing UV banks will continue service and controls will be integrated into new plant SCADA system.
 - 2. Major Equipment:
 - a. Existing UV banks
 - b. Level control gate (WG6001)
 - c. UV system control center
 - 3. Major Instrumentation:
 - a. Level transducer (LE/LIT6104)
 - b. Existing UV transmittance sensor (AE/AIT6101, AE/AIT6201)
 - 4. Control Strategy:
 - a. Local Manual:
 - 1) UV Units:
 - a) UV unit controls shall be from On/Off/Remote selector switches on Hydraulic System Center.
 - b) In On, UV lamps shall be on continuously.
 - c) In Remote, UV lamps shall be controlled by input from plant SCADA system.
 - 2) Level Control Gate:
 - a) Level control gate shall be operated by Forward/Off/Reverse selector switch on System Control Center.
 - b) When Forward or Reverse is selected, the weir gate shall move in corresponding direction. Switch the selector to Off shall stop the gate.

- b. Local Auto:
 - 1) UV Unit: N/A. UV lamps shall be controlled manually via local control center or SCADA input remotely.
 - 2) Level Control Gate:
 - a) In Auto, the weir gate shall adjust automatically to maintain the water level in UV channel, based on the level measured by LE6104 instantaneously.
- c. Interlocks:
 - 1) Software Interlocks:
 - a) UV lamps shall be turned off immediately when low water level is triggered via LE/LIT6104.
- d. Alarms:
 - 1) Power fail (XA6100A)
 - 2) Critical fault (XA6100B)
 - 3) Major fault (XA6100C)
 - 4) Minor fault (XA6100D)
 - 5) UV intensity low (AAL6101A, AAL6201A)
 - 6) Communication alarm (XA6101B, XA6201B)
 - 7) Lamp fail (XA6101A, XA6201A)
 - 8) UV channel low water level (LAL6104)
 - 9) Weir gate actuator fault (XA6001)
- e. FCP/LCP and SCADA:
 - 1) Existing UV hydraulic system center and system control center shall receive all information from UV banks, UV intensity sensor, and level transducer. Control of all setpoints and controllable items shall be adjustable via existing hydraulic system center and system control center.
 - 2) Plant SCADA system shall display items as specified on P&ID.

M. Aerobic Digester (I-701)

- 1. General:
 - a. WAS pumps transfer sludge from sludge buffer tank to existing Digester No.1. Digester No.1 can be bypassed and WAS flows directly into Digester No.2 and No.3. Aeration is provided by a blower for each digester and air is distributed with coarse bubble diffusers in each tank. Once the digestion process is completed, air is cut off to allow solids to settle. Digester No.2 and No.3 are equipped with floating decanter to withdraw supernatant from the digester and discharge into a yard drain manhole near the digesters. Digested sludge is transferred to hauler trucks for land application. The operators also have the option to discharge digested sludge to sludge dry beds for dewatering and temporary storage.
- 2. Major Equipment:
 - a. Blower (BLR7030)
 - b. Floating decanters (FD7021, FD7031)
 - c. Blower control panel
- 3. Major Instrumentation: N/A

4. Control Strategy:
 - a. Local Manual:
 - 1) Blowers:
 - a) Digester blower controls shall be from Hand/Off/Auto selector switches on blower control panels.
 - b) In Hand, blower shall run continuously.
 - c) In Off, blower shall stop running immediately and shall not be called to run by any other command.
 - 2) Floating Decanters:
 - a) Floating decanters shall be controlled by a manual plug valve on the discharge side.
 - b) To remove supernatant, the plug valve shall be opened manually.
 - c) To stop decanter flow, the plug valve shall be manually closed.
 - b. Local Auto: N/A. All digester equipment shall be controlled manually.
 - c. Interlocks: N/A
 - d. Alarms:
 - 1) Blower fault (XA7010, XA7020, XA7030)
 - 2) Blower overheated (TAH7010, TAH7020, TAH7030)
 - 3) Blower discharge high pressure (PAH7010, PAH7020, PAH7030)
 - e. FCP/LCP and SCADA:
 - 1) Each blower control panel shall receive all information from blower motor, temperature, and pressure instruments. Control of all setpoints and controllable items shall be adjustable via blower control panels.
 - 2) Plant SCADA system shall display items as specified on P&ID.

N. Reuse Water System (I-701)

1. General:
 - a. Reuse water pump No.2 is installed in the effluent channel upstream of effluent V-notch weir to pump plant effluent to plant reuse system. The pump feeds effluent to a pre-charged pneumatic tank to supply reuse water for equipment such as rotary drum screens and washing compactor. When pressure in the pneumatic tank drops below a setpoint, the reuse pump automatically starts operating and recharges the tank with reuse water. If operator needs to use the existing water cannons at EQ basins, existing Reuse Pump No.1, which is a vertical turbine pump, is turned on manually to supply required flow and pressure.
2. Major Equipment:
 - a. Reuse pump (P8010)
 - b. Reuse water storage tank (T8010)
 - c. Reuse pump control panel (LCP8010)
3. Major Instrumentation:
 - a. Tank pressure gauge (PI8010)
 - b. Tank pressure switch (PS8010)
4. Control Strategy:

- a. Local Manual:
 - 1) Reuse Pump:
 - a) Reuse pump controls shall be from Hand/Off/Auto selector switches on pump control panel.
 - b) In Hand, reuse pump shall run continuously.
 - c) In Off, reuse pump shall stop running immediately and shall not be called to run by any other command.
 - d) Vertical turbine pump shall be turned on when water cannons are opened for EQ basin cleaning.
- b. Local Auto:
 - 1) Reuse Pump:
 - a) In Auto, Reuse Pump No.2 shall receive a call to run command from PLC in pump control panel.
 - b) In Auto, Reuse Pump No.2 shall be called to run when tank pressure switch is activated indicating the tank pressure is dropped below 65 psi. Reuse Pump No.2 shall cease operation when tank pressure is increased to 85 psi.
- c. Interlocks:
 - 1) Software Interlocks:
 - a) Reuse Pump No.2 shall be called to run and stop by pneumatic tank pressure switch PS8010.
- d. Alarms:
 - 1) Pump fault (XA8010)
- e. FCP/LCP and SCADA:
 - 1) Reuse pump control panel shall receive all information from Reuse Pump No.2 and pressure switch. Control of all setpoints and controllable items shall be adjustable via pump control panel.
 - 2) Plant SCADA system shall display items as specified on P&ID.

END OF SECTION 40 70 23

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SECTION 40 71 13 – ELECTROMAGNETIC FLOW MEASURING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Electromagnetic flow meters for permanent installations both above and below ground. The meters shall utilize bipolar pulse DC coil excitation to measure voltage induced by the flow of conductive liquid through a magnetic flux. The voltage shall be linearly proportional to flow velocity from 0.033 to 33 feet per second.
- B. Related Sections:
 - 1. Control and Information Systems Scope and General Requirements.
 - 2. Powered Instruments, General.

1.2 SUBMITTALS

- A. Furnish complete Product Data, Shop Drawings, Test Reports, Operating Manuals, Record Drawings, Manufacturer's certifications, Manufacturer's Field Reports.
- B. Product Data:
 - 1. Dimensional drawings.
 - 2. Materials of construction.
 - a. Sensor
 - b. Liner
 - c. Electrodes
 - d. Process Connection
 - 3. Measurement accuracy.
 - 4. Range and range ability.
 - 5. Enclosure Rating.
 - 6. Classification Rating.
 - 7. Power.
 - a. Voltage
 - b. Wattage
 - 8. Output options.

1.3 QUALITY ASSURANCE

- A. Manufacture instruments in facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store all instruments in a dedicated structure with space conditioning to meet the recommended storage requirements provided by the Manufacturer.
- B. Any instruments that are not stored in strict conformance with the Manufacturer's recommendation shall be replaced.

1.5 PROJECT OR SITE CONDITIONS

- A. Provide instruments suitable for the installed site conditions including but not limited to material compatibility, site altitude, process and ambient temperature, and humidity conditions.

1.6 CALIBRATION AND WARRANTY

- A. The meter shall have standard one (1) year warranty from date of shipment. If the meter is commissioned by a factory certified technician, the warranty is extended to three (3) years from the date of shipment.

1.7 MAINTENANCE

- A. Provide all parts, materials, etc. necessary for maintenance and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

1.8 LIFECYCLE MANAGEMENT

- A. Instrument documentation, like original calibration certificates, manuals and product status information shall be accessed via a web enabled system with a license. The instrument-specific information shall be accessed via its serial number. When services are provided by an authorized service provider the services information like subsequent field calibrations shall be archived and accessible via this web enabled system.

PART 2 - PRODUCTS

2.1 SYSTEMS/ASSEMBLIES

- A. Manufacturer:
 - 1. Endress+Hauser - Promag P 300
 - 2. Rosemount 8750WA
 - 3. Or Pre-Approved Equal

2.2 MANUFACTURED UNITS

- A. The flow meter shall be a flanged sensor (by application and instrument schedule) and transmitter mounted integral (compact) to the sensor.
1. The flow meter shall be microprocessor based and possess a method in which to store the sensor calibration and transmitter setup information in non-volatile memory. The electronics shall be interchangeable for meters sizes 1/2" – 24".
 2. The sensor shall be the proper size to measure the design flow rate of the piping and measure bi-directional flow as a standard.
 3. The sensor shall consist of a stainless steel flow tube with ANSI B16.5 carbon steel or stainless steel flanges. The flanges shall carry Class 150 pressure.
 4. The system shall simultaneously produce multiple process variables (ex. volume flow and conductivity) while in operation.
 5. The sensor liner and electrode material shall be chosen to be compatible with the process fluid. All fluids require a minimum conductivity of 5 μ S/cm.
 6. The sensor tube shall be lined with PTFE.
 7. The sensor shall house two measuring electrodes, a grounding electrode, and one for physical empty pipe detection. The electrodes shall be made of 316L SS, Alloy C22, Tantalum, Titanium, or Platinum as specified.
 8. The external sensor housing shall enclose the coil assemblies and internal wiring. The materials shall be designed and constructed to prevent moisture ingress and promote corrosion resistance.
 9. The electrode circuit shall have a minimum impedance of 1012 Ohms to overcome moderate coating buildup.
 10. The system shall include an electrical circuit for cleaning electrodes from magnetite buildup as specified.
 11. The sensor shall be rated for NEMA 4X as standard.
 12. The system shall be a compact design insensitive to external vibrations and immune from external piping forces due to robust design.
- B. The transmitter shall be a three-stage microprocessor controller mounted integrally as specified in the instrument schedule. The transmitter shall operate on AC (100 to 240V) or DC (24 V) via a dedicated or universal power supply as specified. The transmitter housing will carry a NEMA 4X rating and shall be constructed to prevent moisture ingress, promote corrosion resistance, and be impervious to saline environments.
1. The transmitter shall allow local or remote programming that can be operated via an optical display or WLAN connection without opening the compartment.
 2. The transmitter display shall indicate simultaneous flow rate and total flow with three Totalizers (eg. forward, reverse and net total) and user-selectable engineering units, readout of diagnostic remedy messages, and support at least 19 standard languages.
 3. The transmitter shall safeguard against entering of invalid data for the particular meter size and all programming parameters shall be access-code protected and retained in the embedded HistoROM.
 4. The transmitter primary output shall be specified, as:
 - a. 4-20mA HART, or
 - b. Modbus RS485, or
 - c. Profibus PA, or
 - d. Foundation Fieldbus, or

- e. EtherNet/IP, or
 - f. Profinet
 - g. and up to (2) secondary configurable analog I/O slots (freely programmable to 4-20mA in/output, 0-10 kHz pulse/frequency, or status input)
- 5. The transmitter output(s) shall be integral to the electromagnetic flowmeter transmitter electronics; using an external third party signal converter is unacceptable.
 - 6. The transmitter output selected must be supported by Add-on Instructions (AOI), faceplates, device drivers, instructions and pre-engineered code.
 - 7. The transmitter shall internally retain all setup parameters, calibration parameters and accumulated measurements in non-volatile memory in the event of power failure.
 - 8. The transmitter shall be protected against voltage spikes from the power source with internal transient protection.
 - 9. The transmitter and sensor must support an onboard, ISO traceable means of attested in-situ verification utilizing redundant references to validate measurement quality over the lifespan.
 - 10. The transmitter shall provide access to service and monitoring parameters designed to identify transient or permanent process influences.
 - 11. The transmitter shall support commissioning and maintenance options via a service interface for operation via an internal web server, accessible via a standard RJ-45 cable.
 - 12. The transmitter shall include a wireless local area network (WLAN) option built into the device display with a five meter operating range. The WLAN shall permit unique SSID programming, four encryption levels and activation/deactivation of the function at the Owner preference.
- C. Remote configuration shall be capable of being performed thorough the programmable automation controller with common off the shelf tools, software, interfaces or gateways. Generic profiles or special tools and hardware will not be acceptable.

2.3 ACCESSORIES

- A. Stainless steel tag – labeled to match the contract documents
- B. Provide grounding rings, as per manufacturer’s recommendations, if required.
- C. Provide sun shield for outdoor installations as required per the instrument schedule.

2.4 SOURCE QUALITY CONTROL AND CALIBRATION

- A. Electromagnetic flow meters shall be factory calibrated on an ISO 17025 accredited test stand with certified accuracy traceable to NIST per “General Requirements for the Competence of Testing and Calibration Laboratories.”
- B. Evidence of accreditation must originate from a national verification agency such as A2LA.
- C. Each meter shall ship with a certificate of a 2-point calibration report exceeding stated standard accuracy of 0.5% or 0.2% of rate as specified.

- D. A real-time computer generated printout of the actual calibration data points shall indicate apparent and actual flows. The flow calibration data shall be confirmed by the manufacturer and shipped with the meters to the project site.
- E. The manufacturer shall provide complete documentation covering the traceability of all calibration instruments.
- F. The manufacturer shall provide ISA data sheet ISA-TR20.00.01 as latest revision of form 20F2321. The manufacturer shall complete the form with all known data and model codes and dash out the inapplicable fields. Incomplete data sheets submitted will result in a rejected submittal.

2.5 SAFETY

- A. All electrical equipment shall meet the requirements of ANSI/NFPA 70, National Electric Code latest addition.
- B. Electrical equipment housing shall conform to NEMA 4X classification.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the complete set of plans, the process fluids, pressures, and temperatures and furnish instruments that are compatible with installed process conditions.
- B. Examine the installation location for the instrument and verify that the instrument will work properly when installed.

3.2 INSTALLATION

- A. As shown on installation details and mechanical Drawings.
- B. As recommended by the manufacturer's installation and operation manual.
- C. Specific attention should be given to the following technical requirements:
 - 1. Verify ground rings (if required) have been installed according to the manufacturer's recommendations.
 - 2. Reduced inlet installations must be accompanied by manufacturer's documented evidence of third party testing and data collection in comparison to a traceable standard.

3.3 FIELD QUALITY CONTROL

- A. Each instrument shall be tested before commissioning and the ENGINEER shall witness the interface capability in the PLC control system and associated registers.

1. Each instrument shall provide direct programming capability through the PLC.
 2. Each instrument shall provide direct control of totalizer reset functions through the PLC
 3. Each instrument shall be supported with a device profile permitting direct integration in the PLC.
- B. The ENGINEER shall witness all instrument verifications in the field.
- C. Manufacturers Field Services are available for start-up and commissioning by a Factory field service representative or a manufacturer's authorized service provider (ASP) – the warranty against manufacturing defects is three years.
1. Manufacturer representative shall verify installation of all installed flow tubes and transmitters.
 2. Manufacturer representative shall notify the ENGINEER in writing of any problems or discrepancies and proposed solutions.
 3. Manufacturer representative shall perform field verification at the time of installation for long-term analysis of device linearity, repeatability and electronics health. A comparative report shall be generated for each meter tested.
 4. Manufacturer representative shall generate a configuration report for each meter.

3.4 ADJUSTING

- A. Verify factory setup of all instruments in accordance with the Manufacturer's instructions.

3.5 PROTECTION

1. All instruments shall be fully protected after installation and before commissioning. Replace any instruments damaged before commissioning.
 - a. The ENGINEER shall be the sole party responsible for determining the corrective measures.

END OF SECTION 40 71 13

SECTION 40 71 69 – PARSHALL FLUME

PART 1 - GENERAL

1.1 SUMMARY

- A. The work covered by this section shall include materials and installation for the fiberglass reinforced plastic (FRP) parshall flume to measure the incoming wastewater flow, as shown on the drawings and described in the specifications.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
 - 1. Section 02 41 19 – Selective Demolition
 - 2. Division 3 – Concrete
 - 3. Division 5 – Metals
 - 4. Division 26 – Electrical
 - 5. Division 27 – Communications

1.3 REFERENCES

- A. ASTM D256 - Standard Test Methods for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.
- B. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
- C. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- D. ASTM D2583 - Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

1.4 COORDINATION

- A. Coordinate installation of anchorages for weirs, baffles, frames and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: For glass-fiber-reinforced-plastic parshall flume. Test results of fiberglass reinforced plastic.
- C. Shop Drawings:
 - 1. Include plans, sections, details, and attachments to other work.
 - 2. Critical dimensions, jointing and connections, fasteners and anchors
 - 3. Materials of construction.
 - 4. Sizes, spacing, and locations of structural members, connections, attachments, openings, fasteners, and loads.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver materials in manufacturer's packaging, including application instructions.
- C. Inspection: Accept Parshall flume and accessories on-site in original packaging. Inspect for damage.
- D. Store equipment and accessories according to manufacturer's instructions.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with parshall flume by field measurements before fabrication.

1.8 QUALIFICATIONS

- A. Manufacturer of baffle wall system shall have full responsibility for products and design. Split responsibility of materials or design is not acceptable.
- B. Manufacturer of baffle wall system shall have completed within the last five (5) years a minimum of five (5) projects of similar type as those required in this scope.
- C. Manufacturer must be ISO9001 certified, and manufacturer all of the FRP components in its own facility.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. The Manufacturer and Contractor shall furnish a warranty extending twelve (12) months after substantial completion date.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The equipment, parshall flume, shall be manufactured by:
 - 1. Warminster Fiberglass Company; Southampton, PA
 - 2. Tracom Fiberglass Products; Alpharetta, GA
 - 3. Enduro Composites, Inc.
 - 4. Strongwell; Bristol, VA
 - 5. Virtual Polymer Compounds; Getzville, NY
 - 6. Or Approved Equal.

2.2 PRODUCTS

- A. All components of the weir, baffle, frame and support system shall be design and fabricated by a single manufacturer to insure uniform and finished appearance as a well as component compatibility.
- B. Baffle planks shall be installed without the need of drilling or fastening, and the panels shall be removable without the need of loosening fasteners or any other mechanical device.
- C. The baffle planks shall be supports in a channel-shaped frame on each end. Such frame shall fold the baffle blanks for a maximum strength and load bearing capability. The channel frames shall be manufacturer of T-304 stainless steel.
- D. The baffle panels, when mounted in their structural support system, shall be square and accurately size to minimize gaps between the frame members and panels.

2.3 PARSHALL FLUME (FE1230)

- A. Material: Fiberglass reinforced plastic:
 - 1. Tensile strength (ASTM D 638): 14,000 psi.
 - 2. Flexural strength (ASTM D 790): 27,000 psi.
 - 3. Flexural modulus (ASTM D 790): 1,000,000 psi.
 - 4. Impact, notched, Izod (ASTM D 256): 10 ft-lb/in.
 - 5. Barcol hardness (resin-rich surface) (ASTM D 2583): 50, minimum, average.
 - 6. Temperature limit: 150 °F.

7. Chemical resistance: Comply with ANSI/AWWA F101, Type II classification.
8. Wall thickness: Minimum 3/16 inch
- B. Construction: One-piece, fiberglass reinforced plastic, with integral stiffening ribs to make unit self-supporting and eliminate external bracing.
 1. For flumes to be embedded in concrete, provide temporary internal bracing.
 2. Make sizes 8-foot, 10-foot and 12-foot in two pieces for shipping.
 3. Parshall flume shall have 18" throat, and shall be able to accurately measure flow up to 15.9 MGD.
- C. Level Transducer (LE/FIT1230)
 1. Level transducers shall comply with Section 40 72 13 – Ultrasonic Level Meters.
- D. Accessories:
 1. Ultrasonic Transponder mounting bracket.
 2. Staff gauge graduated in MGD.

2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install fiberglass reinforced plastic (FRP) parshall flume per the manufacturer's recommendations.

3.2 MATERIAL HANDLING

- A. The Contractor shall protect FRP materials from cuts, scratches, gouges, abrasions, and impacts. When lifting crated FRP materials, spreader bars shall be used (not wire slings unless materials are fully protected). FRP components shall not be dragged across one another unless separated by a non-scratching spacer.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.

- B. Ensure that products are installed plumb and true, free of warp or twist, within tolerances specified by the manufacturer and as indicated in the contract documents.
- C. Set flume at proper elevation in accordance with drawings.
- D. Set floor of flume at inlet end level with flow and across flow. Set side walls plumb. Set top flanges level, each side.
- E. Fasten flume securely to prevent flotation or twisting during placement of concrete.
- F. Place concrete along sides and bottom of flume to ensure complete filling without voids and displacement of flume. Stage placement in alternating lifts, 1/3 height on each side of flume.

3.4 ADJUST AND CLEAN

- A. Clean surfaces in accordance with manufacturer's instructions.
- B. Remove trash and debris, and leave the site in a clean condition.

END OF SECTION 40 71 69

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SECTION 40 72 13 - ULTRASONIC LEVEL METERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ultrasonic level measurement devices.
 - 2. Transmitters.
- B. Related Requirements:
 - 1. Division 26 – Electrical
 - 2. Section 40 70 23 – Process Control Narratives

1.2 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. NSF International:
 - 1. NSF 61 - Drinking Water System Components - Health Effects.
 - 2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 COORDINATION

- A. Coordinate Work of this Section with tank Work.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information for system materials and component equipment, including connection requirements.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
 - 2. Submit installation requirements and other details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
- H. Qualifications Statement:
 - 1. Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.6 QUALITY ASSURANCE

- A. Ensure that materials of construction of wetted parts are compatible with process liquid.
- B. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.
- C. Perform Work according to applicable standards.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three (3) years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish three-year manufacturer's warranty for ultrasonic-level measurement devices.

PART 2 - PRODUCTS

2.1 ULTRASONIC LEVEL MEASUREMENT DEVICES

- A. Manufacturers:
 - 1. Siemens – Echo Max XPS-10
 - 2. Or Pre-Approved Equal
- B. Description:
 - 1. Measuring Range: Up to 20 feet
 - 2. Operating Temperature Range: -40 to 170 °F
 - 3. Operating Pressure: 10 to 36 psig
- C. Operation: Menu guided.
- D. Transmitters:
 - 1. Selected by sensor manufacturer to match sensor.
 - 2. Visual Display: Four digit.
 - 3. Output Signal: 4-20-mA dc.
 - 4. Location: As indicated on Drawings.
 - 5. Control Power:
 - a. Wiring: As specified in Section 26 05 03 - Equipment Wiring Connections.
 - b. 120-V ac, single phase, 60 Hz.
 - c. Furnish local transformers as required.
 - 6. Enclosures: NEMA 250 Type 4.
 - 7. Mounting:
 - a. Integral with sensor
 - b. Wall
 - 8. Furnish cable, field preamplifiers, and signal conditioners as required to maintain accuracy from sensor to terminal device.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. Coordinate location and orientation of level probe assemblies with final equipment installations.
- B. Ensure that instruments are located to be easily accessible for maintenance.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than two (2) days on Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.
- C. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 40 72 13

SECTION 40 72 43 – SUBMERSIBLE LEVEL TRANSMITTERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Pressure differential transmitters used for level indication.

1.2 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. NSF International:
 - 1. NSF 61 - Drinking Water System Components - Health Effects.
 - 2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information for system materials and component equipment, including connection requirements.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
 - 2. Submit installation requirements and other details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of equipment and accessories.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

1.6 QUALITY ASSURANCE

- A. Ensure that materials of construction of wetted parts are compatible with process liquid.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three (3) years' experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for submersible level transmitters.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE GAGE-PRESSURE TRANSMITTERS

- A. Manufacturers:
 - 1. GE Druck model PTX 1830.
 - 2. Dwyer Mercoid Model PBLT2-15-60.
 - 3. Or Pre-Approved Equal.

- B. Description:
 - 1. Accuracy: +/- 0.25%.
 - 2. Output Signal: 4-20 mA dc proportional for zero to full scale.
 - 3. Operating Temperature Range: -40 to 185 °F.
 - 4. Materials: Type 316 stainless steel, polyurethane.
- C. Mounting: Cable Clamp System with strain relief.
- D. Furnish cable, field preamplifiers, sensor termination and lightning surge arrestors as required to maintain accuracy from transducer to terminal device.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

3.2 INSTALLATION

- A. According to manufacturer instructions.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than one day (8 hours) on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in operation and maintenance of equipment.
- C. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 40 72 43

SECTION 40 72 76 – LEVEL SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. A point level switch for use in hazardous areas with all international certificates. It is useable in all industries and has functional SIL2/SIL3 safety. It offers reliable measurement value that is not affected by flow, turbulence, bubbles, foam, vibration, bulk solids content or build-up.

1.2 SUBMITTALS

- A. Furnish complete Product Manufacturer's Technical Information, Operating and Maintenance.
- B. Product Data:
 - 1. Dimensional drawings.
 - 2. Materials of construction.
 - 3. Measurement accuracy.
 - 4. Range and range ability.
 - 5. Enclosure Rating.
 - 6. Classification Rating.
 - 7. Power.
 - 8. Output options.

1.3 QUALITY ASSURANCE

- A. Manufacture instruments facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store all instruments in a dedicated structure with space conditioning to meet the recommended storage requirements provided by the Manufacturer.
- B. Any instruments that are not stored in strict conformance with the Manufacturer's recommendation shall be replaced.

1.5 PROJECT OR SITE CONDITIONS

- A. Provide instruments suitable for the installed site conditions including but not limited to material compatibility, site altitude, process and ambient temperature, and humidity conditions.

1.6 WARRANTY

- A. The meter shall have standard one (1) year warranty from date of shipment and if the meter is commissioned by a factory certified technician, the warranty is extended to three (3) years from the date of shipment.

1.7 MAINTENANCE

- A. Provide all parts, materials, fluids, etc. necessary for maintenance and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

1.8 LIFECYCLE MANAGEMENT

- A. Instrument documentation, like original calibration certificates, manuals and product status information shall be accessed via a web enabled system with a license. The instrument-specific information shall be accessed via its serial number. When services are provided by an authorized service provider the services information like subsequent field calibrations shall be archived and accessible via this web enabled system.

PART 2 - PRODUCTS

2.1 LEVEL SWITCHES

A. Manufacturer:

- 1. Anchor Scientific.
- 2. Endress-Hauser.
- 3. Or Pre-Approved Equal.

B. Mercury-Float Type:

- 1. Switch Description: Normally open (NO) mercury switches.
- 2. Relays: Intrinsically safe.
- 3. Float Casing: Polypropylene.
- 4. Housing: NEMA 250 Type 4X.
- 5. Cable: Oil-resistant thermoplastic.
- 6. Rated Voltage: 600 V.

C. VIBRONIC LEVEL SWITCH

- 1. Input Power: 24 VDC or AC.
- 2. Relay Output: NO contacts.
- 3. Housing: Polyester NEMA 250 Type 4X.
- 4. Sensor type: Tuning fork.
- 5. Vendor model: E&H FLT80

2.2 SOURCE QUALITY CONTROL AND CALIBRATION

- A. A Certificate of Compliance shall be available from the manufacturer if required.
- B. An application data sheet should be filled out, with all known data, and submitted to the manufacturer to ensure proper instrument choice

2.3 SAFETY

- A. All electrical equipment shall meet the requirements of ANSI/NFPA 70, National Electric Code latest addition.
- B. All devices shall be certified for use in the following hazardous areas:
 - 1. Explosion proof: Class I, Div. 1, Groups ABCD, Temperature rating T6 (Ta = 70 °C)
 - 2. Intrinsically safe: Class I, II, III, Div. 1, Groups ABCDEF, Temperature rating T5 (Ta = 70 °C)
 - 3. Non- Incendive- Class I, Div. 2, Groups ABCD, Temperature rating T5 (Ta = 70 °C)
- C. All devices shall be suitable for use as non-incentive devices when used with appropriate non-incentive associated equipment. Devices with intrinsically safe ratings will normally be acceptable with vendor's approval.
- D. Electrical housing shall conform to NEMA 4x classification.
- E. Non- intrinsically safe electrical equipment shall be approved by a Nationally Recognized Testing Laboratory (NRTL) such as FM, UL, ETL, CSA, etc. for the specified electrical area classification.
- F. Electrical equipment specified as intrinsically safe shall qualify as "simple apparatus" or NRTL approved intrinsically safe equipment per ANSI/ISA-RP12.6 "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations," latest edition.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the complete set of plans, the process fluids, pressures, and temperatures and furnish instruments that are compatible with installed process conditions.
- B. Examine the installation location for the instrument and verify that the instrument will work properly when installed.

3.2 INSTALLATION

- A. As shown on installation details and mechanical drawings.
- B. As recommended by the manufacturer's installation and operation manual.

3.3 FIELD QUALITY CONTROL

- A. Demonstrate the performance of all instruments to the ENGINEER before commissioning.
- B. ENGINEER to witness all instrument calibration verification in the field.
- C. Each instrument shall be tested before commissioning and the ENGINEER shall witness the response in the PLC control system and associated displays.
- D. Manufacturer's Field Services:
 - 1. Manufacturer's representative shall verify installation of all installed transmitters.
 - 2. Notify the ENGINEER in writing of any problems or discrepancies and proposed solutions.

3.4 ADJUSTING

- A. Verify set-up and configuration of all instruments in accordance with the Manufacturer's instructions.

3.5 PROTECTION

- 1. All instruments shall be fully protected after installation and before commissioning. Replace any instruments damaged before commissioning.
 - a. The ENGINEER shall be the sole party responsible for determining the corrective measures.

END OF SECTION 40 72 76

SECTION 40 73 13 - PRESSURE AND DIFFERENTIAL PRESSURE GAUGES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Pressure gages.
- B. Related Requirements:
 - 1. Section 40 73 64 – Annular Pressure Seals: Isolation of gages from process fluid.

1.2 REFERENCE STANDARDS

- A. ASME International:
 - 1. ASME B40.100 - Pressure Gauges and Gauge Attachments.
- B. NSF International:
 - 1. NSF 61 - Drinking Water System Components - Health Effects.
 - 2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information for system materials and component equipment, including connection requirements.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
 - 2. Submit installation requirements and other details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of equipment and accessories.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Extra Stock Materials:
 - 1. Gages: Furnish 20 percent spare gages, with a minimum of one gage for each range used.

1.6 QUALITY ASSURANCE

- A. Ensure that materials of construction of wetted parts are compatible with process liquid.
- B. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.8 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish one-year manufacturer's warranty for pressure gages.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

- A. Manufacturers:
 - 1. Ametek; Model Series 1550
 - 2. Wika; Model Series 716
 - 3. Ashcroft; Model Series 1010

- B. Type: Differential - Compound.
- C. Dials:
 - 1. Nominal Diameter: 4 inches.
 - 2. Face: White, laminated plastic dials with black graduations.
 - 3. Scale: Extend over arc not less than 270 degrees.
 - 4. Ranges and Graduation Units: As indicated on Instrument Schedule.
- D. Cases:
 - 1. Liquid filled.
 - 2. Stainless Steel case and wetted parts.
 - 3. Windows:
 - a. Material: Clear, shatterproof glass.
 - b. Thickness: 1/8 inch.
 - c. Provide gasket.
- E. Connection:
 - 1. Location: Bottom.
 - 2. Socket:
 - a. 1/4-inch NPT male thread.
 - b. Extend minimum 1-1/4 inches below gage cases.
 - c. Provide wrench flats.
 - 3. Mounting: Stem.
- F. Measuring Element:
 - 1. Bourdon Tubes:
 - a. Material: Stainless steel to brass socket.
 - b. Provide welded, stress-relieved joints.
 - 2. Movement:
 - a. Rotary.
 - b. Material: Stainless steel.
 - 3. Accuracy:
 - a. Comply with ASME B40.100.
 - b. ± 0.5 percent of full-scale range.
- G. Adjustment:
 - 1. Provide for zero-reading adjustment.
 - 2. Adjusting Screws: Accessible from rear of case without need for disassembly.
- H. Accessories:
 - 1. Shutoff Cocks: Furnished by gage manufacturer.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. According to manufacturer instructions.
- B. Coordinate location and orientation of gages and seal assemblies with final piping and equipment installations.
- C. Ensure that gages are located to be easily read during operation and easily accessible for maintenance.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 40 73 13

SECTION 40 73 63 - DIAPHRAGM SEALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Diaphragm seals.
- B. Related Requirements:
 - 1. Section 40 73 13 - Pressure and Differential Pressure Gauges
 - 2. Section 40 73 26 - Gauge-Pressure Transmitters

1.2 REFERENCE STANDARDS

- A. NSF International:
 - 1. NSF 61 - Drinking Water System Components - Health Effects.
 - 2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with piping work and pump installation.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information for system materials and component equipment, including connection requirements.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
 - 2. Submit installation requirements and other details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of equipment and accessories.

1.6 QUALITY ASSURANCE

- A. Ensure that materials of construction of wetted parts are compatible with process liquid.
- B. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten (10) years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 2. Provide additional protection according to manufacturer instructions.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish one-year manufacturer's warranty for diaphragm seals.

PART 2 - PRODUCTS

2.1 DIAPHRAGM SEALS

- A. Manufacturers:
 - 1. Ashcroft
 - 2. Or Pre-Approved Equal.
- B. Description:
 - 1. Mounting:
 - a. Directly to pressure gauge socket.
 - 2. Wetted Parts and Bolt Materials: Corrosion resistant to process fluid.
 - 3. Provide fill/bleed screw for filling of diaphragm seal.
 - 4. Instrument Connection: NPT, 1/4 inch.
 - 5. Process Connection: NPT, 1/2 inch.
 - 6. Flushing Connection: NPT, 1/4 inch.
 - 7. Working Pressure Rating: Pipeline working pressure + 50 psig.
 - 8. Calibration: Provide cleanout ring to be removed for recalibration or cleaning, without loss of filling liquid or change in calibration.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Diaphragm Seals:
 - 1. Factory-assemble, fill, and calibrate entire assembly, including gage and switch, prior to shipment.
 - 2. Field filling is not acceptable.
- C. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. According to manufacturer instructions.

- B. Mount only one (1) pressure element per diaphragm seal.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 40 73 63

SECTION 40 73 64 – ANNULAR PRESSURE SEALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pressure seals, annular type

B. Related Requirements:

1. Section 40 73 13 - Pressure and Differential Pressure Gauges: Pressure gages requiring isolation from process fluid.

1.2 REFERENCE STANDARDS

A. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information for system materials and component equipment, including connection requirements.

C. Shop Drawings:

1. Indicate system materials and component equipment.
2. Submit installation requirements and other details.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of equipment and accessories.

1.5 QUALITY ASSURANCE

- A. Ensure that materials of construction of wetted parts are compatible with process liquid.
- B. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.7 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish one-year manufacturer's warranty for annular pressure seals.

PART 2 - PRODUCTS

2.1 ANNULAR PRESSURE SEALS

- A. Manufacturers:
 - 1. Ashcroft Model 80 Wafer Isolation Ring
 - 2. Red Valve Series 48 Pressure Sensor
 - 3. Onyx Isolator Ring
 - 4. Or Pre-Approved Equal
- B. Description:
 - 1. Mounting: Wafer Style.
 - 2. Wetted Parts and Bolt Materials: Corrosion resistant to process fluid.
 - 3. Instrument Connection: NPT, 1/4 inch.
 - 4. Working Pressure Rating: Pipeline working pressure + 50 psig.
 - 5. Fill fluid: 50/50 solution of ethylene glycol and water, unless otherwise noted

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Annular Seals:
 - 1. Factory-assemble, fill, and calibrate entire assembly, including gage or switch, prior to shipment.
 - 2. Field filling is not acceptable.
- C. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. According to manufacturer instructions.
- B. Mount only one pressure element per annular seal.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 40 73 64

SECTION 41 22 13.13 – BRIDGE CRANES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Free standing bridge crane, hoist, runway beams, rails, columns, bracing and accessories for Influent Pump Station.

B. Related Requirements:

1. Section 05 12 00 - Structural Steel Framing
2. Division 03 - Concrete
3. Division 26 - Electrical.

1.2 REFERENCES

- A. HMI Standard Specifications for Hoists
- B. ANSI B30.2.0 - Safety Code for Overhead and Gantry Cranes
- C. ANSI B30.11- Monorails and Underhung Cranes
- D. ASTM A36 - Carbon Structural Steel
- E. ASTM A325 - Structural Bolts, Steel, Heat Treated, 120/150 ksi Minimum Tensile Strength
- F. ASTM A490 - Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
- G. ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube
- H. AWS D1.1 - Structural Welding Code
- I. OSHA - Specification 1910.179 - Overhead and Gantry Cranes

1.3 PERFORMANCE AND DESIGN REQUIREMENTS

A. Bridge Crane and Hoist:

1. Crane shall provide coverage of rectangular area of size indicated on Drawings and consist of:
 - a. Support structure requiring only primary structural support without longitudinal or lateral bracing.
 - b. Two rigid, parallel runways.

- c. Rigid, single girder bridge moving perpendicular to runways or monorail.
- d. Modular, pre-engineered design: Crane system shall be capable of expansion, disassembly and relocation, and accepting additional or multiple mixed capacity bridges.
 - 1) Crane shall be designed, fabricated, and installed in accordance with ANSI B30.11, and OSHA 1910.179.
- e. Productivity ratio: Crane shall be designed to manually move load with maximum force of 1/100 load weight.
- f. Runway and bridge track: Enclosed type limiting dust and dirt collection on rolling surfaces with maximum deflection of 1/450 span based on capacity plus 15 percent for lifting device weight.
- g. Crane operating temperature: 5 to 200 °F (-15 to 93 °C).
- h. Crane shall be designed to withstand:
 - 1) Structural design shall include full rated load capacity plus 15% for hoist and trolley weight and 25% impact factor for speed of lifting device and weight of tooling.
 - 2) Crane and hoist dead load.
 - 3) Live load capacity equal to net rated hook load: 2000 pounds.
 - 4) Inertia forces from crane and load movement.
 - 5) Crane Manufacturer shall confirm the weight of actual pump with Contractor or Pump Manufacturer and submit crane product accordingly.
- i. Required hoist lift distance:
 - 1) Influent Pump Station: 40 feet

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Describe capacities, performance, operation, and applied forces to foundation.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.
- C. Shop Drawings:
 - 1. Shop drawings showing configuration, dimensions, service area, and construction and installation details.
- D. Source Quality-Control Submittals: Indicate results of shop/factory tests and inspections.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

- F. Manufacturer Reports: Indicate that equipment has been installed according to manufacturer's instructions.

1.5 COORDINATION/SCHEDULING

- A. Section 01 31 00 - Project Management and Coordination: Requirements for coordination.
- B. Coordinate installation and startup of Work of this Section with plant operations.
- C. Schedule Work of this Section to install bridge crane prior to pump installation Work.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of installed bridge crane.
- C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Operation data: Submit manufacturer's instructions, troubleshooting checklists and repair data
- C. Maintenance data: Include manufacturers literature, cleaning procedures, and replacement parts list
- D. Spare Parts:
 - 1. Furnish one (1) set of manufacturer's recommended spare parts.
 - 2. Furnish a complete list of manufacturer's recommended spare parts.
- E. Tools: Furnish special wrenches, tools, etc. and other devices required for Owner to maintain and service equipment referenced herein.

1.8 QUALIFICATIONS

- A. Manufacturer: A company with more than five (5) years of experience successfully designing and manufacturing cranes and material handling solutions for numerous industries.
- B. Installer: A company that is acceptable to the crane manufacturer and with five (5) years of experience assembling and installing cranes for multiple applications. Installer should be able to:
 - 1. Perform welding using certified operators in accordance with AWS D1.1.

2. Bolt connections in accordance with torque tightening procedures specified in AISC Manual, Part 5.
3. Clearly label crane with rated load capacity with label visible from floor level and loading position.
4. Perform OSHA Load Test Certification.

1.9 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

1. Included on manufacturer's standard form and outlines the manufacturer's agreement to repair or replace assemblies and components that fail in materials and/or execution within warranty period from date of substantial completion.
2. Warranty covers ten (10) years or 20 thousand (20,000) hours for manual push-pull Crane products to cover defects in materials and execution.
3. Warranty covers two (2) years or 4 thousand (4,000) hours for motorized tractor products.

PART 2 - PRODUCTS

2.1 BRIDGE CRANE

A. Manufacturers:

1. The bridge crane shall be manufactured by:
 - a. Gorbel, Inc
 - b. Spanco, Inc
 - c. Or Approved Equal

B. Description:

1. Hanging Bridge Crane: Work station, bridge crane hanging from pre-engineered metal building, two runways, bridge moving perpendicular to runways, and equipped with enclosed track, end trucks, hoist trolley, festooning system, bumpers, and other accessories.
2. The bridge crane shall be installed for lifting influent pumps out of influent pump station wetwell for maintenance and cleaning. The bridge crane shall be securely designed to withstand the one (1) influent pump weighing 4000 pounds.

C. Construction: Fabricate from ASTM A36 steel sections with finished ends and surfaces.

1. Support structure: Support crane runways with frames consisting of two columns and horizontal header.
 - a. Columns: Square tubes with bottom base plate and top header plate.

- b. Header: Fabricated from two back-to-back channels spaced apart and joined with welded end plates. Provide clamp plates, threaded rods, lock washers, and hex nuts for attaching header to column.
 - c. Hanger assemblies: Provide each support frame with pair of hanger assemblies that provide a rigid connection for suspending runways. Assembly to consist of clamp angle, clamp plates, threaded rods, lock washers, and hex nuts.
- 2. Runways: Vierendeel truss fabricated from square steel tubes and enclosed steel track.
 - a. Track: Enclosed, cold formed, steel box track which serves as bottom cord of runway and permits end trucks and festoon carriers to ride on lower inside flanges. Fabricate lower running flanges with 2 degrees taper to center trolley within track.
 - b. Splice joint: Provide truss splice plates, channel-shaped track splice joint, bolts, lock washers, and nuts for joining runway sections. Splice joints must be located within four feet of a support point.
 - c. Festoon stack section: Provide enclosed track extension to provide for stacking festoon carriers at end of runway.
- 3. Bridge: Single girder, Vierendeel truss fabricated from rectangular steel tubes and enclosed steel box track.
 - a. Track serves as bottom cord of bridge and permits hoist trolley and festoon carriers to ride on lower inside flanges.
 - b. Fabricate lower running flanges with 2 degrees taper to center trolley within track.
- 4. End trucks: Rigid frame end truck designed to ride inside enclosed runway track and connect to and suspend bridge.
 - a. Construction: Stamped steel fabrication with both vertical and horizontal wheels to prevent binding in runway. Designs with welds in tension are not acceptable.
 - b. Wheels: Removable, self-centering wheels with sealed lifetime lubricated bearings. Vertical wheels shall be tapered 2 degrees to match track profile.
 - c. Drop lugs: Provide on both sides of truck to limit truck drop in the event of wheel, axle, or load bar failure.
 - d. Connection to the bridge: Provide a rigid connection between bridge and end truck. Articulating connections with threaded hardware are not acceptable.
 - e. Designed for easy attachment of peripherals.
- 5. Hoist trolley: Rigid-body trolley designed to ride inside enclosed track of bridge and to carry hoist and load. Articulating trolleys are not acceptable.
 - a. Construction: Two-piece stamped steel body with two wheels each side and tapered clevis positioning hoist hook at center of trolley so load weight is evenly distributed to all four trolley wheels. Provide removable clevis pin of type and size determined by manufacturer for specified capacity. Trolleys with non-removable clevis pins are not acceptable. Holes provided in body for mechanical connections.
 - b. Wheels: Removable, self-centering wheels with sealed lifetime lubricated bearings. Vertical wheels shall be tapered 2 degrees to match track profile. Non-removable or non-tapered wheels are not acceptable. Steel wheels are not acceptable.
 - c. Drop lugs: Provide on both sides of trolley to limit trolley drop in the event of wheel, axle, or load bar failure.

- d. Designed for easy attachment of peripherals.
- 6. End stops: Molded composite, resilient bumper installed in runway and bridge tracks to prevent end trucks, hoist trolley, and festoon carriers from rolling out of track. Bolt stops without energy absorbing bumper are not acceptable.
- D. Festoon Assemblies:
 - 1. Provide length of cable to supply lifting device. Supply shall be festooned along bridge and runway. Refer to drawings for type and size.
 - 2. Festoon gliders: T-shaped gliders with adjustable applicable attachment to support service runs on runway or bridge and allowing festooning as end truck or hoist trolley travels.
 - 3. Festoon clamp: Steel clamp assembly attached to track to prevent festoon trolleys and gliders from exiting track.
 - 4. Festoon tow clamp: Steel clamp assembly attached to track to prevent festoon from binding under with end truck or trolley.

2.2 ELECTRIC HOIST

- A. Hoist:
 - 1. Heavy Duty Electric Motor with Class F insulation
 - 2. Cast Aluminum Housing with chemical resistant powder coating
 - 3. Gearing fully enclosed lifetime lubricated
 - 4. True vertical lift
 - 5. Heavy Duty DC Brake
 - 6. Integral load limiting device
- B. Lifting tackle:
 - 1. Lower block and hook
 - 2. Safety type
 - 3. Guarded sprocket
 - 4. Slow-opening, non-fracturing hook
 - 5. Safety latch at throat of opening
 - 6. Hook supported by ball or roller thrust bearing to permit easy turning
 - 7. Sheaves: Anti-friction or sleeve bearings
 - 8. Chain: Especially made for hoisting service
 - 9. Stainless Steel Chain container

2.3 SHOP FINISHING

- A. Steel: Steam wash steel crane components with iron phosphate solution and apply blue or yellow baked enamel finish.
- B. Aluminum: Mill finish.
- C. Provide spray can of matching color, air-drying paint for field touch-up.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver materials in manufacturer's packaging, including application instructions.
- C. Inspection: Accept materials on-Site in original packaging. Inspect for damage.
- D. Store materials according to manufacturer's instructions.
- E. Protect materials from water and wet weather.

3.2 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Do not begin installation until support structures have been properly prepared.
- C. Design and construction of reinforced concrete footings and slabs as detailed on Drawings and specified in other sections. Verify that accurate crane applied forces and anchor bolt patterns are provided for foundation design.

3.3 INSTALLATION

- A. Install units and accessories in accordance with manufacturer's instructions and approved shop drawings.
- B. Do not modify crane components in any manner without advance written approval by crane manufacturer.
- C. Clearances for moving crane components:
 - 1. 3 inches minimum vertical clearance from any overhead obstruction.
 - 2. 2 inches minimum horizontal clearance from any lateral obstruction.
 - 3. Prior to applying proper torque to the bolts, ensure runways are:
 - 4. Level to within plus or minus 1/8 inch in 20 feet.
 - 5. Parallel with opposite runway to within plus or minus.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

- C. Perform field quality control testing as recommended by manufacturer.
- D. Move bridge and hoist trolley through entire travel to ensure crane is clear of obstructions and moves freely and smoothly.
- E. Inspect installed crane. Verify all bolts are tight and lock washers fully compressed.
- F. Field test crane and accessories for operating functions. Ensure crane movement is smooth and proper. Adjust as required and correct deficiencies.
- G. Clean surfaces. If necessary, touch-up paint damage, scratches, and blemishes with manufacturer provided matching paint.
- H. Protect crane from other construction operations.

3.5 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Check control module functions and adjust as required.

3.6 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Bridge Crane Supplier shall provide demonstration and training session (minimum 2 hr.) for Owner's representative covering operation and maintenance.

3.7 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 41 22 13.13

SECTION 43 11 33 - ROTARY LOBE BLOWERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Rotary lobe blowers and accessories.
- B. Related Requirements:
 - 1. Section 26 05 03 - Equipment Wiring Connections: Execution and product requirements for connecting equipment specified by this Section.
 - 2. Section 26 29 23 - Variable-Frequency Motor Controllers: Execution and product requirements for equipment specified by this Section.
 - 3. Section 43 05 10 - Common Work Results for Gas Handling Equipment: Blower components and appurtenances common to gas-handling systems.
 - 4. Section 43 05 48 - Vibration and Seismic Controls for Process Gas and Liquid Handling Equipment: Vibration control for equipment specified in this Section.
 - 5. Section 43 05 53 - Identification for Process Gas and Liquid Handling Equipment: Nameplates for equipment specified in this Section.
 - 6. Section 46 05 13 - Common Motor Requirements for Water and Wastewater Equipment: Electric motors and accessories normally supplied as part of equipment assemblies.

1.2 REFERENCE STANDARDS

- A. American Bearing Manufacturers Association:
 - 1. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. American Gear Manufacturers Association:
 - 1. AGMA 6001 - Design and Selection of Components for Enclosed Gear Drives.
 - 2. AGMA 6013 - Standard for Industrial Enclosed Gear Drives.
 - 3. AGMA 6113 - Standard for Industrial Enclosed Gear Drives.
- C. American Society of Mechanical Engineers:
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- D. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Product Data: Submit manufacturer information for blower, including accessories, curves with specified operating point plotted, power, rpm, sound power levels for both blower inlet and outlet at rated capacity, electrical characteristics, and connection requirements.
- C. Shop Drawings: Indicate size and configuration of blower assembly, mountings, weights, and accessory connections.
- D. Manufacturer's Certificate: Certify that rotary blowers meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Manufacturer Reports:
 - 1. Certify that equipment has been installed according to manufacturer instructions.
 - 2. Indicate activities on Site, adverse findings, and recommendations.
- I. Qualifications Statement:
 - 1. Submit qualifications for manufacturer.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations of rotary lobe blowers.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five (5) years' documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store blowers according to manufacturer instructions.
- D. Protection:

1. Protect blowers and appurtenances from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.7 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.8 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish one-year manufacturer's warranty for rotary lobe blower provided by Contractor.
- C. Furnish two-year warranty for blowers provided by BNR Manufacturer.

PART 2 - PRODUCTS

2.1 ROTARY LOBE BLOWERS

A. Manufacturers:

1. Aerzen
2. Kaeser
3. Or Approved Equal
 - a. Specifications and equipment arrangements for the equipment referenced are based on Aerzen. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

- B. Description:** Continuous service, heavy-duty rotary lobe blowers provide sufficient mixing and aeration in biological nutrient removal (BNR) basins and aerobic digesters.

C. Performance and Design Criteria:

	Biological Nutrient Removal (BNR) Basins	Aerobic Digester
Flow Capacity (SCFM)	3,216	1,900
Discharge Pressure (PSI)	11.7	9.5
Maximum Temperature Differential (°F)	240	240

Maximum RPM	3,600	3,600
Motor (HP)	250	125
Number of Blower	3	1
Schedule	BLR3610 BLR3620 BLR3630	BLR7030
Provided by	BNR System Manufacturer	Contractor

D. Casing:

1. Material: Ribbed cast iron.

E. Impeller:

1. Type: Straight, three-lobe.
2. Material: Cast or Ductile Iron.
3. Lubrication: Splash.

F. Drive Shaft:

1. Material: Alloy steel.
2. Seals:
 - a. Type: Lip.
 - b. Material: Viton.
3. Drive Guards:
 - a. Material: Steel.
 - b. Occupational Safety and Health Administration approved.

G. Drive Mechanism: V-belt.

H. Timing Gears:

1. Material: Alloy steel.
2. Comply with AGMA 6013.

I. Bearings:

1. Type: Roller.
2. Minimum L-10 Life: 50,000 hours, according to ABMA 11.
3. Lubrication: Splash oil.

J. Mounting:

1. Vertical.
2. Detachable steel feet.

K. Piping Connection: Flanged, ASME B16.1.

L. Operation:

1. Electrical Characteristics: As specified in Section 26 05 03 - Equipment Wiring Connections and following:
 - a. Voltage: 460 V, 3 phase, 60 Hz.
2. Control Panel:
 - a. BNR Blower:
 - 1) BNR blowers shall be controlled by BNR master control panel FCP3100.
 - b. Digester Blower:
 - 1) Factory mounted.
 - 2) NEMA Type 4.
 - 3) Furnish single-point power connection and grounding lug.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Furnish shop inspection and testing of each blower.

2.3 BLOWER ACCESSORIES

- A. The package layout must minimize the space requirement including the space required for accessing all accessories of the package (including but not limited to: belt drive, pressure safety valve, check valve, flexible connectors and lubrication points on motor and blower) for regular maintenance and periodic checking. The sound enclosure shall not interfere with this requirement and shall not require disassembly of the piping or the use of tools to meet the aforementioned requirements. Operator shall not be required to reach over any component of the blower package to perform oil filling and draining.
- B. Each blower shall be supplied with one combination inlet filter silencer. The filter media must have an efficiency of 90% by weight per ASHRE 52-76 with synthetic dust equivalent to separation > 95% @ 5 microns. The inlet filter silencer shall be suitable for indoor installation and mounted directly to the inlet flange of the blower. Filter element shall be washable by maintenance personnel as a preventative maintenance procedure. Silencer shall be located upstream of the inlet filter. Filter and silencer performance losses shall be included by the blower vendor in the blower performance calculation.
- C. Each blower shall be supplied with one inlet silencer. The inlet silencer shall be a combination chamber and absorptive design for maximum sound attenuation. Absorption materials shall be located upstream of the inlet filter. Inlet silencer performance losses shall be included by the blower vendor in the blower performance calculation.
- D. Each blower shall be supplied with one combination base frame discharge silencer. The silencer shall be a chamber type design for maximum sound attenuation and shall not use fibrous materials or any absorption materials or internal diffusers. The silencer shall feature a single shell of pressure vessel quality steel with continuous welds. The silencer must be subject to a pressure test for tightness and strength at a minimum of 1.65 times the pressure setting of the pressure safety valve. The temperature rating shall be 300°F. The design of the silencer must

accommodate being bolted directly to the blower discharge flange with no intermediary pieces as well as to assure that there will be no pipe beating noise or pipe harmonics whether one blower or multiple blowers are running. Discharge silencer performance losses shall be included by the blower vendor in the blower performance calculation. The discharge silencer shall be designed to reduce the noise emitted by the piping leaving the blower package to 85dB(A), over the entire range of operation, based on a carbon steel, schedule 40 piping of a diameter equal to the blower package nominal connection size. A grounding lug fully welded to the base shall be supplied by the blower manufacturer.

- E. Each blower package shall have a flanged connector located at the discharge of the package. Flexible connectors shall be provided and shall prevent the transmission of noise and vibrations from the blower package into the piping. As a minimum, the material used shall be reinforced silicone rubber. The expansion joint shall be suitable for the maximum operating temperature and pressure ratings of the equipment in the air stream.
- F. Each blower shall be supplied with a base frame to be constructed from welded carbon steel or cast iron that shall be designed to maintain alignment of both, the blower internal components and the drive during operation. The base/discharge silencer shall be designed to prevent distortion while being installed on vibration isolating mounts. The accessories such as V-belt drive, motor, inlet filter, inlet silencer, discharge silencer, relief valve, check valve, vibration isolation feet, inlet and discharge flex connectors, and instrumentation shall be factory assembled. The only connections required by the contractor shall be discharge piping to the blower assembly and the electric power to the motor.
- G. Each blower shall be supplied with Vibration isolating feet with a minimum efficiency of 80%. Blower manufacture shall be responsible for attenuating noise and vibration in the blower package such that no special installation base shall be required nor shall any vibration from the blower package be transmitted to the base or the piping.
- H. Each blower shall be supplied with a single pressure relief valve on the discharge side of the blower mounted after the discharge silencer and before the check valve. The valve shall be set to protect the blower from exceeding its maximum pressure rating. The valve shall have a cast Aluminum body with brass internals. The single valve shall be sized to pass 100% of the design flow. The valve shall be field adjustable, spring loaded, and have a proportional operating characteristic with respect to the pressure set point. If the blower package is supplied with a sound enclosure, the pressure relief valve shall also be housed by the sound enclosure and shall relieve into a segmented section of the sound enclosure.
- I. Each blower shall be supplied with one check valve that shall be installed on the discharge line. The check valve shall be of the full bore low pressure drop, flapper type design with a cast aluminum body, valve plates of aluminum bronze or other anti-corrosion material and a EPDM flat full-contact seal. The valve shall be removable without disturbing the piping. Check valve performance losses shall be included by the blower vendor in the blower performance calculation and shall be factory assembled.
- J. Each blower shall be supplied with the following instrumentation: one pressure gauge that shall be supplied to measure the discharge pressure. The pressure gauge shall read 0-15 PSI. The pressure gauge shall have a stainless steel case and be glycerin filled for pulsation dampening. Minimum dial diameters shall be 4". A pulsation snubber shall be provided. A filter maintenance indicator shall be provided. Minimum dial diameters shall be 4". Discharge

temperature shut-off gauge/switch combination unit. Switch enclosures shall be in accordance with the relevant section of the job specifications.

- K. Each blower shall receive its initial oil filling at the factory. Oil requirements shall be such that the oil shall be available from a local source.
- L. Each blower shall be supplied with a sound enclosure covering the entire blower package including the drive motor. The sound enclosure must be designed for easy inspection and maintenance of all blower package components. Panels shall be made of galvanized steel sheet, internally and externally powder coated in a light reflecting, light gray color per RAL 7032. The skid shall be of the same color. Sound enclosure acoustic material -as a minimum- shall comply with UL 94 - HF1 for fire-retardant, self-extinguishing, non-dripping materials. Materials with a lesser rating are not acceptable. If used, non-flammable packing materials such as compressed mineral fibers are only acceptable if lined with appropriate retaining mat and supported by galvanized perforated sheet. The enclosure shall provide suitable protection for outdoor installation under the specified site conditions (wind load and snow load). The enclosure and the blower package must be both mounted on a skid / oil-drip pan designed for meeting environment protection standards and for easy transportation and installation. A grounding strap shall be installed between the blower base and the package skid to bypass any vibration isolating mounts. Quick release panels, each less than 50 lb (as mandated by MSHA) must provide easy and quick access for routine maintenance of the blower and the package components. Should the panels be heavier than 50 lbs, hinged doors must be supplied, with the appropriate frame, reinforcements and supporting elements. A high efficiency blower shaft driven ventilation fan shall provide ventilation and cooling integral to the sound enclosure. Motor driven ventilation fans shall be permitted as long as the blower manufacturer provides a factory installed and prewired system which includes the fan motor, motor starter, wiring and NEMA 4X stainless steel, fan control panel. Fan shall operate on sufficient HP motors of 230/460 V, 3 phase, 60 Hz power. Fan control panel shall only allow the main blower motor to run after ventilation fan operation is confirmed. CONTRACTOR shall only make electrical connections for the ventilations system in the provided control panel. Cooling fan shall be sized for sufficient heat removal from the sound enclosure. Electrical components, instrumentation and instrument connections shall not be mounted or interface with moving panels of the sound enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify layout, type, and orientation of piping connections.
- C. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. Installation Standards: Install Work according to manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Inspection: Inspect for proper operation of blowers.
- C. Testing:
 - 1. Test each blower minimum four hours at blower's rated capacity.
 - 2. Test in presence of Architect/Engineer.
 - 3. Sound Level: Less than 80 dBA, measured at 5 ft from blower discharge.
- D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 2 trips (each with 8-hour day) on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in maintenance of equipment.
- E. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- F. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Check control functions and adjust as required.

3.5 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 43 11 33

SECTION 43 25 13 - SUBMERSIBLE CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Automatic triplex submersible pump station with controls, rails, accessories, and appurtenances as specified or shown on the plan drawings.
- B. Related Requirements:
 - 1. Section 03 31 00 – Anchorage In Concrete
 - 2. Div. 26 - Execution requirements for electrical connections to equipment specified by this Section.
 - 3. Section 33 051 6.13 – Precast Concrete Utility Structures for Wetwell and Valve Vault
 - 4. Section 40 05 13 - Common Work Results for Process Piping: Piping components, appurtenances, and identification requirements common to process piping systems.

1.2 REFERENCE STANDARDS

- A. ASTM International:
 - 1. ASTM A48 - Standard Specification for Gray Iron Castings.
 - 2. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit information concerning materials of construction, fabrication, and protective coatings.
- C. Certified Pump Curves
- D. Shop Drawings:
 - 1. Submit detailed dimensions for materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and other details.
 - 2. Include manufacturer's specified displacement tolerances for vibration at operational speed specified for pumps.

- E. Manufacturer's Certificate: Certify that pump and accessories meet or exceed specified requirements.
 - 1. Certify installation is completed according to manufacturer's instructions.
- F. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- G. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- I. Manufacturer Reports: Indicate that equipment has been installed according to manufacturer's instructions.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.5 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for pumps and components.

1.6 QUALITY ASSURANCE

- A. The pump manufacturer shall have a minimum of 1,000 units of similar type pumps, installed and operating for no less than five (5) years in the United States.
- B. The pump manufacturer shall perform the following inspections and tests on each pump before shipment from factory:
 - 1. Impeller, motor rating and electrical connections shall first be checked for compliance to the customer's purchase order.
 - 2. A motor and cable insulation test for moisture content or insulation defects shall be made.
 - 3. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.
 - 4. The pump shall be run for 30 minutes, submerged a minimum of six (6) feet under water.
 - 5. After operational test No. 4, the insulation test (No. 2) is to be performed again.
- C. A written report stating the foregoing steps have been performed shall be supplied with each pump at the time of shipment upon request.

- D. The pump cable end will be sealed with a high quality protective covering, to make it impervious to moisture or water seepage prior to electrical installation.

1.7 SPARE PARTS

- A. The pump manufacturer shall furnish one (1) set of recommended spare parts.
- B. The pump manufacturer shall furnish a complete list of recommended spare parts.
- C. The pump manufacturer shall furnish any special tool for the Owner to service, maintain, repair, and disassemble the pumps.

1.8 WARRANTY

- A. The pump manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and material for a period of five (5) years or 10,000 hours under the Municipal Wastewater - Permanent Installation Warranty Policy.

PART 2 - PRODUCTS

2.1 INFLUENT PUMPS

- A. Manufacturers:
 - 1. Flygt.
 - 2. KSB.
 - 3. Or Pre-Approved Equal.
 - a. Specifications and equipment arrangements for the equipment referenced are based on Flygt. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.
- B. Schedule:
 - 1. Influent Pump No.1 (P1010)
 - 2. Influent Pump No.2 (P1020)
 - 3. Influent Pump No.3 (P1030)
 - 4. Influent Pump No.4 (P1040)
 - 5. Influent Pump No.5 (P1050)
- C. Design Criteria:
 - 1. Quantity of Pumps: 5
 - 2. Design Point of Each Pump:
 - a. 1,736 GPM @ 130 ft (P1010, P1050)
 - b. 3,472 GPM @ 130 ft (P1020, P1030, P1030)

3. Static Head: 110 ft
 4. Motor:
 - a. 110 HP, 460V, 3 Phase, 60 Hz (P1010, P1050)
 - b. 185 HP, 460V, 3 Phase, 60 Hz (P1020, P1030, P1040)
 5. Inlet Size: 10 in or 250 mm
 6. Discharge Size: 8 in
 7. Impeller Size:
 - a. 17.32 in or 440 mm (P1010, P1050)
 - b. 13.87 in or 350 mm (P1020, P1030, P1040)
 8. Impeller Material: Ductile iron
- D. Each pump shall be furnished with a submersible electric motor suitable for continuous submergence, a cast iron discharge connection with anchor bolts, upper guide bar bracket, 45 feet of stainless steel lifting chain, and 100 feet of hypalon jacketed type SPC cable, P-MSHA approved and sized according to N.E.C. and ICEA standards.
- E. The pumps shall be capable of handling raw, unscreened sewage. The discharge connection elbow shall be permanently installed in the wet well along with the discharge piping. The pumps shall be automatically connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection or service. There shall be no need for personnel to enter pump well. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pumping unit shall be guided by no less than two 304 stainless steel guide rails and pressed tightly against the discharge connection elbow with metal-to-metal contact. Sealing of the discharge interface by means of a diaphragm, o-ring, or other devices will not be acceptable. No portion of the pump or the guide support system other than the discharge connection shall bear directly on the floor of the sump. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 30 ft.
- F. Accessories:
1. The influent pumps shall be provided with the following accessories:
 - a. Discharge connections.
 - b. 304 stainless steel rail system with top, bottom, and intermediate guide bars.
 - c. 304 stainless steel lifting chain, or equal.
 - d. 304 stainless steel electrical cable holders.
 - e. 304 stainless steel chain hook.
 - f. Float switches and mounting hardware with one (1) spare. Manufacturer shall be Anchor Scientific or pre approved equal. The cable shall be of sufficient length such that it can be routed in conduit to the pump control panel without splicing.
 - g. 316 stainless steel or titanium submersible pressure transducer and mounting hardware with one (1) spare. Manufacture shall be Cerlic, Endress & Hauser, KPSI TM, or pre approved equal. The cable shall be of sufficient length such that it can be routed in conduit to the pump control panel without splicing. Pump Manufacturer shall provide submersible pressure transducer as part of pump package. Pump Manufacturer shall provide performance and compatibility guarantee of included pressure transducer for level measurement.
 - h. Anchor bolts for rail system and pump discharge base shall be 316 SS.

- i. Covers shall be delivered to the precast wetwell supplier for installation in the wetwell top slab as specified in Section 33 05 16.13 Precast Concrete Utility Structures.
2. Control Panel:
 - a. Pump control panel shall be provided by System Integrator and shall control all influent pumps.
3. Lifting Chains:
 - a. Minimum length equal to wetwell depths plus 5 feet at minimum.
 - b. Material: 304 Stainless Steel
 - c. Load Rating: Sufficient to permit lifting and lowering the pump.
4. Bridge Cranes:
 - a. Furnish one (1) bridge crane system to lift the pumps out of the wet well. The bridge crane shall conform to Section 41 22 13 – Bridge Crane.
 - b. Crane manufacturer shall be responsible for sizing the crane properly to handle the weight of pumps.
 - c. Contractor shall be responsible for installing and testing the bridge crane system.

2.2 LEVEL CORRECTION PUMPS

A. Manufacturers:

1. Flygt.
2. KSB.
3. Or Pre-Approved Equal.
 - a. Specifications and equipment arrangements for the equipment referenced are based on Flygt. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

B. Schedule:

1. Level Correction Pump No.1 (P3410)
2. Level Correction Pump No.2 (P3420)

C. Level correction pumps shall transfer liquid in level correction tank to EQ Basin No.1 via an 8” force main.

D. Design Criteria:

1. Quantity of Pumps: 2
2. Design Point of Each Pump: 600 GPM @ 58 ft
3. Static Head: 52 ft
4. Motor: 14 HP, 460V, 3 Phase, 60 Hz
5. Inlet Size: 6 in
6. Discharge Size: 4 in
7. Impeller Size: 9.41 in or 239 mm

8. Impeller Material: Cast iron or ductile iron

- E. Each pump shall be furnished with a submersible electric motor suitable for continuous submergence, a cast iron discharge connection with anchor bolts, upper guide bar bracket, 20 feet of stainless steel lifting chain, and 100 feet of hypalon jacketed type SPC cable, P-MSHA approved and sized according to N.E.C. and ICEA standards.
- F. The discharge connection elbow shall be permanently installed in the wetwell along with discharge piping. The pumps shall be automatically connected to the discharge connection elbow when lowered into place, and shall be easily removed for service. There shall be no need for personnel to enter pump well. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pumping unit shall be guided by no less than two 304 stainless steel guide rails and pressed tightly against the discharge connection elbow with metal-to-metal contact. Sealing of the discharge interface by means of a diaphragm, O-ring, or other devices will not be acceptable. No portion of the pump or the guide support system other than the discharge connection shall bear directly on the floor of the sump. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 15 ft.

2.3 REUSE PUMPS

- A. Reuse pump shall be supplied in the scope of reuse water equipment package as specified in Section 43 42 21 – Reuse Water Storage Tank and Pump.

2.4 PUMP CONSTRUCTION

- A. Major pump components shall be of gray cast iron, Class 35B, with smooth surfaces devoid of blow holes and other irregularities. Where watertight sealing is required, O-rings made of nitrile rubber shall be used. All exposed nuts and bolts shall be of AISI-type 304 stainless steel. All surfaces coming into contact with sewage, other than stainless steel, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump. The impeller shall be coated with an acrylic dispersion zinc phosphate primer.
- B. All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machine surfaces. This will result in controlled compression of nitrile rubber O-rings without the requirement of a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall be used.
- C. The cable entry water seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall be comprised of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body containing a strain relief function, separate from the function of sealing the cable. The assembly shall bear against a shoulder in the pump top. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the motor interior from foreign

material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

- D. Each pump shall be provided with a tandem mechanical rotating shaft seal system. Seals shall run in an oil reservoir. Lapped seal faces must be hydrodynamically lubricated at a constant rate. The lower seal unit, between the pump and oil chamber, shall contain one stationary and one positively driven tungsten carbide ring. The upper seal unit, between the oil sump and motor housing, shall contain one stationary tungsten carbide ring and one positively driven rotating tungsten carbide ring. Each interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment but shall be easily inspected and replaceable. The following seal types shall not be considered acceptable or equal to the dual independent seal specified: shaft seal without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower units. Cartridge type seal systems shall not be acceptable.
- E. Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall not require an oil pressure equalizer ring for oil pressure compensation. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside.
- F. The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.
- G. The pump shall have a separate seal leakage chamber to capture any leakage past the upper secondary mechanical seal. The leakage chamber shall have a float type switch that will signal if the chamber should reach 50% capacity.
- H. The pump shaft shall rotate on two (2) permanently lubricated bearings with an L-10 bearing life of 50,000 hours when operating at any usable portion of the pump curve. The upper bearing shall be a single roller bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row bearings shall not be acceptable.
- I. Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The shaft shall be AISI-type 431 stainless steel.
- J. The impeller shall be of gray cast iron, ASTM A-48 Class 35B, dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design unless specified otherwise. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impellers shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.
- K. The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have integral spiral-shaped, sharp-edged groove(s) that is cast into the suction cover. The spiral groove(s) shall provide the sharp edge(s) across which each impeller vane leading edge shall cross during

rotation so to remain unobstructed. The internal volute bottom shall provide effective sealing between the multi-vane semi-open impeller and the volute.

- L. The Pump volute shall be manufactured to accommodate a device designed by the pump manufacturer to produce a flushing action at the start of the pump cycle. Water from the pump will be forced through the device into the wet well as a jet flushing stream. This device is mounted on the pump and is based on the ejector principle with a ball as a closing device. The operation is automatic and induced by the pump flow and pressure. Electrical components or cabling will be not accepted.

2.5 MOTOR

- A. Motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180 °C (356 °F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40 °C (104 °F) and capable of no less than 30 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125 °C (260 °F) shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.
- B. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40 °C (104 °F) ambient and with a temperature rise not to exceed 80 °C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting current and torque.
- C. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.
- D. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.
- E. Motors shall be sufficiently cooled by the surrounding environment or pumped media. A cooling jacket is not required.

2.6 CONTROLS

- A. Each pump motor shall be equipped with a variable frequency drive (VFD) sized for the appropriate voltage and power. The VFD shall be included in the influent pump package.
- B. High Water Level Alarm:
 - 1. Furnish and install a high water level alarm horn and light at the pump station panel. The unit shall be factory constructed on top of the pump control panel. The unit shall consist of a loud audible horn with manual adjustment for pitch; a flashing red light with a 100 watt bulb and red vapor proof globe and guard, and a control center for horn silencer with reset and test switches.
- C. Liquid Level Sensors:
 - 1. Furnish and install an ultrasonic level transducer for automatic control of pumps and provide float switches for Low Level, Lead Pump, Lag Pump, and High Level, in case of ultrasonic level transducer failure/fault. The Lead Pump and High Level float switches shall initiate an alarm and SCADA contacts; the Low Level float switch shall be hardwired to shut pumps off in any condition and send an alarm to SCADA.
- D. SCADA:
 - 1. The pump control panel shall be furnished with a communication module with an Ethernet/IP connector for remote monitoring by the plant SCADA system. The following data shall be made available to the SCADA system:
 - a. Pump Run/On
 - b. Pump Stop/Off
 - c. Pump Speed
 - d. Pump Fault
 - e. Wetwell Level
 - f. High Level Alarm
 - g. Low Level Alarm
 - h. Pressure Differential Level Transducer Fault Alarm
- E. Control Description/Sequence:
 - 1. Refer to Section 40 70 23 – Process Control Narratives for detailed description for controls of all submersible pump.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify layout and orientation of pumps, accessories, and piping connections.

3.2 INSTALLATION

- A. Install pumps and accessories where indicated on Drawings and according to manufacturer's instructions.
- B. Provide and connect piping, accessories, and power and control conduit and wiring to make system operational, ready for startup.
- C. Flush piping with clean water.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Pre-operational Checks:
 - 1. Check pump and motor alignment.
 - 2. Check for proper motor rotation.
 - 3. Check pump and drive units for proper lubrication.
- C. Startup and Performance Testing:
 - 1. The pump shall be tested at start-up and voltage, current, and other significant parameters recorded. The manufacturer shall provide a formal test procedure and forms for recording data. Only factory certified service personnel shall perform start-up service. Proof of certification shall be required prior to equipment approval.
- D. Verify pump performance by performing time-drawdown test or time-fill test.
- E. Check pump and motor for high bearing temperature and excessive vibration.
- F. Check for motor overload by taking ampere readings.
- G. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace system components that fail to perform as specified, and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
 - 3. Document adjustments, repairs, and replacements in manufacturer's field services certification.
- H. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than one trip of one day on-Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.
- I. Furnish installation certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 43 25 13

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SECTION 43 42 21 - REUSE WATER STORAGE TANK AND PUMP

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Welded steel pressure tank.
2. Submersible reuse water pump.

B. Related Requirements:

1. Section 09 96 00 - High Performance Coatings
2. Section 26 - Electrical
3. Section 43 25 13 – Submersible Centrifugal Pumps

1.2 SUBMITTALS

A. Shop Drawings: Tank dimensions, materials of construction, tank lining methods, anchors, attachments, lifting points, taps, and drains.

B. Manufacturer's Certificate:

1. Tanks and appurtenances meet or exceed specified requirements.

C. Welder Certificates: Certify welders and welding procedures employed on Work, verifying ASME qualification within previous 12 months.

D. Test and Evaluation Reports: Installation certificate from equipment manufacturer's representative as described in PART 3.

E. Manufacturer Instructions: Installation requirements, including storage and handling procedures.

F. Source Quality-Control Submittals: Indicate results of shop tests and inspections.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

I. Qualifications Statements:

1. Qualifications for manufacturer.
2. Welder Certificates: Submit welder certification of compliance with ASME BPVC-IX.

1.3 QUALITY ASSURANCE

- A. Perform Work according to ASME BPVC-IX for welding materials and procedures.
- B. Perform Work according to ASME Standards, Section VIII, Division 1, Pressure Vessels.
- C. Manufacturer: Company specializing in manufacturing products specified in this Section with three years' experience.
- D. Welders: ASME qualified within previous 12 months for employed weld types.
- E. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of AL.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials according to manufacturer instructions.
- B. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
 - 3. Provide additional protection according to manufacturer instructions.

1.5 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.6 WARRANTY

- A. Furnish One (1) year manufacturers' warranty for welded steel pressure tanks.

PART 2 - PRODUCTS

2.1 WELDED STEEL PRESSURE TANKS

- A. Manufacturers:
 - 1. Wessels Company
 - 2. Grundfos
 - 3. AA Tanks

4. Or Pre-Approved Equal
 - a. Specifications and equipment arrangements for the equipment referenced are based on Wessels Company pressure tank. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

B. Description:

1. Pressure tank shall be used to store reuse water and fed by Reuse Pump No.2. Pressure tank shall be periodically filled to supply washwater to unit processes intermittently. When the tank does not have sufficient volume to provide flow, the tank shall be bypassed and Reuse Pump No.2 shall supply washwater to plant reuse loop continuously.
2. Welded steel tank, ASME-labeled for working pressure of 125 psig.
3. Pre-charged pressure tank with replaceable bladder. Bladder shall be manufactured from heavy-duty butyl rubber.
4. Pressure tank shall have NPT epoxy lined connections and 0.302" – 3/2" charging valve connection for on-site charging of tank.
5. Pressure tank shall have pressure gauge and bladder integrity monitor.
6. Configuration: Vertical
7. Height: 115 in
8. Tank Diameter: 60 in
9. Tank Volume: 1,056 gal
10. Service Connection: 4 in

C. Schedule:

1. Reuse Water Storage Tank (T8010)

D. Supports:

1. Tank Base:
 - a. Pressure tank shall be supported by a base at the bottom of tank. The base shall be able to support the weight of tank plus water when it's full.
 - b. The base shall provide sufficient a ground clearance of 9 in at minimum to allow piping and fittings connected to tank service connection.
 - c. The base shall be mounted directly to concrete slab as indicated by construction drawings to prevent any movement of tank. Anchors and bolts shall be ASTM A325 galvanized, sized and provided by the tank manufacturer
 - d. Tank base shall be integrated with the tank and constructed of the same material as pressure tank.
 - e. Base Diameter: 54 in

E. Fabrication:

1. Tank Assembly:
 - a. Tank shell shall be fabricated of A36 carbon steel with adequate safety factor and corrosion allowance of 0.125 inches.

- b. Tank interior shall be SSPC SP 6/NACE 3 - Commercial Blast Cleaning and provided with a suitable primer and epoxy coating, coating system shall be 6-8 mils MDFT, specification Section 09 96 00.
- c. Tank exterior shall be Commercial Blast Cleaned and provided with a suitable epoxy primer 2 MDFT for field painting by Contractor in accordance with these specifications.
- d. Furnish fittings to accept gages and safety controls, 4" system connection, and lift rings.
- e. One (1) connection on tank exterior for pressure gauge
- f. One (1) bladder integrity monitor
- g. One (1) 4" NPT system connection
- h. One (1) 0.302 – 32NC charging valve connection
- i. Comply with ASME Section VIII.

F. Accessories:

1. Pressure Gauges:

- a. Pressure gauge shall be provided by pressure tank Manufacturer
- b. At minimum 4-inch diameter dial with white face and black numbers, 304 stainless steel case, 316 stainless steel internals, and 316 stainless steel welded parts (connection, socket, and bourdon tube), bronze or non-metallic internals shall not be allowed.
- c. Liquid filled with glycerin or other suitable oil to stabilize movement and increase readability of the gauge during operation.
- d. Provide ½" 304 stainless steel snubber with internal filter disc.
- e. Shall have a minimum scale of 0 – 120 psig.
- f. Shall have a non-adjustable pointer.
- g. Shall have ½" MNPT bottom connection.
- h. Minimum accuracy of 0.5% of full scale.
- i. Pressure gauge shall be installed on the exterior of pressure tank at specific location designated for pressure gauge.

2.2 REUSE WATER PUMP

A. General:

- 1. Reuse water pump shall be in the scope of reuse water equipment package. The pump shall conform to Section 43 25 13 – Submersible Centrifugal Pumps.
- 2. Piping, fittings and instruments shall be installed to connect reuse pump to pressure tank. Unless specified in the scope of pressure tank, all piping, fittings and instruments shall be provided by Contractor.

B. Manufacturers:

- 1. KSB.
- 2. Flygt.
- 3. Or Pre-Approved Equal.
 - a. Specifications and equipment arrangements for the equipment referenced are based on KSB. Changes to the arrangement indicated in the specifications and in the plan

set shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

C. Schedule:

1. Reuse Pump No.2 (P8010)

D. Design Criteria:

1. Quantity of Pumps: 1
2. Design Point: 120 GPM @ 250 ft
3. Static Head: 70 ft
4. Motor: 30 HP, 460V, 3 Phase, 60 Hz
5. Inlet Size: 2.5 in
6. Discharge Size: 2 in
7. Impeller Size: 7 13/16 in or 199 mm
8. Impeller Material: Cast iron
9. Pump Casing Material: Cast iron

- E. Reuse pump shall be furnished with a submersible electric motor suitable for continuous submergence, a cast iron discharge connection with anchor bolts, upper guide bar bracket, 12 feet of stainless steel lifting chain. Reuse pump shall supply sufficient flow and head to the pneumatic tank for reuse water storage and supply reuse water continuously to headworks for screen and washing compactor operation.

2.3 SOURCE QUALITY CONTROL

- A. Provide U-1A data report for completed tank.

B. Certificate of Compliance:

1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify layout and orientation of tank accessories and piping connections.

3.2 INSTALLATION

- A. Maintain manufacturer's recommended clearances around and above tanks.
- B. Install tank on concrete piers as indicated on the plan drawings.

- C. Piping:
 - 1. Connect piping to tank.
- D. Install tank accessories not factory mounted.
- E. Touch-up and Field Painting: As specified in Section 09 96 00 – High-Performance Coatings.

3.3 FIELD QUALITY CONTROL

- A. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- B. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

END OF SECTION 43 42 21

SECTION 46 05 53 - IDENTIFICATION FOR WATER AND WASTEWATER EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Labels.
5. Lockout devices.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for equipment identification and schedule, including equipment number, location, function, and manufacturer's name and model number.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved black letters on light, contrasting background color.

2.2 TAGS

A. Metal Tags:

1. Stainless steel construction; stamped letters.
2. Minimum Tag Size and Configuration: 1 inch x 2-inch (minimum) with finished edges.

2.3 STENCILS

A. Description:

1. Clean-cut symbols.
2. Letter Height: 1-3/4 inch.

B. Stencil Paint: Semi-gloss enamel.

2.4 LABELS

A. Description:

1. Laminated Mylar construction.
2. Minimum Size: 1.9 by 0.75 inch.
3. Adhesive backed, with printed identification.

2.5 LOCKOUT DEVICES

A. Lockout Hasps:

1. Anodized aluminum construction.
2. Furnish hasp with erasable label surface.
3. Minimum Size: 7-1/4 by 3 inches.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Identify equipment with nameplates.
- B. Identify inline pumps and other small devices with tags.
- C. Identify control panels and major control components outside panels with plastic nameplates.
- D. Apply stencil painting as described above.
- E. Install identifying devices after completion of coverings and painting.

- F. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.
- G. Labels:
 - 1. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
 - 2. For unfinished covering, apply paint primer before applying labels.
- H. Install tags using corrosion-resistant chain.

END OF SECTION 46 05 53

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SECTION 46 21 01 - MANUAL BAR SCREEN

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manual Bar Screen.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer's product data for system materials and component equipment.

C. Shop Drawings:

1. Indicate system materials and component equipment.
2. Submit dimensional drawings, installation and anchoring requirements, fasteners, and other details.

D. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Manufacturer Reports: Indicate that equipment has been installed according to manufacturer's instructions.

G. Qualifications Statements:

1. Submit qualifications for manufacturer and installer.
2. Submit manufacturer's approval of installer.

1.3 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.

B. Project Record Documents: Record actual locations of installed screen.

C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
 - 1. Furnish one (1) set of manufacturer's recommended spare parts.
 - 2. Furnish a complete list of manufacturer's recommended spare parts.
- C. Tools: Furnish special tools and other devices required for Owner to maintain, disassemble and repair manual bar screen and associated components.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five (5) years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver materials in manufacturer's packaging, including application instructions.
- C. Inspection: Accept screen and associated components on-Site in original packaging. Inspect for damage.
- D. Store materials according to manufacturer's instructions.

1.7 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. The Manufacturer and Contractor shall furnish a warranty extending twelve (12) months after substantial completion date of the project in its entirety.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Or-Tec
- B. JWC Environmental
- C. Or Pre-Approved Equal

1. Specifications and equipment arrangements for the equipment referenced are based on Or-Tec. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

2.2 DESCRIPTION

- A. A manually cleaned bar screen shall be installed in the bypass channel of coarse mechanical screen at the influent pump station. The manual bar screen shall be used to remove large debris including stringy rag-like materials from the influent sewage. The manual bar screen shall only be in service when the coarse mechanical screen is overflowed or taken out of service for maintenance.

2.3 PERFORMANCE AND DESIGN CRITERIA

- | | |
|-------------------------|---|
| A. Peak Flow: | 15.0 MGD |
| B. Channel Width: | 48 inches |
| C. Channel Depth: | 96 inches |
| D. Screen Grid Opening: | 2 inches (50 mm) |
| E. Screen Angle: | 75° |
| F. Drying Deck: | Provide at intermediate level, above screen channel |

2.4 BAR SCREEN

- A. Structure:
 1. The Manual Bar screen shall consist of a bar screen panel, two side frames, perforated drying deck and manual rake.
 2. Equipment shall be installed so as not to obstruct the flow of raw wastewater to bar screen. Screen components including shapes (rods, angles, and channels), side frames, bar rack, rake, drying deck, fasteners and anchor bolts shall be manufactured from Type 304 stainless steel. Manual bar screen with any of these items manufactured from materials other than 304 stainless steel shall not be acceptable.
- B. Bar Screen Panel:
 1. Screen panel face shall be made of a parallel array of bars with even spaces between them. Bars shall be 1/4" wide and 1" deep. Bars shall be fully welded in a stainless steel frame.
 2. The mid-section of the bar is cross-supported by support beams at every 20" interval.
 3. All material for bars, drying deck, rake and the support beams shall be made of 304 Stainless Steel. The bar screen panel shall be mounted and bolted between a pair of side

frames. Screens which utilize material other than stainless steel as the main screen media shall not be acceptable for this project.

4. The screen shall be supplied with a rake that allows operators to manually clean the screen face. The rakes penetrating teeth shall fully clean the gaps between the bars and keep the screen operational. Screening shall be drawn up the face of the screen and discharged onto a perforated drying deck above the channel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

3.2 INSTALLATION

- A. Install screen and associated components according to manufacturer's instructions and as indicated on Drawings.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. After installation, inspect and test for proper operation.
- C. Manufacturer will provide factory service during one (1) trip, for one (1) day, for inspection of installation, equipment start-up, and operator training.
- D. Equipment Acceptance:
 1. Adjust, repair, modify, or replace components failing to perform as specified, and rerun tests.
 2. Make final adjustments to equipment under direction of manufacturer's representative.
- E. Furnish installation certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.

END OF SECTION 46 21 01

SECTION 46 21 14 – COARSE MECHANICAL SCREEN

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanically cleaned rake bar screen.
2. Screening conveyor.

B. Location: new influent pump station

C. Related Requirements:

1. Section 05 50 00 – Metal Fabrications: Fasteners, brackets, and other miscellaneous metal fabrications as required by this Section.
2. Section 09 96 00 – High-Performance Coatings: Product and execution requirements for painting as required by this Section.
3. Section 26 05 03 – Equipment Wiring Connections: Execution requirements for electrical connections to equipment specified by this Section.
4. Section 40 72 13 – Ultrasonic Level Meters.
5. Section 46 05 53 – Identification for Water and Wastewater Equipment.

1.2 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:

1. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer's product data for system materials and component equipment, including electrical characteristics.

C. Shop Drawings:

1. Indicate system materials and component equipment.
2. Submit wiring and control diagrams, installation and anchoring requirements, fasteners, and other details.

D. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

E. Field Quality Control Submittals: Indicate results of Contractor-furnished tests and inspections.

- F. Manufacturer Reports: Indicate that equipment has been installed according to manufacturer's instructions.
- G. Qualifications Statements:
 - 1. Submit qualifications for manufacturer and installer.
 - 2. Submit manufacturer's approval of installer.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations of installed screens and screenings conveyors.
- C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
 - 1. One (1) set of scraper blades with clips and fasteners.
 - 2. One (1) set of brushes with clips and fasteners.
 - 3. Furnish one (1) set of manufacturer's recommended spare parts for the screen and conveyor.
 - 4. Furnish a complete list of manufacturer's recommended spare parts.
- C. Tools: Furnish special tools and other devices required for Owner to maintain, disassemble, and repair screen and conveyor.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with a minimum of ten (10) years of experience manufacturing these products.
- B. Coarse mechanical screen and screening conveyor shall be supplied by a single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver materials in manufacturer's packaging, including application instructions.

- C. Inspection: Accept screens and screenings conveyors on-site in original packaging. Inspect for damage.
- D. Store equipment and accessories according to manufacturer's instructions.

1.8 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. The Manufacturer and Contractor shall furnish a warranty for the coarse mechanical screen, screening conveyor and accessories, extending one (1) year after substantial completion date of the project in its entirety.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The coarse mechanical screen and screening conveyor shall be manufactured by:
 - 1. SAVECO
 - 2. Hydro-Dyne
 - 3. Huber
 - 4. Parkson
 - 5. JWC
 - 6. Or Pre-Approved Equal
 - a. Specifications and equipment arrangements for the equipment referenced are based on SAVECO. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

2.2 RAKE BAR SCREEN

- A. Schedule:
 - 1. Coarse Mechanical Screen No.1 (SCR1000)
- B. Description:
 - 1. Channel-mounted bar screens cleaned by chain-driven rake arm, which meshes with bar rack and travels up rack, cleaning and collecting captured debris.
 - 2. Front-cleaning to prevent rake from sliding over accumulated material.
 - 3. Replaceable rake arm capable of carrying trapped material up and out of influent channel, across a deadplate to discharge into the screening conveyor.
 - 4. Frame shall be integral and self-supporting.

5. Bar type shall be rectangular or tear drop.
6. Discharge Wiper
 - a. The wiper shall be pivoted, brushless, automatic, and self-positioning with return to rest.
 - b. The wiper shall be replaceable plastic.
7. Full covers shall be installed on portions of screen above top of channel and on discharge chutes.
8. No deflection, damage, or distortion by loads imposed by 5-foot water differential between upstream and downstream side of bar rack at maximum water depth in downstream channel.
9. No obstructions allowed in influent channel except bar rack and rake arm.
10. Structural Supports and Fasteners: Located above maximum water level, except bar rack supports.

C. Performance and Design Criteria:

- | | |
|------------------------------------|--------------------------------|
| 1. Inclination: | 75° from horizontal |
| 2. Number of Screen: | 1 |
| 3. Peak Flow per Screen: | 15.0 MGD |
| 4. Design Flow per Screen: | 5.0 MGD |
| 5. Minimum Flow per Screen: | 0.5 MGD |
| 6. Max. Velocity through the Grid: | 6.0 ft/s |
| 7. Bar Rack Opening Size: | 1 inch (25 mm) |
| 8. Head Loss at Peak Flow: | 16 inches @ 30% blinding |
| 9. Channel Width: | 48 inches |
| 10. Channel Height: | 84 inches |
| 11. Max. Upstream Water Depth: | 60 inches |
| 12. Screening Discharge Height: | 48 inches above top of channel |
| 13. Motor Size: | 1.0 hp |

D. Components:

1. Bar Rack
 - b. Bar rack shall be manufactured from 304 stainless steel.
 - c. Bar rack shall be mounted to the side frame on both sides and the bottom of influent channel with designated inclination angle.
 - d. Bar rack openings shall be 25 mm (1").
 - e. If rectangular, bar rack shall consist of continuous bars with cross section 8 mm (.315") x 40 mm (1.57").
 - f. If teardrop, bar rack shall consist of continuous bars with 8 mm (0.315") in width, 60 mm (2.4") minimum in depth, and a tail with 5 mm (0.2") in width.
 - g. Bottom bar rack shall be curved from specified inclination angle to horizontal at bottom of channel.
2. Rake
 - a. Rakes shall be manufactured from 304 stainless steel.
 - b. Rakes shall be mounted to the roller chain on both sides.
 - c. Rakes shall be installed in a way the teeth engage bar rack at minimum space.
 - d. Screen shall have minimum four (4) rakes installed at equal distance.

3. Sprockets and Shaft
 - a. Upper sprocket shall be manufactured from solid 304 stainless steel and mounted to the drive shaft.
 - b. Drive shaft shall be manufactured from 304 stainless steel and supported with flanged grease-lubricated ball bearing assemblies.
 - c. The unit shall utilize lower chain return guides in order to maintain proper rake alignment and maintain proper engagement of the rake assemblies with the bar rack.
4. Drive Assembly
 - a. Drive assembly shall be a shaft-mounted reducer with an electric motor. The motor shall be TEFC, 1.0 HP, 480V, 3-Phase, 60 Hz.
 - b. Gear reducer shall be a helical gear type as manufactured by NORD or approved equal. A cast iron frame; design in accordance with AGMA recommendations for Class I service shall be provided.
5. Roller Chain
 - a. Roller chains shall be manufactured from stainless steel.
 - b. Rollers shall be manufactured from stainless steel or polyamide.
 - c. Bushings and pins shall be manufactured from stainless steel.
 - d. Roller chains shall be installed within a stainless steel guide channel covering full distance of travel.
6. Scraper
 - a. The screening scraper shall be manufactured from 304 stainless steel with polyethylene scraper blade.
 - b. Scraper blade shall be installed with easy access for cleaning and replacement.
7. Cover
 - a. The portion of screen above the operating floor level shall have 304 stainless steel covers.
 - b. The covers shall provide easy and quick access to the equipment for cleaning and maintenance.
8. Side Frame
 - a. The side frame shall be manufactured from 304 stainless steel and mounted to the concrete side wall of influent channel.
 - b. Side frame shall be properly sealed against channel wall to eliminate open space.

2.3 COARSE SCREENING CONVEYOR

A. Schedule:

1. Coarse Screening Conveyor No.1 (SCY1001)

- B.** One (1) coarse screening conveyor shall be provided for Coarse Mechanical Screen No.1 (SCR1000) to transport screening to dumpster. Screening conveyor and all related components shall be supplied by the same manufacturer as coarse mechanical screen. Screening conveyor shall be installed with an inclined angle that allows screening to be discharged into a dumpster.

C. Spiral Screw:

1. Spiral screw shall be shaftless and push configuration.
2. Spiral screw shall be constructed from alloy steel or 304 stainless steel.
3. Protective primer coating shall be applied as minimum.

D. Trough Assembly:

1. The trough assembly shall consist of a U-trough, wear liner, inlet and outlet area, and trough cover.
 - a. U-trough shall be manufactured from 304 stainless steel with minimum thickness of 5 mm (3/16").
 - b. The wear liner will support the spiral throughout the trough length and be constructed of 6 mm (1/4") thick polyethylene minimum. Wear liner shall be provided in four (4) feet segments maximum and held in place by clips for ease of replacement.
 - c. U-trough shall have one (1) vertical inlet, one (1) outlet and one (1) drain connection.
 - d. Except for the inlet area, the trough shall be supplied with covers. Trough covers shall be provided with gaskets and constructed from stainless steel and bolted to the flanges of the U-trough.
2. Discharge Chute
 - a. The discharge chute shall be manufactured from stainless steel.
 - b. The discharge chute shall have side covers that are easily removed for cleaning and replacement.
3. Drive Assembly
 - a. Drive assembly shall be a shaft-mounted reducer with an electric motor. The motor shall be TEFC, 2.0 HP, 460V, 3-Phase, 60 Hz.
 - b. Gear reducer shall be a helical gear type with hollow input shaft. The unit will be provided with a cast iron frame and be designed in accordance with AGMA recommendations for Class II service based on the horsepower required to operate the conveyor.

2.4 CONTROLS

A. Control Panel:

1. One (1) factory control panel (FCP) shall be supplied by screen Manufacturer. The control panel shall be for controlling both the coarse mechanical screen (SCR1000) and the coarse screening conveyor (SCY1001).
2. Each control panel shall include the following components:
 - a. CONTROL POWER ON indicating light.
 - b. RUN indicating light for screen.
 - c. UPSTREAM HWL indicating light for screen.
 - d. Torque OVERLOAD indicating light for screen.
 - e. Reset push button.
 - f. Elapsed time meter.

- g. Main disconnect switch.
 - h. Emergency Stop push button.
 - i. Local Control Station: Each screen shall have a local control station mounted locally to the screen and contain HAND/OFF/AUTO selector switch, FORWARD/OFF/REVERSE selector switch and Emergency Stop pushbutton.
 - j. The coarse screening conveyor shall be interlocked with the coarse mechanical screen for automatic operation.
 - k. Control panel shall be provided by the equipment manufacturer and shall meet the requirements of the manufacturer's specification. The panel shall be a stainless steel enclosure.
 - l. The control panel shall be mounted locally at the coarse mechanical screen and screening conveyor.
 - m. Control panel shall contain an HMI.
 - n. Control panel shall be provided with sun shield.
 - o. The control panel shall contain the motor starters. Starters shall comply with Division 26 – Electrical.
 - p. Surge protection shall be according to Specification 26 43 13 – Surge Protection for Low-Voltage Electrical Power Circuits.
 - q. The panel shall include a Hirschmann Model Gecko 4TX Managed Ethernet Switch (or equal) to provide connectivity to plant-wide SCADA System.
 - r. All other electrical components shall be in accordance with Division 26 – Electrical.
 - 3. Materials:
 - a. Control panel shall be NEMA 4X and UL listed.
 - 4. Programmable Logic Controller:
 - a. Control panel shall contain a programmable logic controller (PLC). The PLC shall be Allen Bradley MicroLogix.
 - b. The PLC shall include Ethernet/IP.
- B. Sequence of Operation: Refer to Section 40 70 23 – Process Control Narratives
- 1. Coarse Mechanical Screen (SCR1000):
 - a. H-O-A switch for screen operation
 - 1) When HAND mode is selected, the screen shall run continuously.
 - 2) When the OFF mode is selected, the screen shall stop.
 - 3) When the AUTO mode is selected, screen shall start by a signal from one of the following:
 - a) Upstream level system: Upstream water level will be monitored by the level transducer and displayed on the control panel. The control panel (FCP1000) shall have an Operator adjustable on and off upstream level setpoint for the screen. FCP1000 shall send a call to run signal based on these setpoints. When the screen starts, the screen shall run until the level drops below the setpoint in FCP1000 and the call to run signal from FCP1000 is ceased. If the level transducer has an error, the screen shall run continuously.
 - b) Timer (backup)
 - c) Input error from transducer (loss of echo)

- b. F-O-R switch for screen operation
 - 1) When FORWARD/REVERSE is selected, the screen shall run in the corresponding direction if H-O-A switch is in Hand. When the screen is in Auto, the FORWARD/REVERSE signal is sent from FCP1000.
 - 2) When OFF is selected, the screen shall stop while H-O-A switch is in Hand or Auto.
 - 2. Rake Bar Screening Conveyor (SCY1001):
 - a. H-O-A switch for conveyor operation
 - 1) When HAND mode is selected, the conveyor shall run continuously.
 - 2) When the OFF mode is selected, the conveyor shall stop.
 - 3) When the AUTO mode is selected, conveyor shall run while the rake bar screen is running and for a vendor pre-set amount of time after the screen turns off.
- C. Instrumentation:
- 1. Level Control System:
 - a. The screen Manufacturer shall provide an upstream level control system for the coarse mechanical screen consisting of one (1) ultrasonic level sensor and transmitter conforming to Section 40 72 13 – Ultrasonic Level Meters connected to FCP1000 for operation of the coarse mechanical screen.
 - 2. All ultrasonic level sensors and transmitters shall match transmitters used in remainder of plant. Coordination with System Integrator is required.

2.5 NAMEPLATES

- A. Conform to the requirements of Section 46 05 53 – Identification for Water and Wastewater Equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that facility is ready to receive screening equipment and conveyors.

3.2 INSTALLATION

- A. Install screening equipment and conveyors according to manufacturer's instructions and recommendations.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 – Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Manufacturer Services:
 - 1. Start-up
 - a. Furnish the services of a factory representative, having complete knowledge of proper operation, start-up procedure and maintenance requirements, for not less than three (3) eight (8) hour days, to inspect the final installation and supervise a test run of the screen, conveyor, and accessories.
 - 2. Training
 - a. Furnish the services of a factory representative, having complete knowledge of the operation and maintenance requirements of the system, to instruct the Owner's personnel in the proper operation of the equipment. Training for proper operation and maintenance of the equipment shall be scheduled for one (1) eight (8) hour day and shall be concurrent with trip to site required for start-up.
- D. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified, and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- E. Furnish installation certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

3.4 ASSEMBLY, INSPECTION, AND TESTING

- A. Following installation, operating tests will be performed to demonstrate to the Engineer that each mechanism and the system as a whole will function in a satisfactory manner. The Contractor shall make, at Contractor's own expense, all necessary changes, modifications, and/or adjustments required to ensure satisfactory operation.

3.5 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 46 21 14

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SECTION 46 21 15 – ROTARY DRUM SCREEN

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes all screening equipment at proposed headworks.
 - 1. Internally-Fed Rotary Drum Screen
 - 2. Fine Screening Conveyor
 - 3. Fine Screening Washing Compactor
- B. Related Requirements:
 - 1. Section 03 20 00 – Anchorage in Concrete.
 - 2. Section 05 50 00 – Metal Fabrications: Fasteners, brackets, and other miscellaneous metal fabrications as required by this Section.
 - 3. Section 09 96 00 – High-Performance Coatings: Product and execution requirements for painting as required by this Section.
 - 4. Section 26 05 03 – Equipment Wiring Connections: Execution requirements for electrical connections to equipment specified by this Section.
 - 5. Section 46 05 53 – Identification for Water and Wastewater Equipment.

1.2 SUBMITTALS

- A. Shop drawings shall be submitted in accordance with the requirements of Section 01 33 00 - Submittal Procedures. The equipment manufacturer shall include descriptive literature, dimensional prints of all components described herein, and performance data in sufficient detail to fully describe the equipment being installed.
- B. Operation and maintenance manuals shall be submitted in accordance with the requirements of Section 01 33 00 - Submittal Procedures.

1.3 COORDINATION

- A. Section 01 31 00 – Project Management and Coordination: Requirements for scheduling.
- B. The Contractor shall review design and layout drawings to ensure that installation arrangements are suitable for the specified equipment. Any potential conflicts or recommended modifications shall be coordinated with the Engineer and noted on the shop drawings or by a pre-submittal request for information, if appropriate.
- C. Coordinate installation and startup of Work of this Section with Owner and Engineer.

1.4 SCHEDULING

- A. Section 01 31 00 – Project Management and Coordination: Requirements for scheduling.
- B. Schedule Work of this Section to install equipment prior to connecting piping Work.

1.5 DELIVERY, STORAGE AND HANDLING

- A. All equipment shall be suitably packaged to facilitate handling and protect against damage during transit and storage. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times.
- B. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces, which are damaged prior to acceptance of equipment, shall be repaired to the satisfaction of the engineer.
- C. Grease and lubrication oil shall be applied to all bearings and similar items.
- D. Each item of equipment shall be tagged or marked as identified on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.
- E. Motors, electrical equipment, and other equipment with bearings shall be stored and maintained. Electrical equipment, controls, and insulation shall be protected against moisture and water damage. All space heaters furnished in electrical equipment shall be connected and operated continuously.
- F. Screen, conveyor, compactor and accessories shall be delivered, stored and protected in accordance with the manufacturer's recommendations and the requirements of Section 01 60 00 – Product Requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.7 QUALITY ASSURANCE

- A. The manufacturer shall provide the Engineer with written certification that all equipment furnished complies with all applicable requirements of Specifications.
- B. The manufacturer shall have at least five (5) years of experience in the design and construction of the rotary drum screens, screening conveyor and washing compactor described herein, with at least ten (10) similar equipment installations.

1.8 TOOLS AND SPARE PARTS

- A. Spare parts shall be prepared for long term storage, sufficiently labeled, and shipped in separate containers.
 - 1. Furnish one (1) set of manufacturer's recommended spare parts for the screen and conveyor.
 - 2. Furnish a complete list of manufacturer's recommended spare parts.
- B. Tools: Furnish special tools and other devices required for Owner to maintain, disassemble and repair screens, conveyors, and washing compactors.

1.9 WARRANTY

- A. The Manufacturer and Contractor shall furnish a warranty extending twelve (12) months after substantial completion date of the project in its entirety.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The equipment shall be manufactured by:
 - 1. SAVECO
 - 2. Parkson
 - 3. JWC
 - 4. Or pre-approved equal
 - a. Specifications and equipment arrangements for the equipment referenced are based on SAVECO. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

2.2 EQUIPMENT

- A. Schedule:
 - 1. Rotary Drum Screen No.1 (SCR1110)
 - 2. Rotary Drum Screen No.2 (SCR1120)
 - 3. Rotary Drum Screen No.3 (SCR1130)
 - 4. Screening Conveyor No.1 (SCY1111)
 - 5. Screening Washing Compactor (SWC1112)
- B. Description:

1. Rotary drum screen shall be fully automatic, internally-fed, perforated plate media, cylindrical drum screen designed to receive a pumped flow of raw wastewater.
2. Conveyor shall be designed with a shaftless screw to receive raw wastewater screenings from multiple rotary drum screens and transport to downstream washing compactor.
3. Washing compactor shall be designed to receive screenings from conveyor, wash out the organic materials, dewater, and compact raw wastewater screenings, inert solids, and general trash without binding, clogging, or obstruction in the compactor mechanism. Compacted screening shall be discharged to a dumpster for final disposal.

C. Rotary Drum Screen:

1. Design Requirements:
 - a. No. of Units: 3
 - b. Design Flow: 7.5 MGD
 - c. Influent Total Suspended Solids: 300 mg/L
 - d. Screen Opening: 6 mm
 - e. Max Influent Velocity: 5 ft/s
 - f. Motor Size: 1.5 HP
 - g. Wash Water Requirement: 75 gpm @ 75 psi

D. Screw Conveyor:

1. Design Requirements:
 - a. No. of Units: 1
 - b. Capacity: 125 ft³/hr
 - c. Screw Diameter: 10 in
 - d. Through Thickness: 10 gauge
 - e. Length: 18 ft
 - f. Angle of Incline: 0 – 5°
 - g. Number of Inlets: 4
 - h. Number of Outlets: 1
 - i. Screw Speed: 22 rpm max
 - j. Horsepower: 2 HP
 - k. Power Supply: 460 V, 3 phase, 60 Hz

E. Washing Compactor:

1. Design Requirements:
 - a. No. of Units: 1
 - b. Capacity: 125 ft³/hr
 - c. Inlet Solids Concentration: 8% - 10%
 - d. Screw Diameter: 8 7/8 in min
 - e. Length: 7.5 ft
 - f. Angle of Incline: 15°
 - g. Motor Horsepower: 5 HP
 - h. Volume Reduction: 60% min
 - i. Compacted Solids Percent: 40% min
2. Spray Flush System:
 - a. Solenoid Valve Diameter: 1/2 inches

- b. Flush Water Requirement: 15 gpm @ 60 psi
- c. Flush Water Connection Size: 1/2 inch

2.3 DESIGN REQUIREMENTS

- A. Each screen shall be capable of treating a peak flow of 7.5 MGD of domestic wastewater at a total suspended solids (TSS) concentration of 300 mg/l.
- B. The conveyor shall be sized to convey design material at a handling rate less than 60% of the conveyor's rated capacity or 25% of trough filling. Each conveyor drive unit shall be designed for 100% of rated capacity.
- C. The compactor shall be sized to convey the above volumetric rate at less than 40% of the compactor rated capacity or 30% trough filling. The compactor drive unit shall be designed for 100% of compactor rated capacity.

2.4 MATERIALS

- A. Unless otherwise specified, the materials used in the fabrication of the equipment furnished under this section shall conform to the following:

1. Rotary Drum Screens:

System Component	Material
Drum Cylinder	304L Stainless Steel
Conveying Flight	304L Stainless Steel
Discharge Chute	304L Stainless Steel
Cleaning Brush	Nylon (Bristles) 304L Stainless Steel (Shaft)
Spray Bar	304L Stainless Steel
Headbox	304L Stainless Steel
Drain Pan	304L Stainless Steel
Fasteners	304L Stainless Steel

2. Screw Conveyor:

System Component	Material
Trough and Cover	304 Stainless Steel
Spiral	High Strength Alloy Steel
Inlet Hopper	304 Stainless Steel

Wear Liner	UHMW-PE
Fasteners	Stainless Steel
Support Legs	304 Stainless Steel

3. Washing Compactor:

System Components	Material
Body	304 Stainless Steel
Inlet Hopper	304 Stainless Steel
Discharge	304 Stainless Steel
Spiral	High Strength Alloy Steel
Wear Bars	304 Stainless Steel
Dewatering Zone	304 Stainless Steel
Support Legs	304 Stainless Steel
Fasteners	304 Stainless Steel

2.5 ROTARY DRUM SCREEN

A. Schedule:

1. Rotary Drum Screen No.1 (SCR1110)
2. Rotary Drum Screen No.2 (SCR1120)
3. Rotary Drum Screen No.3 (SCR1130)

B. Screen Assembly:

1. The screening element shall be a perforated cylinder constructed of minimum 22-gauge, type 304L stainless steel. Each end of the screen elements shall be fitted with a type 304L stainless steel end ring welded to the screen element substructure throughout the circumference. Rings shall be a minimum thickness of 0.135-inch and have stiffening flanges welded around their circumference. One end ring shall be at the discharge end and designed with an extended bell mouth to provide effective discharge of dewatered solids away from the base of the unit. Each end ring shall also include a steel track area specifically designed to be supported by the carbon fiber belt drive system. The drum shall be a minimum 50 inches in diameter and a minimum 157 inches in length.
2. The screening element perforations shall be 6 mm in diameter.
3. The screen element shall be equipped with type 304L stainless steel flights arranged in a continuous helical pattern throughout the length of the screen causing solids to continually move towards the discharge end. The diverter height shall be a minimum of 4-inches. The flights shall be designed to structurally strengthen the perforated cylinder and make it suitable for the intended duty.

C. Base Frame and Lower Collection Pan:

1. The base frame shall be constructed of type 304L stainless steel sections and shall be accurately fabricated to provide a mounting surface for the screen assembly. The frame shall be designed to withstand all loads imposed by the screen components, plus wastewater passing through the unit. The base shall also be designed in such a way to allow for four-pin support without the linear deflection exceeding 0.04-inch. Four (4) 304SS anchor bolt holes shall be incorporated into the base.
2. The lower collection pan shall be fabricated of type 304L stainless steel and shall be integral to the screen assembly. Pan shall be sloped towards the outlet pipe to prevent ponding of water in collection pan. Screen-filtered effluent shall be gravity discharged from the inclined collection pan through a 304L stainless steel minimum 26-inch diameter plain end discharge pipe. Drum screens that require field assembly of the lower collection pan or do not include a sloped lower collection pan shall not be allowed.

D. Inlet Pipe, Headbox, and Overflow Assembly:

1. All components of the piped inlet and headbox assembly shall be fabricated of minimum 14-gauge type 304L stainless steel. The inlet connection to the headbox assembly shall be a maximum 24-inch diameter plain end pipe.
2. An inlet pipe of special hydraulic design to accommodate a maximum of 5208 gpm inflow shall be furnished. It shall be supported from the feed end of the screen frame. Flow entering the inlet shall be baffled to reduce forward velocity and provide momentary flow equalization. Flow shall be controlled to provide smooth, uniform distribution over the side weir surface parallel to the drum axis.
3. An integral overflow system, with alarm detection device, shall be provided to ensure that unscreened flow is bypassed when flow exceeds the design flow, or if the screen should be inoperative for any reason during flow to the screen. Bypass flow shall be directed to a separate maximum 16-inch diameter, 304L stainless steel, plain end pipe outlet for discharge into the plant sewer system. Drum screens without an integral overflow system will not be allowed.

E. Splash Guards:

1. The screen shall be equipped with external splash guards constructed of minimum 14-gauge type 304L stainless steel. These guards shall be located on each side of the screening element and attached to the base. The guards shall also be designed to contain and direct the entire flow through the screen base discharge opening.
2. The splash guards shall have internal guided flow vanes and be self-supporting throughout their entire length. Additionally, the guards shall also support the weight of the inspection cover hoods.

F. Inspection Cover Hoods:

1. Inspection cover hood assemblies shall be provided for each screen. Each cover hood will be sized to facilitate handling by the operator or maintenance personnel. Each section shall be sufficiently durable to withstand visual damage from 1-inch hailstones and designed for a live load of 40 psf on horizontal projection plus 30 psf wind loads.
2. Each inspection hood section on the cover hood assembly shall be capable of being opened and removed by one operator. Each section of the cover hood shall consist of two

- (2) inspection panels, plus support members, and cover hood assembly. All inspection panels shall be secured by a keyed lock.
 3. Inspection covers shall be 304 stainless steel and suitable for outdoor installation.
- G. Screen Cleaning System:
1. Each screen shall be provided with an external spray system and two (2) counter rotating horizontal cleaner roller brushes. As available, potable or plant reuse water shall be supplied to the spray system at the required volume and pressure.
 2. The removable external spray system shall consist of a type 304 stainless steel spray header and 304 stainless steel spray nozzles. The external spray header shall be parallel to the screen axis with the spray nozzles positioned to clean the entire screen surface. Design washwater flow shall be 75 gpm at 75 psi. Inlet connection to the spray header shall be 1-inch NPT.
 3. The counter rotating cleaner roller brushes shall consist of a rotary nylon brush bristle mounted on a type 304 stainless steel shaft with sealed bearings at each end. The brushes are located above the perforated cylinder and rotates in contact with the cylinder as it turns. The angular contact generated by the unique shape of the brush cleans the perforations. The joint cleaning action of the brush and intermittent wash water sprays effectively maintains the open area of the screen cylinder and prevents blinding.
- H. Solids Discharge Chute and Screen End Cover:
1. Each screen shall be provided with a heavy-duty type 304L stainless steel solids discharge chute. The lower part of the chute shall fit closely beneath the screen discharge, so that all solids are captured. The hopper shall extend downward. The chute shall converge to a nominal 34-inch x 10-inch discharge opening and the converging sides shall be not less than 60 degrees from horizontal.
 2. The discharge end of the screen shall be enclosed by a removable cover, which when opened shall provide access to the screen interior. Screen end cover shall be secured by a keyed lock when the screen is operating. The cover shall be fiberglass with 0.125" minimum thickness. All resin shall be chemical-resistant and shall contain light stabilizers such as UV-9, or equal. Resin shall be suitable for service in temperatures ranging from 300 °F to 1400 °F. Fiberglass reinforcement shall consist of a combination of chopped strand mat and woven roving, shall be equal to PPG 526, and shall be treated with a finish compatible to the resin being used. Cover shall be formed on a suitable mold to insure constant and accurate dimensions of the finished units. Mold shall be designed so the end cover can be cast in one (1) piece without joining members by bonding or bolting. All layers shall contain pigment to produce a translucent panel. Handles shall be provided to allow the cover to be lifted by one operator.
 3. The discharge end of the enclosure shall be provided with a 304L stainless steel, 6-inch, plain end pipe odor control outlet.
- I. Drive and Motor:
1. The screen shall have a drive system consisting of one (1) electric motor, one (1) 304 stainless steel pinion gear on reducer, and one bull gear on the drum. Drive assemblies which include steel chains, trunnion wheels, stabilizer wheels, sprockets, chain tensioners, or chain oilers, will not be accepted.
 2. The cylinder drive system shall consist of a NORD Gear electric motor coupled to a NORD Gear helical gear reducer. Motor shall have the following characteristics:

- a. 460V, 3-phase, 60 Hz
 - b. 1.5 HP
 - c. Inverter Duty
 - d. TEFC
 - e. Minimum 1.15 service factor
3. The motor will be directly coupled to a flange mounted, parallel helical, double reduction gear. The reducer shaft shall be keyed to a type 304 stainless steel driving shaft. The drive assembly shall be externally mounted onto the inlet end of the 304 stainless steel screen frame. The assembly shall provide vibration free operation with minimum wear. The reducer shall be sized to maintain a minimum 1.1 service factor.

J. Electrical Devices:

1. In addition to the drive motor, the following electrical devices will be supplied with each unit. Proper wiring from the devices to the control panel will be the responsibility of the Contractor.
 - a. One (1) spray water solenoid valve shall be shipped loose and provided for control of the spray wash system on the unit. Solenoid valves will be activated on a signal from the drum screen control panel at preset intervals. The valves shall be NEMA 4x/7, normally closed, slow-closing, pilot operated, bronze body.
 - b. A conductive probe shall be installed in the overflow box to detect any overflow condition. The probe shall provide a local and remote alarm and initiate a continuous cleaning cycle in the event of an overflow condition due to screen blinding. The probe shall be supplied by screen Manufacturer.

2.6 SCREW CONVEYOR

A. Schedule:

1. Screening Conveyor No.1 (SCY1111)

B. Spiral Flight:

1. Spiral flight for the shaftless screw conveyor shall be designed to convey material without a center shaft.
2. The spiral flight shall be designed with the stability to prevent distortion and jumping in the trough.
3. Spiral flighting shall have full penetration welds at all splice connections. The flights shall be fabricated and welded on a jib to assure true alignment and shall be assembled according to the manufacturer's recommendations. The spiral flights shall be coupled to the end shafts by a pipe to shaft connection of sufficient strength to transmit thrust and/or torsion applicable to meet performance criteria.

C. Drive and Shaft Connections:

1. Spiral flights shall be connected to the drive end shaft using an end flange and a pipe sleeve to effectively transmit torque from the drive shaft to the spiral flight. The plate flange shall be a minimum of 8 mm thick.

2. The flange and pipe sleeve shall be welded to the spiral flights, with welded gusset plates used for additional reinforcing. The end shaft shall extend through the pipe sleeve and be secured using stainless steel bolts penetrating the pipe sleeve and the end shaft. Bushings may be used between the pipe sleeve and the end shaft if necessary.

D. Trough:

1. The trough assembly shall consist of a U-trough, wear liner, inlet flanges, and trough cover.
2. The U-trough shall be constructed from material 304 stainless steel.
3. The U-trough shall have a replaceable wear liner from 1/4 inch thick UHMW-PE. The liner is held in place by clips along the length of the conveyor.
4. Hold-down angles from 304 stainless steel shall be provided on both sides of the trough assembly to control excessive vertical movement of the spiral flights. Hold-downs shall not interrupt material transportation.
5. Four (4) flanged inlets to the conveyor trough from rotary drum screens.
6. The trough will be supplied with covers. Trough covers will be provided with neoprene gaskets and constructed from minimum 14 gage thick type 304 stainless steel and bolted to the flanges of the U-trough.

E. Chutes:

1. The conveyor shall include four (4) inlet chutes – three (3) for immediate use and one for a future screen. Each trough shall be equipped with filling and/or discharge chutes for transferring material to or from another conveyor. The chutes shall be fabricated from a minimum 12-gauge plate. Equal level transfers shall be permitted. Each chute shall be sized to fit the screening discharge chutes of the drum screens.

F. Trough Covers:

1. A minimum 14-gauge 304 stainless steel cover shall cover the portion of each trough that is not covered by the filling chute.

G. Conveyor Supports:

1. Each conveyor shall be furnished complete with supports suitable for mounting. The legs shall be securely bolted to the concrete surface.
2. The supports shall be shop fabricated from rectangular structural steel shapes and plates. All shop welding shall conform to the latest standard of the American Welding Society.
3. Structural Design:
 - a. The ratio of the unbraced length to least radius of gyration (slenderness ratio) shall not exceed 120 for a compression member (of angles about the z-z axis). In addition, all structural members and connections shall be designed so that the unit stresses will not exceed AISC allowable stresses by more than 1/3 when subject to loading of twice the running torque of the drive motor.
 - b. Supports shall be provided near the drive units (1 to 2 feet) and at locations 12 feet apart along the conveyor.
 - c. Support loads shall be based on a completely filled trough plus dead weight of the equipment.
 - d. Support legs shall be securely bolted to the concrete surface.

H. Drive Unit:

1. The screw conveyor drive shall consist of a speed reducer, electric motor, and trough end seal. Drives shall be mounted as show on the trough end. The drive system shall be designed for starting the conveyor fully loaded. Drive size shall be as recommended by the manufacturer. All electric motors shall be totally enclosed and fan cooled. The design of all drive components shall be such that jamming of any components shall not cause damage to the equipment. Trough end seal shall be a compression-type Packing Gland. Provisions shall be installed as required to protect the equipment.

I. Gear Reducer:

1. All gear reducers shall be commercially built, minimum AGMA Class I, single, double, or triple reduction, helical gear units with high capacity roller bearings. Bearings shall be designed for the thrust loads from the spiral flights and shall have a B-10 live of 30,000 hours. The reducers shall be standard air-cooled units with no auxiliary cooling allowed.

J. Motor:

1. All electrical motors shall be fan cooled, severe duty, totally enclosed, and shall be rated 460 volt, 3 phase, 60 Hz except where noted otherwise.

K. Hold Down Provisions:

1. Hold down provision shall be installed on shaftless screw conveyors if required by the manufacturer's design or if excessive vertical movement of the spiral flights occurs during the first year of operation.
2. Evidence of excessive vertical movement shall include wear on the trough cover plates. Hold-down provisions shall be of welded steel construction supported by the conveyor trough and be designed to minimize material flow interruption. The manufacturer shall design the hold-down provisions.

L. Wear Liner:

1. Trough replaceable wear liner from 5/8 inch thick UHMW-PE shall be held in place by clips along the length of the conveyor.

M. Overload:

1. Overload protection shall be provided, if required to protect the drive components and shaftless screw from torsion loadings exceeding the torque rating of the shaftless auger.

2.7 WASHING COMPACTOR

A. Schedule:

1. Screening Washing Compactor (SWC1112)

B. Shafted Screw:

1. The washing compactor shall be provided with an epoxy coated, shafted, high tensile alloy steel screw located inside a 304 stainless steel cylindrical compacting zone.
2. The compacting screw shall have a decreased pitch at discharge end to maximize compaction and dewatering. The decreased section of the screw shall have increased thickness for maximum strength.
3. The end plate at the gear drive end of the shafted screw shall incorporate a lip seal protected from the screenings by a polyethylene plate ring.
4. Six (6) equally spaced stainless steel wear bars shall be located at the discharge end of the compaction screw. Wear bars shall be stainless steel.

C. Washing/Compacting Zone:

1. Each unit shall be provided with a receiving hopper to direct screenings into the washing compacting zone. The hopper shall be constructed of 1/8" thick 304 stainless steel.
2. The unit shall have a dual washing/compaction zone equipped with stainless steel spray bars and stainless steel spray nozzles designed to wash organics from screenings as they are deposited into the unit.
3. The unit shall not macerate screenings, making them more difficult to capture and remove. Units incorporating a grinder in the inlet area shall not be accepted.
4. The bottom of the washing/compacting zone shall be perforated with 5 mm holes that allows the wash water to discharge into the drain housing.
5. An additional set of spray nozzles with a 1/2-inch NPT connection shall be at the end of the compacting zone to maximize washing.
6. Solenoid valves shall be NEMA 4X rated and operated via the programmable controller and/or manually.

D. Compactor Supports:

1. The compactor shall be furnished complete with supports suitable for anchoring to the concrete base as required by the compactor press configuration shown on the plans. The supports shall be shop-fabricated from 304 stainless steel structural steel shapes and plates. The supports shall be designed to avoid interference with other equipment or equipment supports. The supports shall be designed to prevent excessive vibration of any portion of the compactor unit under all loading conditions.

E. Motor:

1. The spiral compactor shall be driven at a maximum speed of 30 rpm by an electric motor directly connected to a gear reducer. The gear reducer shall be flange mounted to the adjustable gland box sealing with grease distributor. The drive system shall be designed for starting the compactor fully loaded.
2. The motor shall be NORD squirrel-cage, TEFC electric induction. Motor shall be constructed with Class F insulated winding with a Class B temp rise. Motor rating shall be 5 HP, 1760 rpm, 230/460 volt, 3 phase, 60 Hz, continuous duty at 40 °C ambient temperature rise.

F. Gear Reducer:

1. The gear reducer shall be direct –coupled to the compactor drive shaft at the head end. Gear reducers shall be NORD helical gear units with high capacity roller bearings. Bearings shall be designed for the thrust loads from the spiral flights, suitable rated to

accommodate the axial load, and shall have an AFBMA B-10 life of 30,000 hours. The reducers shall be standard air-cooled units with no auxiliary cooling required.

2. The applied torque of the drive unit and gear reducer shall be adequate to start the spiral compactor when fully loaded.
3. The gear reducer shall be driven by a 5 HP, 240/480 V, 3 phase, 60 Hz TEFC motor.

G. Bearings:

1. Bearings shall have a B-10 life rating of 30,000 hours and conform to ABMA standards.

H. Covers:

1. A protective cover fabricated of stainless steel shall be provided for the exposed length of the compactor. The cover shall be easily removable for inspection and maintenance of the washing compactor.

I. Construction:

1. All chutes or hoppers shall be supported to prevent the exertion of undue forces and moments on the compactor flanges. The compactor will be mounted on a flat and level concrete slab suitable for supporting the dead weight of the equipment.

2.8 CONTROLS

A. Rotary Drum Screens:

1. One (1) factory control panel (FCP) shall be supplied to control all equipment: three (3) screens, one (1) conveyor, and one (1) washing compactor. Space for one (1) future screen shall be included in the panel.
2. Factory control panel shall be furnished by the rotary drum screen Manufacturer and shall meet the requirements of the manufacturer's specification. The panel shall be NEMA 4X, type 304 stainless steel enclosure.
3. The panel shall contain soft start motor starters for the screens, conveyor, and washing compactor, in accordance with Section 26 29 13.06 and a transformer for 120 VAC control power.
4. The panel shall be furnished with the following door front mounted devices:
 - a. H-O-A switch for operation of each screen.
 - b. H-O-A switch for wash water system of each screen.
 - c. CONTROL POWER ON indicating light.
 - d. RUN indicating light for each screen.
 - e. OVERFLOW indicating light for each screen
 - f. Torque OVERLOAD indicating light for each screen.
 - g. Elapsed Time Meter.
 - h. Main Disconnect Switch.
 - i. Emergency Stop Pushbutton.
5. Remote System Interface: The panel shall be provided with 120 VAC, 10 amp, Form C dry contacts for remote status. It shall accept 120 VAC dry contacts for remote control. The remote system shall include the following points:
 - a. Panel outputs – Discrete

- 1) RUN status for each screen to plant SCADA system.
 - 2) FAULT status for each screen to Plant SCADA system.
 - 3) OVERFLOW status for each screen to Plant SCADA System.
 - b. Panel inputs – Discrete
 - 1) Emergency stop from field mounted Emergency Stop device at each screen.
 - 2) Overflow switch from each screen.
 6. Panel shall be provided with powered 120 VAC outputs for wash water solenoid valves on each screen.
 7. Repeat cycle timer for each screen wash water solenoid.
 8. Control Strategy: See Section 40 70 23 – Process Control Narratives
- B. Screw Conveyor:
1. The screw conveyor controls shall include the following:
 - a. H-O-A switch for operation of conveyor.
 - b. RUN indicating pilot light.
 - c. FAULT indicating pilot light (torque overload).
 - d. Elapsed Time Meter.
 - e. Overload Reset Pushbutton.
 - f. All required Timers.
 2. The conveyor shall be interlocked with the rotary drum screens for automatic operation. The conveyor shall continue to run after the contacts open again for pre-set period of time to clear the inlet hoppers.
 3. Two (2) normally open isolated relay contacts, rated 3 amperes minimum at 120 volts AC shall be provided for remote indication. One shall close whenever the conveyor is running (RUN), and the other shall close when the conveyor stops for motor overload or emergency stop (ALARM).
 4. Nameplates shall be provided on the face of the panel or on the individual devices as required.
 5. The conveyor shall be equipped with a NEMA 4X, 304SS remote-mounted emergency stop pushbutton.
 6. The conveyor controls shall be integrated into the rotary drum screen control panel.
 7. Control Strategy: See Section 40 70 23 – Process Control Narratives
- C. Washing Compactor:
1. The washing compactor controls shall include the following:
 - a. H-O-A switch for operation of compactor.
 - b. H-O-A switch for wash water system.
 - c. CONTROL POWER ON indicating pilot light.
 - d. RUN indicating pilot light.
 - e. FAULT indicating pilot light (torque overload).
 - f. WASH VALVE OPEN indicating pilot light.
 - g. Elapsed time meter
 - h. Overload Reset Pushbutton
 - i. All required Timers
 2. The compactor shall be interlocked with the drum screens for automatic operation. The compactor shall continue to run after the contacts open again for an adjustable time to

clear the inlet hopper. Spray water shall be automatically controlled during the compactor operation when the spray wash selector switch is in the AUTO position.

3. Two (2) normally open isolated relay contacts, rated 3 amperes minimum at 120 volts AC shall be provided for remote indication. One shall close whenever the compactor is running (RUN), and the other shall close when the compactor stops for motor overload or emergency stop (ALARM).
4. Nameplates shall be provided on the face of the panel or on the individual devices as required.
5. Washing compactor controls shall be integrated into the rotary drum screen control panel.
6. Control Strategy: See Section 40 70 23 – Process Control Narratives

2.9 SURFACE FINISH

- A. All stainless steel sub-assemblies will be acid passivated after welding for corrosion resistance and to provide a superior surface finish. This will be done by full dipping of weldments; or by using an acid passivation paste in the weld and heat effected areas and spray-on acid solutions elsewhere. After passivation, the weldments will be thoroughly rinsed with clean water and allowed to air dry. Sandblasting, bead blasting, or grit blasting of stainless steel surfaces will not be allowed in lieu of acid passivation.
- B. Motors and gear reducers will remain the manufacturer's standard finish for severe environment. All plastic parts will remain unfinished, supplied as the manufacturer's standard.

2.10 ANCHOR BOLTS

- A. Contractor shall provide type 304 stainless steel anchor bolts and support stands as required for installation of the equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that facility is ready to receive rotary drum screens, conveyer and washing compactor.

3.2 INSTALLATION

- A. All equipment specified herein shall be installed in accordance with reviewed shop drawings and the manufacturer's instructions and recommendations.
- B. To minimize the risk of galling, anti-seize thread lubricant shall be liberally applied to male threads of all stainless steel anchor bolts and other stainless steel fasteners immediately prior to assembly and tightening.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Manufacturer Services:
 - 1. Start-up:
 - a. Furnish the services of a factory representative, having complete knowledge of proper operation, start up procedure and maintenance requirements, for one (1), eight (8) hour day, to inspect the final installation and supervise a test run of the screens, conveyor, and compactor.
 - 2. Training:
 - a. Furnish the services of a factory representative, having complete knowledge of the operational and maintenance requirements of the system to instruct the Owner's personnel in the proper operation of the equipment. Training for proper operation and maintenance of the equipment shall be scheduled for one (1), eight (8) hour day and will be concurrent with trip to site required for purposes of start-up.
- D. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace system components that fail to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.

3.4 ASSEMBLY, INSPECTION AND TESTING

- A. Following installation, operating tests will be performed to demonstrate to the Engineer that each mechanism and the system as a whole will function in a satisfactory manner. The Contractor shall make, at Contractor's own expense, all necessary changes, modifications and/or adjustments required to ensure satisfactory operation.
- B. Conveyors shorter than 15 feet shall be totally assembled with gear drive and shop tested for at least one hour before shipment. Larger deliveries shall be shipped in sections of a maximum of 40 feet.

3.5 FIELD PAINTING

- A. All shop primed surfaces shall be cleaned and painted as specified in Section 09 96 00 – High-Performance Coatings.
- B. Electric motors, speed reducers, and other standard components shall be supplied with the manufacturer's standard finish.

3.6 CLEANING

- A. Prior to acceptance of the work of this Section, thoroughly clean all installed materials, equipment, and related areas in accordance with Section 01 70 00 – Execution and Closeout Requirements.

3.7 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

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SECTION 46 23 23 - GRIT REMOVAL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vortex Grit Removal Equipment.
2. Grit Pump.
3. Hydrocyclone.
4. Grit Classifier.

B. Location: New headworks at Pendleton-Clemson Regional WWTP

C. Related Requirements:

1. Section 05 50 00 – Metal Fabrications: Fasteners, brackets, and other miscellaneous metal fabrications as required by this Section.
2. Section 09 96 00 – High-Performance Coatings: Product and execution requirements for painting as required by this Section.
3. Section 40 70 23 – Process Control Narrative
4. Section 46 05 53 – Identification for Water and Wastewater Equipment: Nameplates for equipment specified in this Section.

1.2 SUBMITTALS

A. Manufacturer shall provide, at a minimum, the following information in accordance with Section 01 33 00 – Submittals.

1. Product Data/Information: Descriptive literature, bulletins and/or catalogs of the equipment.
2. Certified general arrangement drawings showing all important details including materials of construction, dimensions, loads on supporting structures, and anchor bolt locations.
3. Complete data on motors and gear reducers.
4. Maintenance Instructions.
5. Installation Instructions.
6. Wiring diagrams and electrical schematics for all control equipment to be furnished.
7. Parts List.
8. Qualification Data.
9. Sample Warranty.

1.3 COORDINATION

A. Section 01 31 00 – Project Management and Coordination: Requirements for scheduling.

- B. The Contractor shall review design and layout drawings to ensure that installation arrangements are suitable for the specified equipment. Any potential conflicts or recommended modifications shall be coordinated with the Engineer and noted on the shop drawings or by a pre-submittal request for information, if appropriate.
- C. Coordinate installation and startup of Work of this Section with Plant Operations.

1.4 SCHEDULING

- A. Section 01 31 00 – Project Management and Coordination: Requirements for scheduling.
- B. Schedule Work of this Section to install equipment prior to connecting piping Work.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations of installed grit removal equipment.
- C. Operation and Maintenance Data: Submit instructions for equipment and accessories.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
 - 1. Furnish one (1) set of manufacturer's recommended spare parts for Vortex Grit Chambers, Grit Pumps, Hydrocyclones and Grit Classifiers.
 - 2. Furnish a complete list of manufacturer's recommended spare parts.
- C. Tools: Furnish special tools and other devices required for Owner to perform maintenance work on Vortex Grit Chambers, Grit Pumps, Hydrocyclones and Grit Classifiers.

1.7 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five (5) years of documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver materials in manufacturer's packaging, including application instructions.

- C. Inspection: Accept materials on-Site in original packaging. Inspect for damage.
- D. Store materials according to manufacturer's instructions.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish one (1) year manufacturer's warranty, beginning upon equipment startup, for vortex grit removal equipment and accessories.
- C. The Contractor shall furnish a warranty extending twelve (12) months after substantial completion date of the project in its entirety.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The equipment shall be manufactured by:
 - 1. Smith & Loveless
 - 2. Ovivo USA
 - 3. Huber Technology
 - 4. Or Pre-Approved Equals
 - a. Specifications and equipment arrangements for the equipment referenced are based on Smith & Loveless. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

2.2 GENERAL

- A. Description:
 - 1. The influent shall be tangentially introduced into the grit chamber where it creates a forced vortex causing the organics to separate from the grit and be lifted up with the effluent while the heavier grit particles settle to the bottom of the lower chamber. A slurry pump shall transfer the collected grit into a grit classifier for dewatering before final disposal.
- B. Performance and Design Criteria:
 - 1. Number of Grit Chambers: 2
 - 2. Peak Flow Rate: 15.0 MGD
 - 3. Peak Flow per Grit Chamber: 7.5 MGD

- | | | |
|-----|--|------------------------------------|
| 4. | Headloss @ Peak Flow Rate | < 1 in. |
| 5. | Grit Capture of 2.65 S.G. Material: | 95% of all grit > 105 mesh in size |
| 6. | Influent Channel Width: | 32 in. |
| 7. | Influent/Effluent Orientation: | 360° |
| 8. | Upper Chamber Diameter: | 10 - 12 ft. |
| 9. | Upper Chamber Depth: | 6 - 9 ft.. |
| 10. | Lower Chamber (Hopper) Diameter: | 3 - 5 ft. |
| 11. | Lower Chamber (Hopper) Depth: | 5 - 7 ft. |
| 12. | Vortex Drive Motor HP: | 1.5 HP |
| 13. | Grit Pumping: | Centrifugal Pumps |
| 14. | Grit Pump Capacity: | 200 - 300 gpm |
| 15. | Grit Pump TDH: | 40.0 ft |
| 16. | Grit Pump Motor: | 15.0 HP Max |
| 17. | Grit pump shall be capable of passing 3" sphere. | |

2.3 VORTEX GRIT CHAMBER

A. Schedule:

1. Vortex Grit Chamber No.1 (VGR1210)
2. Vortex Grit Chamber No.2 (VGR1220)

B. Drive Unit:

1. Physical Characteristics:

- a. The drive unit shall consist of a solid external main gear, turntable, pinion, secondary speed reducer, support base, and drive unit bearing. The drive shall be mounted on the operating platform frame and support the entire rotating load of the mechanism. The main external gear shall be forged of alloy hardened steel. The pinion shall be heat treated alloy steel. All speed reducers shall be fully enclosed and running in oil or grease. Support base for the drive shall be of welded steel to assure rigidity. Oil and dust shields shall be provided. The drive bearing shall include a forged steel precision gear/bearing set with fully contoured raceways hardened to a minimum 58 60 Rc. The main gear and pinion shall run in an oil bath or be grease lubricated. If an oil bath is used, an oil sight glass, fill pipe, and drain line shall be provided for the reservoir. Lubrication fittings shall be readily accessible.
- b. All structural steel shall conform to the requirements of ASTM A36. Steel pipe used for structural members shall conform to ASTM A53. Steel members in contact with liquids, either continuously or intermittently, shall have a minimum thickness of 1/4". All aluminum shall be type 5052, 6061, or 6063 alloy unless noted.

2. Design Parameters:

- a. The drive unit shall be specifically for service on the vortex grit separator equipment supplier to ensure unit responsibility. The drive main bearing shall be designed for the total rotating mechanism loads with a minimum B10 life of 50 years or 450,000 hours. The drive unit shall be capable of producing and withstanding the previously listed momentary peak torque while starting. The

- pinion and bull gear shall have a service factor of 5.0 or greater at standard operating speeds.
- b. No overhung pinions shall be allowed on the speed reducing unit. The lower pinion bearing shall not be located below the turntable base.
- c. Any and all welding on the drive unit shall be done using E70XX weld rod.
- 3. Turntable:
 - a. The turntable base shall have an annular bearing raceway upon which the rotating assembly rests. The drive shaft shall be fastened to and supported from the gear hub. Ball bearings shall be of the highest quality high carbon chrome alloy steel running in fully contoured races, as part of a precision gear/bearing set. The balls shall be grease lubricated and protected by elastomer seals.
- 4. Speed Reducing Unit:
 - a. The speed reducing unit shall consist of cycloidal or helical speed reducers directly connected to a motor without the use of chains or V-belts, and shall be keyed to the pinion.
 - b. The main ring gear of cycloidal drives shall be made of high carbon chromium bearing steel and be fixed to the drive casing. An eccentric bearing on the high-speed shaft shall roll cycloidal discs of the same material around the internal circumference of this main ring gear. The lobes of the cycloid disc shall engage successively with pins in the fixed ring gear. The movement of the cycloid discs shall be transmitted then by pins to the low speed shaft.
 - c. The speed reducer shall have a service factor of 1.25.
 - d. The reducers shall be fitted with radial and thrust bearings of proper size for all mechanism loads and run in a totally submerged oil bath or be grease lubricated.
- 5. Motor:
 - a. The motor shall be an 1800 RPM, squirrel cage, induction type, TEFC, ball bearing heavy duty unit of ample power for starting and operating the mechanism without overload, with a service factor of 1.15. A motor canopy shall be provided. The motor shall be 1.5 HP, 460-volt, 3 phase, 60 Hz.
- 6. Torque Tube and Impeller:
 - a. The torque tube shall be attached to the drive gear, and shall be fitted with axial flow impeller blades to rotate in the upper chamber contents about the vertical axis.
 - b. All components shall be constructed from 316 stainless steel.
- 7. Lower Chamber (Hopper) Cover Plate:
 - a. A floor plate to cover the lower chamber (hopper) shall be provided for installation by the Contractor. The floor plate shall be provided in two sections to allow for removal and access to the lower hopper and shall include a circular opening centered over the hopper and sized to allow grit passage while minimizing organic capture. The floor plate shall not interfere with the operation of the grit removal mechanism or the scour assemblies if provided.
 - b. The cover plates shall be constructed from 1/4-inch thick 304 or 316 stainless steel.
- C. Grit Fluidization:
 - 1. The bottom of the drive tube shall be equipped with fluidizer vanes. The fluidizer vanes shall be located within 6" of the elevation of the pump suction inlet. The vanes shall be

bolted to the propeller drive tube in a helical fashion so as to gently pump the grit upward and keep the grit fluidized at the grit pump suction inlet.

2. The vanes shall be fabricated of the same material as the drive tube and shall be bolted to the drive tube to facilitate easy removal of the drive tube.
3. The grit fluidizer shall be a helical pump that continuously pumps the grit upward at the center of the grit collection chamber to prevent the grit from packing down around the pump suction pipe and enhances the performance of the propeller in keeping organics in suspension.

2.4 GRIT PUMP

A. Schedule:

1. Grit Pump No.1 (GP1211)
2. Grit Pump No.2 (GP1221)

B. General:

1. One (1) grit pump shall be supplied for each vortex grit chamber and shall be vertical, top mounted, vacuum pump. The pump shall be designed for pumping the specified flow at the total dynamic head required by the hydrocyclone.

C. Pump:

1. Manufacturer:
 - a. The manufacturer for grit pumps shall be the same as other grit removal equipment unless pre-approved by Engineer.
 - b. Grit pumps shall be supplied with other grit removal equipment as a package.
2. The grit pump shall be a 4" vertical, flooded suction, close-coupled with curved 5-vane flow inducer completely out of the flow path between the pump inlet and discharge connection, so that the grit pumped is not required to pass through the impeller.
3. All internal clearances shall provide for the passage of a 3" spherical solid to preclude clogging of the pump and suction line.
4. The pump shall be designed to be in-line mounted directly to a flange on the straight 4" suction line. The suction line shall be horizontal and connected to the bottom of the grit storage hopper. The pump shall be vertical, for easy removal of the motor and impeller, to facilitate maintenance of the suction line by providing a straight path to any potential blockage.
5. The pump shall be of Ni-Hard construction, with Ni-Hard impeller, and especially designed for the use of mechanical seals and vacuum priming.
6. In order to minimize seal wear caused by lineal movement of the shaft, the shaft bearing nearest the pump impeller shall be locked in place so that end play is limited to the clearance within the bearing. To minimize seal wear resulting from shaft deflection caused by the radial thrust of the pump the shaft from the top of the impeller to the lower bearing supporting the impeller shall have a minimum diameter of (1-7/8"). The dimension from the lower bearing to the top of the impeller hub shall not exceed 6".
7. The bottom bearing of the motor shall be locked in place and designed to handle all thrust loads and the necessary radial load.

8. The upper bearing shall be free to move up and down and, thus, carry only radial load, allowing for thermal expansion of the shaft.
9. The shaft shall be solid stainless steel through the mechanical seal to eliminate corrosion and abrasive rust particles.
10. The pump shall be specifically designed for vacuum priming service and have been proven in this service for a period of at least ten (10) years. The pump shall have an adapter providing a large water reservoir above the impeller to provide for positive exclusion of air from the impeller. The seal shall be inside this area to assure lubrication and grit shall be excluded from this area by a full size impeller shroud.
11. Pump shall be arranged so that the complete rotating element can easily be removed from the casing without disconnecting the electrical wiring or disassembling the motor, impeller, backhead or seal.
12. The pump shall be sealed against leakage by a single mechanical seal, constructed so as to be automatically drained and automatically primed each time the pump is drained and primed. Water which lubricates the mechanical seal shall be automatically drained from around the seal if the pump loses prime in order to allow both the pump and the seal to be drained; thereby, preventing freezing and breakage of the seal during power outages in sub-freezing temperatures.
13. The seal shall be of carbon and ceramic materials.
14. The grit pump shall be capable of delivering 250 gpm.
15. Pump motor shall be vertical, solid shaft, TEFC NEMA P-base, squirrel-cage induction-type, suitable for 3-phase, 60 Hz, 460 V. It shall have Class F insulation, but the motor shall have Class B temperature limits. The motor shall have normal starting torque and low starting current, as specified for NEMA Design B characteristics. It shall have a 1.15 service factor. Grit pump motor shall be 15 HP.
16. The motor-pump shaft shall be centered, in relation to the motor base, within 0.005". The shaft run-out shall be limited to 0.003".
17. Motor shall be fitted with heavy lifting eyes or lugs, each capable of supporting the entire weight of the pump and motor.

D. Lifting Stanchion:

1. A stanchion with lifting arm shall be provided to lift the grit pump for disassembly. The lifting arm shall have a hook over the center of the motor to support a hoist. Installation shall be as shown in the contract drawings. The lifter shall be designed for a 1,000 lbs. lifting load.

2.5 HYDROCYCLONE

A. Schedule:

1. Hydrocyclone No.1 (HC1212)
2. Hydrocyclone No.2 (HC1222)

B. General:

1. The hydrocyclone (or grit concentrator) shall separate water and organic materials from grit slurry pumped by grit pump prior to entering grit dewatering screw or grit classifier.
2. Pumped grit slurry shall enter hydrocyclone through a flanged inlet. Concentrated grit slurry shall exit hydrocyclone and enter grit screw conveyor or grit classifier through the

outlet at bottom. Water and organic materials shall exit the hydrocyclone through opening on top and return to main wastewater stream. Opening on top shall also serve as vent for gas release.

3. Hydrocyclone shall have capacity of receiving 250 GPM and discharging 150 GPM.
4. Hydrocyclone shall be provided along with other grit removal equipment by the same Manufacturer.

C. Construction:

1. The hydrocyclone shall consist to two major pieces, the top section and bottom section.
2. Top Section Material: Minimum thickness of 1/2" Ni-Hard high nickel iron. Minimum thickness of 3/4" Ni-Hard high nickel iron in high wear areas. Unit shall be coated with minimum 6 mil dry film thickness epoxy resin.
3. Bottom Section Material: Minimum thickness of 3/4" Ni-Hard high nickel iron. Unit shall be coated with minimum 6 mil dry film thickness epoxy resin.
4. No moving parts; operates totally on hydraulic principles.

2.6 GRIT CLASSIFIER

A. Schedule:

1. Grit Classifier No.1 (GCL1213)
2. Grit Classifier No.2 (GCL1223)

B. General:

1. Provide inlet hopper to receive mixture of grit and water, sufficiently large to allow grit to settle out of water.
2. Provide minimum 4" overflow in inlet hopper.
3. Provide unit as freestanding with support legs to hold conveyor at approximately 20-degree angle from horizontal.
4. Drive screw conveyor with gear motor mounted on discharge end.

C. Construction:

1. Screw:
 - a. Diameter: 6 in minimum.
 - b. Length: 10 ft minimum.
 - c. Material: 304 stainless steel minimum.
2. Screw Bearings:
 - a. Outlet End: Anti-friction type.
 - b. Inlet End: Greaseable bronze bushing.
3. Screw Trough:
 - a. Material: 304 stainless steel
 - b. Open 12" steel formed, U-shaped.
 - c. Provide minimum 2" diameter drain at inlet end.
 - d. Provide minimum 8" diameter (round) or 8" x 8" (rectangular) outlet.

- e. Provide minimum 5' of clearance between support floor and centerline of discharge.
- 4. Inlet Hopper:
 - a. Material: 304 stainless steel.
 - b. Overflow: Full-length, double-sided outlet weir trough with 4-in. flange.
 - c. Slope three sides of hopper at least 50 degrees to horizontal.
 - d. Projected Surface Area: 17.0 sq. ft.
 - e. Parallel plates to improve retention of fine grit.
- 5. Drive:
 - a. Provide belt driven shaft mounted helical gear reducer.
 - b. Mount on plate bolted to flanges of screw trough at discharge end.
- 6. Motor:
 - a. 3 HP maximum, 230/460 V, 3-phase, 60 Hz, TEFC.
- 7. Cover:
 - a. Material: 304 stainless steel.
 - b. Expanded steel flattened mesh cover over hopper and trough openings.
- 8. Grit Level Sensor:
 - a. A sonic level limit switch with direct contact probe shall send a signal to the controller to begin the grit discharge cycle.
 - b. This switch shall not be affected by external vibration.
 - c. It shall actuate a dedicated DPDT DC relay in the grit concentrator control panel.
 - d. The electronic enclosure of the switch shall be NEMA 4X.
 - e. The probe shall be constructed of 316 stainless steel with a 1 ½" NPT mounting connection.
- 9. Automatic Spring-Loaded Lubricator:
 - a. Unit relies on the movement of the bushing to pull grease from the refillable reservoir to the bushing surface.
 - b. The reservoir and base shall be constructed of clear polycarbonate, which allows for visual inspection.
 - c. Thread size: 1/8" NPT.
 - d. Capacity: 6 oz.
 - e. Size: 3" diameter x 6" tall.
 - f. Operating Temperature Range: -10 °F to 250 °F.

2.7 CONTROLS

A. Electrical:

- 1. Factory Control Panel (FCP1210):
 - a. The Grit Removal Equipment shall include a 480-volt primary control panel in a NEMA 4X type 304 stainless steel enclosure suitable for wall mounting with the following components to provide proper operation of the equipment. The control panel shall be provided by the grit removal equipment Manufacturer.

- 1) Step down control transformer and disconnect
- 2) Branch circuit protection
- 3) Vortex and pump drive motor starters
- 4) Grit pump casing heater power supply
- 5) Emergency stop pushbutton
- 6) Vortex drives On-Off selector switches.
- 7) Hand-Off-Auto selector switches for the pump and grit classifiers.
- 8) Push button cycle start for pump and grit classifier.
- 9) Hour meter for each motor.
- 10) Control power and run indicating lights.
- 11) Alarm light indicating over current and starter overload.
- 12) Alarm reset pushbutton.
- 13) Programmable logic control (PLC) to provide necessary control logic and monitor equipment mounted electrical devices.
- 14) Run and alarm auxiliary contacts.
- 15) All components within the control panel shall be UL listed or recognized, and the complete grit system control panel itself shall be labeled as a UL 508A General Use Industrial Control Panel.
- 16) To facilitate wire tracing and servicing, the control wiring shall be run in enclosed wireways, with removable covers, rather than tied up in bundles.
- 17) Control relays up to 6-amp capacity shall be the modular, plug-in type, with integral LED indicating lights to show activation. Larger control relays shall be enclosed to be "finger safe".
- 18) A duplex GFI protected convenience outlet shall be provided in the panel for operation of 120-volt AC devices.

B. Sequence of Operation:

1. Vortex Impeller Operation:

- a. O-O switch for vortex impeller operation.
 - 1) When the vortex selector switch is in On position, the drive and impeller will run continuously.
 - 2) Turning the vortex selector switch to Off will stop the unit. The vortex impeller shall remain stopped and cannot be called to run.

2. Grit Pump Operation:

- a. H-O-A switch for grit pump operation.
 - 1) Hand Operation: When the grit pump selector switch is in the Hand position, the pump will run continuously.
 - 2) Turning the selector switch to Off will stop the pump. The grit pump shall remain stopped and cannot be called to run.
 - 3) Automatic Operation: When the grit pump selector switch is in the Auto position, the pump shall cycle on and off per the grit system automatic sequence adjustable timer.
- b. The grit pump shall contain a high temperature shutdown switch that the FCP must monitor and turn off the pump in the case of overheating.
- c. Vacuum priming system with a pinch valve shall be supplied with each grit pump for priming prior to transferring grit slurry. The pinch valve shall remain closed

until the suction piping and pump are fully primed. The vacuum priming system shall be supplied as part of grit removal equipment package.

3. Grit Classifier Operation:
 - a. H-O-A switch for grit classifier operation.
 - 1) Hand Operation: When the grit classifier selector switch is in the Hand position, the classifier spiral will run continuously.
 - 2) Turning the selector switch to Off will stop the unit. The classifier shall not be called to run if the switch is in Off position.
 - 3) Automatic Operation: When the grit classifier selector switch is in the Auto position, the grit classifier shall be activated by the operation of grit pump. While the grit pump is operating, the classifier shall cycle on and off by the settings of a repeat cycle timer. Once the grit pump completes operation, the classifier shall run for an adjustable off delay time. The delay time shall be preset by Manufacturer.
4. Remote Control:
 - a. The PLC in factory control panel (FCP) of grit removal equipment shall communicate with plant SCADA system. Status of all grit removal equipment shall be monitored via SCADA system.
5. Fault Conditions:
 - a. Excessive motor current will trip the starter overload relays, immediately stop the drive motor, and illuminate the alarm indicating light. This fault shall be reset by depressing the motor starter overload reset internal to the control panel.
 - b. Momentary motor over current will trip the current monitor, immediately stop the drive motor, and illuminate the alarm indicating light. Pushing the reset pushbutton will reset this fault.

2.8 HIGH PERFORMANCE COATINGS

- A. Surface Preparation:
 1. All structural steel surfaces shot blasted with steel grit.
 2. Weld splatter and surface roughness removed by grinding.
 3. Comply with SSPC-SP6 specifications.
- B. Coating - Grit Mechanism:
 1. Single, 3 mil DFT primer - shop applied.
- C. Coating – Hydrocyclone and Grit Classifier:
 1. Single, 6 mil DFT, VERSAPOX® epoxy resin.

2.9 ACCESSORIES

- A. Anchorage and Fasteners:

1. Anchor Bolts:
 - a. All anchor bolts shall be a minimum of 1/2-inch diameter and made of type 304 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.
2. Fasteners:
 - a. All fasteners shall be type 304 stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.
 - b. All structural fasteners shall be type 18-8 stainless steel. Drive assembly fasteners shall be ASTM A449 (SAE Grade 5) zinc plated carbon steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that headworks installation is ready to receive grit removal equipment.

3.2 INSTALLATION

- A. Install grit removal equipment according to manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. After installation, inspect and test for proper operation.
- D. Manufacturer Services:
 1. Start-Up:
 - a. Furnish the services of a factory representative, having complete knowledge of proper operation, start-up procedure and maintenance requirements, for not less than two (2) eight (8) hour days, to inspect the final installation and supervise a test run of the equipment.
 2. Training:
 - a. Furnish the services of a factory representative, having complete knowledge of the operation and maintenance requirements of the system, to instruct the Owner's personnel in the proper operation of the equipment. Training for proper operation

and maintenance of the equipment shall be scheduled for one (1) eight (8) hour day and shall be concurrent with trip to site required for start-up.

E. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified, and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.

F. Furnish installation certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Check control functions and adjust as required.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Blow systems clear of free moisture and foreign matter.

3.6 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

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SECTION 46 53 54 – BIOLOGICAL WASTEWATER TREATMENT SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. The Biological wastewater treatment system (including control logic and equipment for the sequencing batch aerobic granular sludge process) shall be supplied by a company of good reputation that is licensed to provide sequencing batch aerobic granular sludge (AGS) process services, including control logic and equipment, in the US.
- B. The Contractor shall procure the biological wastewater treatment system from Aqua-Aerobic Systems, Inc., Rockford IL as the Supplier of AquaNereda AGS treatment system services (including control logic, equipment, operator training, and startup assistance). The Contractor shall be responsible for all components outside of the Supplier's scope that are necessary to ensure the functional operation of the AGS process.
- C. The AGS system services Supplier shall be responsible for all engineering necessary in order to select, furnish, inspect the installing contractor's equipment installation and connections, calibrate, and place into operation the AGS system along with all other equipment and accessories as specified herein.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
 - 1. Section 03 20 00 – Anchorage in Concrete
 - 2. Section 03 41 00 – Precast Structural Concrete
 - 3. Division 5 – Metals
 - 4. Section 09 96 00 – Painting
 - 5. Division 26 – Electrical
 - 6. Division 27 – Communications
 - 7. Division 40 – Process Integration
 - 8. Section 43 11 33 – Rotary Lobe Blowers
- C. The specifications for equipment and controls under this section supersede specifications for equipment and controls specified elsewhere in the contract documents and drawings. Purchased components such as gear reducers, pumps, motors, valves, and actuators shall be provided with standard recommended manufacturers paint, unless otherwise specified within this section.
- D. The AGS area electrical classification shall be Nonclassified. Motors within the basin shall be rated for a temperature code T2A (280 °C).

1.3 QUALITY ASSURANCE

- A. Electrically Actuated Valves: Actuated valves shall be tested to Aqua-Aerobic Systems protocol prior to shipment. Testing shall consist of the following:
 - 1. Project and nameplate data verification per assembly documentation
 - 2. Limit switch and torque switch setup and cycle test
 - 3. Hydrostatic test (two pressurization cycles) for all plug and butterfly valves
- B. Pumps: The pumps shall be shop inspected and tested prior to shipment. Testing shall consist of the following:
 - 1. Project and nameplate data verification per assembly documentation
 - 2. Final Inspection
- C. Blowers: The blowers shall be shop inspected and tested prior to shipment. Testing shall consist of the following:
 - 1. Project and nameplate data verification per assembly documentation
 - 2. Final Inspection

1.4 SYSTEM OPERATION AND MAINTENANCE MANUALS

- A. Complete system Operation and Maintenance (O&M) manuals shall be available in hardcopy and electronic form. The electronic form shall be provided in PDF format and be fully bookmarked. The PDF files shall be active and searchable for quick access to key information. The O&M manuals shall address:
 - 1. General project information
 - 2. Installation and start-up
 - 3. Process design and operational control description
 - 4. Mechanical, electrical and field instrumentation component description
 - 5. Maintenance and troubleshooting
 - 6. Mechanical and electrical drawings

1.5 MOTOR COMPLIANCE

- A. Motors shall be in compliance with the Energy Independence and Security Act of 2007 (EISA 2007).
- B. All three phase motors and components shall be 480 V, 60 Hz.
- C. All single phase motors and components shall be 120 V, 60 Hz.

1.6 TOOLS AND SPARE PARTS

- A. The system supplier shall furnish one (1) set of recommended spare parts and one (1) year of routine consumables.

- B. The system supplier shall furnish a complete list of manufacturer's recommended spare parts and routine consumables.
- C. The system supplier shall furnish any special tools and devices necessary to disassemble, service, repair, and adjust the equipment.

1.7 WARRANTY

- A. The CONTRACTOR shall furnish a warranty extending twelve (12) months after substantial completion date of the project in its entirety.
- B. The Supplier shall furnish a warranty extending twenty-four (24) months after substantial completion date of the project in its entirety.

1.8 PROCESS PERFORMANCE GUARANTEE

- A. The single source supplier of the AGS System equipment shall provide a written Process Performance Guarantee to guarantee the AGS System will meet the effluent criteria specified under Section 2.2 B of this specification. The guarantee period shall commence at time of plant start-up, once the system has reach equilibrium (or within six months of equipment shipment whichever first shall occur), and shall be in force for a period of one year. The Process Performance Guarantee shall be submitted as part of the engineer's submittal data.
- B. The OWNER will promptly notify the AGS System Supplier of the failure to meet process guarantee and specify the respect in which such guarantee has not been met. If the Supplier disputes any claimed failure, notice of such dispute shall be furnished promptly to ENGINEER and OWNER.
- C. The AGS System Supplier shall approve of the ENGINEER's design prior to the bidding of the contract and shall approve, in writing, the CONTRACTOR'S installation of the equipment including, but not limited to, the mechanical, electrical and controls components, and all other aspects associated with the AGS process. Thus, the AGS System Supplier shall be responsible for fulfillment of the process guarantee herein.

1.9 NDA/END USE AGREEMENT

- A. The CONTRACTOR shall be required to comply with the AquaNereda® Non Disclosure Agreement as supplied by Aqua-Aerobic Systems, Inc. and HaskoningDHV Nederland B.V., with respect to the AquaNereda® Technology.

1.10 EXCEPTIONS

- A. This specification shall cover all equipment, including valves, instruments, pipes, blowers, and control panels, etc, provided by system Manufacturer. If any particular item is not consistent with another specification, this specification shall overrule and the requirements in this specification shall be sufficed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The AGS System shall be supplied by:

1. Aqua-Aerobic Systems, Inc

2.2 AGS FUNCTIONAL REQUIREMENT

A. The supplier of the AGS system shall be completely responsible for the proper design of their system including, but not limited to, control logic, diffused aeration equipment, pumps, blowers, automated valves, instrumentation and controls. All equipment shall perform as specified and the completed installation shall operate in accordance with the requirements of the plans and specifications.

B. The performance requirements are summarized as follows:

1. Flow:

- | | |
|-------------------------|----------|
| a. Average Design Flow: | 5.0 MGD |
| b. Max Design Flow: | 10.0 MGD |

2. Influent Design Criteria:

- | | |
|-----------------------|----------|
| a. BOD ₅ : | 250 mg/L |
| b. TSS: | 300 mg/L |
| c. TKN: | 55 mg/L |
| d. TP: | 5 mg/L |

3. Effluent Design Criteria (after Filtration):

- | | |
|------------------------|----------|
| a. BOD ₅ : | 10 mg/L |
| b. TSS: | 10 mg/L |
| c. NH ₃ -N: | 1 mg/L |
| d. TN: | 5 mg/L |
| e. TP: | 0.5 mg/L |

4. Wastewater Temperature:

- | | |
|-------------|-------|
| a. Minimum: | 14 °C |
| b. Maximum: | 24 °C |

5. Ambient Temperature:

- | | |
|-------------|-------|
| a. Minimum: | 5 °C |
| b. Maximum: | 30 °C |

2.3 AGS REACTOR BASINS

A. AGS basin structures shall not be included in AGS Supplier scope.

- B. Structure: The basin shall be field erected as shown on the contract drawings and summarized below:

1. Basin Quantity: 3
2. Basin Geometry: Rectangular
3. Inside Dimensions:
 - a. Length: 88 ft
 - b. Width: 78.5 ft
 - c. Top of Wall: 27 ft
 - d. Side Water Depth: 23.3 ft
 - e. Volume: 1.20 MG
4. Schedule:
 - a. T3100
 - b. T3200
 - c. T3300

- C. Influent Plug Valves: Furnish one (1) electrically operated flanged plug valve for each basin to control the influent flow. Valves shall be a 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated non-lubricated ductile or cast iron plug with 80% port opening, assembled and tested with an electric actuator. Valve actuator shall include motor winding protection, manual override, and limit switch feedback in the open and closed position. Actuator(s) include compartment heater and local controls consisting of pushbutton(s), selector switch(es), and light(s). Field wiring and junction/box disconnect shall be provided by the installing contractor. Provisions for valve access shall be provided by the installing contractor. The valves shall be as summarized below:

1. Valves:
 - a. Quantity: 1 per basin
 - b. Size: 30"
 - c. Model: Milliken 601 or approved equal
 - d. Schedule:
 - 1) V3104
 - 2) V3204
 - 3) V3304
2. Valve Actuators:
 - a. Quantity: 1 per valve
 - b. Manufacturer: Auma or equal
 - c. Power: 480 V/3 phase
 - d. Type: Open/Close Service

- D. Magnetic Flow Meter:

1. One (1) magnetic flow meter shall be installed to monitor influent flow to BNR basins. The magnetic flow meter shall not be in the scope of BNR equipment package.

- E. Influent Distribution Assembly:

1. Furnish one (1) influent distribution assembly for each basin. Header assemblies shall be HDPE. Lateral pipe assemblies and vents shall be PVC. Supports, anchors and adhesive anchors of 304 stainless steel construction shall be supplied. Gasket kits for each assembly shall be supplied. The distribution header shall be configured for attachment to 24" diameter influent pipe flange as shown on drawings.

F. Effluent Weir Assembly:

1. Furnish one (1) effluent weir assembly for each basin. Weir channel, weir lateral assemblies, supports and adhesive anchors shall be constructed of 304 stainless steel.
2. Each effluent weir assembly shall consist of five (5) effluent weir troughs. Trough covers shall be provided to keep the effluent troughs out of direct sunlight. Troughs shall be installed in accordance with construction drawings.

G. Sludge Removal System:

1. General: Furnish one (1) solids waste/sludge removal system for each basin. Sludge removal manifold shall be of HDPE construction. Sludge waste header shall be 30" and lateral pipes shall be 10" as shown on the drawings. Supply 304 Stainless steel supports, U bolts, and anchors. Gasket kits for each manifold shall be supplied.
2. Plug Valves: Furnish electrically operated flanged plug valve(s) for each basin to control the waste sludge flow and level correction flow. Valves shall be a 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated non-lubricated ductile or cast iron plug with 80% port opening, assembled and tested with an electric actuator. Valve actuator shall include motor winding protection, manual override, and limit switch feedback in the open and closed position. Actuator(s) include local controls consisting of pushbutton(s), selector switch(es), and light(s). Field wiring and junction/box disconnect shall be provided by the installing contractor. Provisions for valve access shall be provided by the installing contractor. The valves shall be as summarized below.

3. Sludge Waste Valves:

- | | |
|---------------------------------|---------------------------------|
| a. Valve Quantity: | 1 per basin |
| b. Valve Size: | 20" |
| c. Valve Type: | Butterfly |
| d. Valve Model: | Milliken 511A or approved equal |
| e. Actuator Quantity: | 1 per valve |
| f. Actuator Manufacturer: | Auma or approved equal |
| g. Actuator Power: | 480 V/3 phase |
| h. Actuator Type: | Open/Close Service |
| i. Actuator Compartment Heater: | Yes |
| j. Valve Schedule: | |
| | 1) V3108 |
| | 2) V3208 |
| | 3) V3308 |

4. Sludge Waste Throttling Valves:

- | | |
|--------------------|--------------------------------|
| a. Valve Quantity: | 1 per basin |
| b. Valve Size: | 20" |
| c. Valve Type: | Plug |
| d. Valve Model: | Milliken 601 or approved equal |

- e. Actuator Quantity: 1 per valve
- f. Actuator: Manual
- g. Valve Schedule:
 - 1) V3107
 - 2) V3207
 - 3) V3307
- 5. Sludge Air Valves:
 - a. Valve Quantity: 2 per basin
 - b. Valve Size: 4"
 - c. Valve Type: Butterfly
 - d. Valve Model: ABZ
 - e. Actuator Quantity: 1 per valve
 - f. Actuator Manufacturer: Auma or equal
 - g. Actuator Power: 120 V/1 phase
 - h. Actuator Type: Open/Close Service
 - i. Actuator Compartment Heater: Yes
 - j. Valve Schedule:
 - 1) V3113
 - 2) V3114
 - 3) V3213
 - 4) V3214
 - 5) V3313
 - 6) V3314
- 6. Sludge Air Throttling Valve:
 - a. Quantity: 1 per basin
 - b. Size: 4"
 - c. Type: Butterfly
 - d. Model: ABZ
 - e. Actuator: Manual
 - f. Schedule:
 - 1) V3115
 - 2) V3215
 - 3) V3315
- 7. Level Correction Valve:
 - a. Valve Quantity: 1 per basin
 - b. Valve Size: 20"
 - c. Valve Type: Butterfly
 - d. Valve Model: Milliken 511A or approved equal
 - e. Actuator Quantity: 1 per valve
 - f. Actuator Manufacturer: Auma or approved equal
 - g. Actuator Power: 120 V/1 phase
 - h. Actuator Type: Open/Close Service
 - i. Actuator Compartment Heater: Yes
 - j. Valve Schedule:
 - 1) V3106
 - 2) V3206

3) V3306

8. Level Correction Throttling Valve:

- | | | |
|----|--------------------|--------------------------------|
| a. | Valve Quantity: | 1 per basin |
| b. | Valve Size: | 20" |
| c. | Valve Type: | Plug |
| d. | Valve Model: | Milliken 601 or approved equal |
| e. | Actuator Quantity: | 1 per valve |
| f. | Actuator: | Manual |
| g. | Valve Schedule: | |

1) V3105

2) V3205

3) V3305

H. Fixed Grid Fine Bubble Diffuser System:

1. General: Fixed grid aeration diffuser system shall be designed to operate at the following maximum air flow rate, at the specified submergence, and pressure and oxygen transfer rate.

2. Design:

- | | | |
|----|------------------------------|---------------------|
| a. | Airflow per Basin: | 2,787 scfm |
| b. | Pressure @ Top of Drop Pipe: | 11.66 psig |
| c. | Diffuser Submergence: | 22.3 ft |
| d. | Diffuser Quantity: | 704 disks per basin |
| e. | Oxygen Transfer Rate: | 23,581 lbs/d |
| f. | Riser Pipe Size: | 10" |
| g. | Manifold/Header Material: | PVC |
| h. | Supports Material: | 304 stainless steel |
| i. | Riser Pipe: | 304 stainless steel |

3. Materials and Fabrications:

- a. Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel with a 2D finish conforming to ASTM A240, 554, 774, 778. Fabricate non-welded parts and flanges from sheets, plates or bars of 304 stainless steel conforming to ASTM A240 or ASTM A276. Weld in the factory with ER 316L filler wire using MIG, TIG or plasma-arc inert gas welding processes. Provide a cross section equal to or greater than the parent metal. Clean all welded stainless steel surfaces and welds after fabrication to remove weld splatter and finish clean all interior and exterior welds by full immersion pickling and rinse with water to remove all carbon deposits and contaminants to regenerate a uniform corrosion resistant chromium oxide film per ASTM A380 Section 6.2.11, Table A2.1 Annex A2 and Section 8.3.

4. Drop Pipes:

- a. Provide a minimum 12 ga. 304 stainless steel drop pipe from the air main connection to a point 3 ft above the manifold. Provide a stainless steel flange with a 150-pound drilling at the top connection. Provide a stainless steel gasketed coupling for connection to the manifold.

5. Manifolds:

- a. Provide a Schedule 40 PVC aeration manifold fixed to the floor of each AGS basin for connection to the air distribution headers. Fabricate maximum 30 feet long manifolds with threaded union or flanged joints to connect manifold sections and to connect to the air distribution headers to prevent rotation and blow apart. Fabricate manifolds of Schedule 40 conforming to ASTM D1784, D1785 and D2466. Design piping, pipe joints and supports to resist expansion/contraction thrust forces of the air distribution headers over a temperature range of 125° F. PVC components to be produced from PVC compound with a minimum tensile strength of 7000 psi. Design manifolds to withstand 125° F mean wall temperature. PVC components shall have minimum 1.5 percent titanium dioxide to minimize ultraviolet light degradation. Factory solvent weld all PVC joints and diffuser holders.
6. Air Distribution Headers and Diffuser Holders:
 - a. Fabricate maximum 24 feet long PVC air distribution headers with diffuser holders factory solvent welded to the crown of the pipe for positive air seal and strength. Fabricate minimum 4 inch diameter air distribution headers conforming to ASTM D3915 and D3034. Connect air distribution header sections with threaded union or flange joints to prevent blow apart and rotation. Design joints with mating halves factory solvent welded to the ends of the air distribution header. Design threaded union joints with spigot and socket ends joined with a threaded ring and sealed with an O-ring gasket. Design union joints with threads of a minimum of 0.013 square inches to provide adequate strength of the socket and retainer ring. Design flange joints with an angle face ring, follower flange with 150 lb drilling and stainless steel hardware. Diffuser holders shall have a continuous contact area of 13 square inches minimum to ensure structural integrity and shall be designed to hold 9" diameter EPDM membrane diffusers. Air distribution headers and diffuser holders to resist a dead load of 200 lbs applied vertically to the outer edge of the diffuser holder. Provide end caps at the end of each air distribution header.
7. Pipe Supports:
 - a. Provide each section of manifold and air distribution header with a minimum of two (2) supports. Support spacing to be limited to a maximum of 8 feet. Design all supports to allow for thermal expansion and contraction forces over a temperature range of 125 °F and to minimize stress build up in the piping system. Design supports shall be adjustable without removing the air distribution header from the support. Design supports shall include hold down guide straps, support structure and two anchor bolts. Design guide straps with a 2 inch minimum width to eliminate point load on manifold and minimize binding. Design support for a total of 4 inch vertical adjustment for leveling of manifold within 1/4 inch of a common plane.
8. Air Distributor and Manifold Supports:
 - a. Provide guide and fixed type supports to allow expansion/contraction. Design supports to include hold down straps, support structure, locating plate and single anchor bolt. To prevent improper installation, the locating plate shall be able to be installed in either of two directions relative to the support. Design support for a total of 3 inch vertical adjustment for leveling air distribution headers within 1/4 inch of a common plane. Guide straps shall have 1 1/2-inch wide top and bottom contoured bearing surface with chamfered edges to minimize binding and resistance to movement of air distributor under full buoyant uplift load. Design

strap with 1/8 inch clearance around distributor so strap is self-limiting and cannot be over tightened.

9. Diffuser Assemblies:

- a. Furnish diffuser assemblies including diffuser, holder, retaining ring and air flow control orifice. Incorporate an integral check valve into the membrane diffuser.
- b. Test diffuser using primary sampling criteria outlined in Military Standard 105E. Manufacture circular membrane diffuser with integral O-ring of EPDM synthetic rubber compound with precision die formed slits. Add carbon black to the material for resistance to ultraviolet light. Design diffuser as one piece injection molded part with a minimum thickness of 0.080 inch for 9 inch diameter unit. Extractable oil content shall not exceed 10%. Limit the maximum tensile strength of the diffuser to 10 psi when operating at 2.4 scfm/ft² of material.
- c. Visual Uniformity: Observe diffusers for uniform air distribution across the active surface of the diffuser at 1.0 scfm/diffuser and 2 inches submergence. Active surface shall be defined as the perforated horizontal projected area of the diffuser. Factory test diffusers for a dynamic wet pressure (DWP) of 12 inches $\pm$ 20% water column @ 1.0 SCFM/diffuser and 2 inches submergence.

10. Diffuser Holders:

- a. Design holder with air flow control orifice, integral diffuser support plate and removable retainer ring. Holder shall provide support for the diffuser and seal the diffuser in the holder to prevent air leakage around the O-ring. Design retainer ring threads with minimum cross section of 1/8 inch and allow for one complete turn to engage threads.

11. Anchor Bolts:

- a. Design a mechanical or adhesive anchor bolt system for embedment in 4000 psi concrete with a pullout safety factor of 4. Condensate evacuation system shall be provided to substantially drain the submerged aeration piping system for each aeration grid.

I. Pressure Transducer:

1. General: Furnish one (1) submerged pressure transducer for water level measurement in each BNR basin.
2. Design:
 - a. Quantity: 1 per basin
 - b. Manufacturer: Keller LevelRat or approved equal
 - c. Mounting materials of construction:
 - 1) Brackets: 304 SS
 - 2) Supports: 304 SS
 - 3) Anchors: 304 SS
 - d. Tank Connection 304 SS adhesive anchors
 - e. Schedule:
 - 1) LE/LIT3100
 - 2) LE/LIT3200
 - 3) LE/LIT3300

J. Level Switch:

1. General: Furnish one (1) vibronic level switch conforming to the requirements of Section 40 72 76 - Level Switches for each BNR basin. Each level switch shall trigger high water alarm and notify the operator.
2. Design:
 - a. Quantity: 1 per basin
 - b. Manufacturer: Anchor Scientific or approved equal
 - c. Tank Connection: 304 SS adhesive anchors
 - d. Schedule:
 - 1) LSH3100
 - 2) LSH3200
 - 3) LSH3300

K. Analytical Instrumentation:

1. General:
 - a. All in-basin instrumentation shall be provided with all mounting hardware, pole probe mounting assemblies and accessories as shown on the drawings, for installation by the installing contractor. Installing contractor shall be responsible for the Ethernet connection from the analyzer transmitter to the PLC enclosure, as shown on the drawings.
 - b. All probes shall include controls, tubing and solenoid valves for automatic probe cleaning using reuse water (RUW) supply. Installing contractor shall be responsible for all wiring and tubing and connections necessary to complete the probe cleaning system.
 - c. All probes and sensors shall be manufactured from 304 stainless steel.
2. Ammonia:
 - a. Furnish one (1) Horiba HC-200NH controller per basin. The controller shall communicate with the main PLC via 4-20 mA signals. The controller shall have a NEMA 4X enclosure with corrosion-resistant finish and shall be AC powered from a 100-230V AC power source. Each probe module shall include a sunshield.
 - b. Furnish one (1) AM-2000 NH₃ probe per basin. Sensors shall be suspended on a removable mounting pipe assembly and shall include an ultrasonic cleaner. Stainless steel pipe, stainless steel supports and stainless steel anchors shall be provided. Field attachment of the pipe and supports to the basin shall be the responsibility of the installing contractor. Field wiring, conduit, and installation of cable shall be the responsibility of the installing contractor.
 - c. Schedule:
 - 1) AE/AIT3100E
 - 2) AE/AIT3200E
 - 3) AE/AIT3300E
3. Nitrate:
 - a. Furnish one (1) Hach Nitratax NO₃⁻ probe per basin. The probe shall conform to the requirements of Section 40 75 66 - Nitrate/SAC Analyzers. The probe shall be suspended on a removable mounting pipe assembly. Stainless steel pipe, stainless steel supports and stainless steel anchors shall be provided. Field attachment of the

- pipe and supports to the basin shall be the responsibility of the installing contractor. Field wiring, conduit, and installation of cable shall be the responsibility of the installing contractor.
- b. Schedule:
 - 1) AE3100F
 - 2) AE3200F
 - 3) AE3300F
 - c. The NO₃⁻ probe shall be connected to the main controller AIT3100A furnished by Hach.
4. Dissolved Oxygen:
- a. Furnish one (1) Hach LDO DO probe per basin. The probe shall conform to the requirements of Section 40 75 43 – Fluorescent Dissolved Oxygen Measuring. The probe shall be suspended on a removable mounting pipe assembly. Stainless steel pipe, stainless steel supports and stainless steel anchors shall be provided. Field attachment of the pipe and supports to the basin shall be the responsibility of the installing contractor. Field wiring, conduit, and installation of cable shall be the responsibility of the installing contractor.
 - b. The instrument shall also measure and transmit a continuous temperature reading at the DO probe location.
 - c. Schedule:
 - 1) AE3100B
 - 2) AE3200B
 - 3) AE3300B
 - d. The DO probe shall be connected to the main controller AIT3100A furnished by Hach.
5. TSS:
- a. Furnish one (1) Hach Solitax TSS probe per basin. The probe shall conform to the requirements of Section 40 75 53 - Process and Immersion Turbidity and Total Suspended Solids Sensor. The probe shall be suspended on a removable mounting pipe assembly. Stainless steel pipe, stainless steel supports and stainless steel anchors shall be provided. Field attachment of the pipe and supports to the basin shall be the responsibility of the installing contractor. Field wiring, conduit, and installation of cable shall be the responsibility of the installing contractor.
 - b. Schedule:
 - 1) AE3100A
 - 2) AE3200A
 - 3) AE3300A
 - c. The TSS probe shall be connected to the main controller AIT3100A furnished by Hach.
6. pH/ORP:
- a. Furnish two (2) Hach pH/DO probes per basin, one (1) for ORP and one (1) for pH/temperature. The probe shall simultaneously measure pH and ORP and conform to the requirements of Section 40 75 13 - pH/ORP Sensors. The probe shall be suspended on a removable mounting pipe assembly. Stainless steel pipe, stainless steel supports and stainless steel anchors shall be provided. Field

attachment of the pipe and supports to the basin shall be the responsibility of the installing contractor. Field wiring, conduit, and installation of cable shall be the responsibility of the installing contractor.

b. Schedule:

- 1) AE3100C
- 2) AE3100D
- 3) AE3200C
- 4) AE3200D
- 5) AE3300C
- 6) AE3300D

c. The pH and ORP probes shall be connected to main controller AIT3100A furnished by Hach.

7. Phosphate:

a. Furnish one (1) Hach PO₄⁻ probe per basin. The probe shall continuously measure PO₄⁻ concentration in the BNR basin. The probe shall be suspended on a removable mounting pipe assembly. Stainless steel pipe, stainless steel supports and stainless steel anchors shall be provided. Field attachment of the pipe and supports to the basin shall be the responsibility of the installing Contractor. Field wiring, conduit, and installation of cable shall be the responsibility of the installing contractor.

b. Schedule:

- 1) AE3100G
- 2) AE3200G
- 3) AE3300G

c. The PO₄⁻ probe shall be connected to the main controller AIT3100A furnished by Hach.

2.4 BLOWERS

A. General: Furnish three (3) rotary lobe type, positive displacement “hybrid” blowers as described below with premium efficient, T.E.F.C. U.S. Electric, Class F insulation. The blowers shall be manifolded for combined operation. Each motor shall include a single phase normally closed motor winding thermostat. Each blower assembly shall be complete and mounted on a base weldment with four-corner anti-vibration mountings, designed for direct application on a concrete slab or other solid foundation. Each assembly shall be suitable for shipment as a complete unit, factory assembled (less discharge pipe fittings) as much as possible to facilitate shipping and handling. Equipment shall include a blower, electric motor, belts and sheaves, inlet package, integrated discharge silencer, discharge check valve, rubber inlet sleeve and discharge connection, pressure relief valve, butterfly discharge isolation valve, and rubber expansion joint and inlet air filter. A personnel protection guard shall be included over the belts and sheaves.

B. Design:

1. Blower

a. Quantity:

3

b. Manufacturer:

Aerzen or approved equal

- c. Type: Rotary lobe
 - d. Model: GM 150S
 - e. Airflow Rate per Blower: 3,241 scfm
 - f. Maximum Discharge Pressure: 11.66 psig
 - g. Inlet Configuration: Combination filter/silencer
 - h. Enclosure: Yes
 - i. Installation: Outdoor/weatherproof
 - j. Schedule:
 - 1) BLR3610
 - 2) BLR3620
 - 3) BLR3630
2. Motor:
- a. Size: 250 HP
 - b. Manufacturer: Teco, Siemens, or approved equal
 - c. Variable frequency drive (VFD) shall be provided for each BNR blower and conform to Section 26 29 23 – Variable Frequency Motor Controllers. VFDs shall be included in the BNR equipment package.
3. Pressure Relief Valve:
- a. Schedule:
 - 1) V3614
 - 2) V3624
 - 3) V3634
4. Check Valve:
- a. Schedule:
 - 1) V3617
 - 2) V3627
 - 3) V3637
5. Inlet Vacuum Sensor:
- a. Provide inlet vacuum gauge with transmitter to continuously measure and transmit inlet air pressure.
 - b. Inlet vacuum gauge shall be Ashcroft, Dwyer 2040, or approved equal.
 - c. Range: 0 – 40 inches of water
 - d. Dial Size: 4"
 - e. Case: Cast aluminum with acrylic cover
 - f. Accuracy: $\pm 2\%$ of span
 - g. Schedule:
 - 1) PE/PIT3611
 - 2) PE/PIT3621
 - 3) PE/PIT3631
6. Discharge Pressure Sensor:
- a. Provide discharge pressure sensors with transmitter to continuously measure and transmit discharge air pressure.
 - b. Schedule:
 - 1) PE/PIT3614

- 2) PE/PIT3624
- 3) PE/PIT3634
- 7. Discharge Pressure Gauge:
 - a. Provide a discharge pressure gauge to obtain pressure readings.
 - b. Manufacturer: Ashcroft, or equal.
 - c. Range: 0 - 20 psig
 - d. Dial: 4 1/2", 270° scale
 - e. Case: Stainless steel
 - f. Accuracy: ±0.5% (Grade 2A)
 - g. Schedule:
 - 1) PI3610
 - 2) PI3620
 - 3) PI3630
- 8. Discharge Temperature Gauge/Switch:
 - a. Provide a discharge temperature gauge/switch to remove power in the event of an unsafe blower discharge temperature is reached.
 - b. Discharge temperature gauge/switch shall be Jumo 8523-20-10 or approved equal.
 - c. Manufacturer: Jumo, or approved equal.
 - d. Model: 8523-20-10
 - e. Range: 32 °F – 572 °F
 - f. Dial: 4"
 - g. Enclosure: NEMA 4
 - h. Output: SA 28 SPDT microswitch
 - i. Electrical Rating: 5A @ 250 V
 - j. Schedule:
 - 1) TI/TAH3612
 - 2) TI/TAH3622
 - 3) TI/TAH3632
- 9. Oil Temperature Sensor:
 - a. Provide a blower oil temperature sensor with transmitter to continuously measure and transmit blower oil temperature.
 - b. Schedule:
 - 1) TE3610
 - 2) TE3620
 - 3) TE3630

C. Control Panel:

- 1. Blowers for AGS basins shall be controlled by the master control panel for AGS equipment control and instrumentation readout. The control panel shall be provided by AGS Manufacturer as part of AGS equipment package with the following features:
 - a. Color touch screen HMI display
 - b. Display, monitoring, and alarm functions as shown on P&ID drawings
 - c. Shutdown of blower on high oil temperature or high discharge pressure
 - d. Track and log maintenance
 - e. Display run hours

- f. Log alarms
- g. E-Stop button mounted on front of blower enclosure
- 2. Control enclosure:
 - a. NEMA 4X for outdoor installation.
 - b. Factory installed integral to sound enclosure.
 - c. Control power supply:
 - 1) 460 VAC
 - 2) 10 amp feed with 24 VDC transformer

2.5 AIR CONTROL VALVES AND FLOWMETER

A. Air Control Valves:

- 1. Furnish electrically operated butterfly valves as specified above to direct the airflow. Valves shall be AWWA C-504 Class 150B electrically operated butterfly valves a 125# flanged end connection, ASTM A-536 ductile iron body with a 316 SS edge, fully lined EPDM seat vulcanized in the body, 304 stainless steel shaft assembled and tested. Valve actuator shall include motor winding protection, manual override, and limit switch feedback in the open and closed position. Actuators include local controls consisting of pushbuttons, selector switches, and lights. Field wiring and junction/box disconnect shall be provided by the installing contractor.

B. Flowmeter:

- 1. Furnish one (1) air flowmeter assembly for each basin. Each flowmeter assembly shall consist of a FCI ST51A insertion flowmeter and a FCI Vortab flow conditioner or approved equal. Each transmitter shall have a NEMA 4X enclosure containing a display and the microprocessor based electronics. Each sensor shall be a thermal dispersion type. The sensor shall utilize a 1/2" compression fitting and shall be fabricated of stainless steel. The location of the sensor in the process flow must have a total of twelve (12) pipe diameters of undisturbed length upstream downstream of the sensor. A local 18-36 VDC power source for the transmitter, and a twisted shielded pair for the 4-20 mA output signal from the transmitter to the main control panel shall be provided by the installing contractor.

C. Design:

1. Air Control Valves:

- a. Quantity: 1 per basin
- b. Valve Size: 6"
- c. Valve Model: ABZ Lugged
- d. Valve Seat: Viton
- e. Valve Disk: Stainless steel
- f. Actuator Type: Modulating service
- g. Actuator Quantity: 1 per valve
- h. Actuator Manufacturer: Auma or approved equal
- i. Actuator Power: 480 V/3 phase
- j. Schedule:

- 1) V3112
 - 2) V3212
 - 3) V3312
2. Air Isolation Valves:
- a. Quantity: 1 per basin
 - b. Valve Size: 12"
 - c. Valve Model: ABZ Lugged
 - d. Valve Seat: Viton
 - e. Valve Disk: Stainless steel
 - f. Actuator Type: Manual
 - g. Schedule:
 - 1) V3110
 - 2) V3210
 - 3) V3310
3. Thermal Mass Flow Meter:
- a. Quantity: 1 per basin
 - b. Type: Insertion flow meter
 - c. Size: 1/2"
 - d. Manufacturer and Model: FCI ST51A
 - e. Schedule:
 - 1) FE/FIT3110
 - 2) FE/FIT3210
 - 3) FE/FIT3310

2.6 WATER LEVEL CORRECTION TANK

- A. Structure: Water Level Correction Tank shall be retrofired from the existing Secondary Clarifier No.1 as shown on the construction drawings and summarized below:

1. Basin Quantity: 1
2. Inside Dimensions:
 - a. Diameter: 45 ft
 - b. Maximum Water Level: 12 ft
 - c. Basin Volume: 143,000 gallons
3. Schedule:
 - a. T3400

- B. Level Correction Pumps:

1. Two (2) submersible non-clog pumps shall be installed in Level Correction Tank to transfer level correction (LC) water back to EQ Basin No.1. LC pumps shall **NOT** be in the scope of BNR system Manufacturer and shall be furnished in accordance with Section 43 25 13 – Submersible Centrifugal Pumps by Contractor.
2. Furnish submersible non-clog pump(s) as specified herein. Each pump shall be equipped with a submersible electrical motor connected for three phase operation. Pump housing shall be painted cast iron. Pump shall include an adequate length of multi-conductor

chloroprene jacketed type SPC cable suitable for submersible pump applications. The power cable shall also be sized according to NEC and ICEA standards. The pump shall be supplied with a mating cast iron discharge elbow. Each unit shall be fitted with an adequate length of steel lifting chain of adequate strength to permit raising and lowering the pump. The discharge connection elbow shall be permanently installed with the discharge piping. The pump shall be automatically connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection or service. There shall be no need for personnel to enter the basin. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. An upper guide bar bracket shall be provided with each pump. Supply of all discharge piping, supports, gaskets, and hardware beyond the flanged connection specified above shall be the responsibility of the installing contractor. Valve shall have a 125# flanged end connection, ASTM A-126 Class B cast iron body. Field attachment of the pump to the basin shall be the responsibility of the installing contractor.

3. Design:

a. Pump:

- | | |
|---------------------|--|
| 1) Quantity: | 2 |
| 2) Manufacturer: | Flygt or approved equal |
| 3) Pump Function: | Transfer level correction water to EQ No.1 |
| 4) Operating Point: | 600 gpm @ 58 ft TDH |
| 5) Schedule: | |
| a) P3410 | |
| b) P3420 | |

b. Motor:

- | | |
|-----------|---------------|
| 1) Size: | 14 HP |
| 2) Power: | 220 V/3 phase |

4. Connections:

- | | |
|---------------|----|
| a. Discharge: | 4" |
|---------------|----|

5. Material of Construction:

- | | |
|----------------------------------|--------------------------------------|
| a. Lifting Chain: | 304 stainless steel |
| b. Upper Guide Bars and Bracket: | 304 stainless steel |
| c. Tank Connection: | 304 stainless steel adhesive anchors |

C. Pressure Transducer:

1. Furnish submersible pressure transducer for water level measurement in the Level Correction Tank.

2. Design:

- | | |
|--|-----------------------------------|
| a. Quantity: | 1 |
| b. Manufacturer: | Keller LevelRat or approved equal |
| c. Schedule: | |
| 1) LE/LIT3400 | |
| d. Mounting materials of construction: | |
| 1) Support pipe: | PVC |
| 2) Supports: | 304 stainless steel |

- 3) Anchors: 304 stainless steel
- e. Tank Connection: 304 stainless steel adhesive anchors

D. Level Switch:

- 1. Furnish vibronic level switch conforming to the requirements of Section 40 72 76 - Level Switches. The level switch shall trigger an alarm at high water level in Level Correction Tank and send a signal to plant SCADA system.
- 2. Design:
 - a. Quantity: 1
 - b. Manufacturer: Anchor Scientific or approved equal
 - c. Schedule:
 - 1) LSH3400

2.7 SLUDGE BUFFER TANK

A. Structure: Sludge Buffer Tank shall be retrofitted from existing Secondary Clarifier No.2 as shown on the construction drawings and summarized below:

- 1. Basin Quantity: 1
- 2. Inside Dimensions:
 - a. Diameter: 45 ft
 - b. Maximum Operating Level: 12 ft
 - c. Basin Volume: 143,000 gallons
- 3. Schedule:
 - a. T3500

B. WAS Pumps:

- 1. WAS pumps shall be supplied by Owner.
- 2. Existing sludge pumps shall remain in service and continue to serve as WAS pumps.
- 3. Existing Sludge Pump Details:
 - a. Quantity: 3 in service; 1 spare (all existing)
 - b. Manufacturer: Gorman Rupp T6A-B-6
 - c. Pump Function: Transfer WAS to Digester No.1
 - d. Operating Point: 220 gpm @ 102 ft
- 4. Schedule:
 - a. P3510
 - b. P3520
- 5. Motor:
 - a. Size: 11.5 HP
 - b. Power: 460 V/3 phase
- 6. Connections:
 - a. Discharge: 6"

b. Suction 6"

C. Magnetic Flow Meter:

1. Schedule:

- a. FE/FIT3510
- b. FE/FIT3520

- 2. Existing magnetic flow meters shall remain in service and continuously measure WAS flow from each pump.
- 3. Contractor shall integrate existing magnetic flow meters into plant SCADA system for continuous WAS flow monitoring and recording.
- 4. Existing Magnetic Flow Meter Details:

- a. Quantity: 2
- b. Size: 4"

D. WAS Withdraw Pipe:

- 1. Existing 10" settled sludge draw line shall continue to serve as sludge draw line once the clarifier is converted into sludge buffer tank.

E. Telescoping Valve:

- 1. One (1) telescoping valve shall be installed to allow supernatant in sludge buffer tank to flow into the level correction tank.
- 2. Telescoping valve shall be provided in conformance with Section 40 05 71 – Telescoping Valves by Contractor.

F. Pressure Transducer:

- 1. General: Furnish submerged pressure transducer for water level measurement in the Sludge Buffer Tank.
- 2. Design:
 - a. Quantity: 1
 - b. Manufacturer: Keller LevelRat or approved equal
 - c. Mounting materials of construction:
 - 1) Support pipe: PVC
 - 2) Supports: 304 SS
 - 3) Anchors: 304 SS
 - d. Tank Connection: 304 SS adhesive anchors
- 3. Schedule:
 - a. LE/LIT3500

G. Level Switch:

- 1. General: Furnish vibronic level switches conforming to the requirements of Section 40 72 76 - Level Switches. The level switch shall trigger an alarm at high water level alarm and send a signal to plant SCADA system.

2. Design:
 - a. Quantity: 1
 - b. Manufacturer: Anchor Scientific or approved equal
3. Schedule:
 - a. LSH3500

2.8 CONTROL PANEL WITHOUT MOTOR STARTERS

- A. The control system shall be designed to optimize the AquaNereda® process while minimizing operator attention and to accommodate the continuous maximum daily flow without adjusting cycle structures. The control software program shall be factory tested prior to installation at the jobsite.
- B. The control system shall be a timer based system with level overrides and shall provide control, sequence, monitoring, and alarm annunciation capabilities. The operator shall be able to access the timer values and set points through the operator interface panel to allow for adjustment of cycle times and system flexibility. The control system shall be designed to automatically accommodate the plant's full range of loads and flows.
- C. A complete control system shall be provided as described in the following and as shown on the contract drawings. The control system shall include 115 volt control circuit breaker, microprocessor control, operator interface display, indicator lights, and HAND-OFF-AUTOMATIC selector switches.
- D. The incoming service of the control system shall be 115 V, 60 Hz, single-phase. Controls for the equipment listed below shall be provided within the AquaNereda control panel. Elapsed time indication shall be provided through the operator interface of the AquaNereda control panel for equipment indicated by an asterisk(*). Controls are as follows:

1. AquaNereda AGS Equipment:
 - a. (3) Influent Valve(s)
 - b. (3) Air Control Valve(s)
 - c. (6) Air Control Valves(s) – Sludge
 - d. (3) Sludge Wasting Valve(s)
 - e. (3) Level Correction Valve(s)
 - f. (3) DO Signals
 - g. (3) TSS Signals
 - h. (3) 4-20 mA NH₃ Signals
 - i. (3) PO₄⁻ Signals
 - j. (3) NO₃⁻ Signals
 - k. (3) pH Signals
 - l. (3) ORP Signals
 - m. (3) 4-20 mA Pressure Transducers
 - n. (3) Level Sensors
 - o. (1) Common Alarm
 - p. (3) Air Mass Flow Meters
 - q. (1) Existing Influent Flow Meter (by Owner)
 - r. (1) Existing BNR Influent Flow Control Valve (by Owner)

- s. (3) 250 HP BNR Blowers
- 2. Water Level Correction Tank Equipment:
 - a. Level Correction Pumps (by Contractor)
 - b. (1) 4-20 mA Pressure Transducer(s)
 - c. (1) Level Switch
- 3. Sludge Buffer Tank Equipment:
 - a. (2) Existing WAS Pumps (by Owner)
 - b. (2) Existing WAS Flow Meters (by Owner)
 - c. (1) 4-20 mA Pressure Transducer
 - d. (1) Level Switch
- E. Control Panel Wiring and Assembly:
 - 1. All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. Short circuit rating of control enclosure shall be 5 kA RMS symmetrical @ 120VAC maximum.
 - 2. All control panel single conductor wire shall be 16 AWG multi-strand machine tool wire (MTW) minimum, with PVC insulation.
 - 3. Wire colors are as follows:
 - a. 208 VAC or Higher Black
 - b. 120 VAC Control Power Red
 - c. Neutral White
 - d. Ground Green with Yellow Stripe
 - e. Power from Remote Source Orange
 - f. Neutral from Remote Source White with Orange Stripe
 - g. 24 VDC (+) Blue
 - h. 24 VDC (-) White with Blue Stripe
 - i. Intrinsically Safe Light Blue
 - 4. All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing. Wire markers shall be a thermal transfer printable type. The material shall be a self-laminating vinyl. Labels shall be Brady THT-9-427-10 or approved equal.
 - 5. Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122 °F (50 °C). Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door.
 - 6. Control components mounted internal and external to the enclosure shall be mounted with stainless steel hardware and clearly labeled with a plastic identification nametag. The tag shall be white with black lettering.
- F. Control Panel Quality Assurance:
 - 1. All Control Panels shall be UL certified. Testing by supplier's electrical engineering prior to releasing for shipment shall be completed. Testing shall consist of the following:
 - a. Point to point testing of all wiring prior to application of power
 - b. Intended supply voltage shall be applied to the enclosure
 - c. All components shall be tested for proper operation and calibration
 - d. The PLC and operator interface program shall be loaded and functionally checked
 - e. All components shall be checked to confirm proper mounting specifications have been followed

- f. Enclosure shall be inspected for defects and repaired if necessary
 - g. All labeling of wires and devices are correct, properly installed and clean
 - 2. The Manufacturer shall finalize the factory checkout by completing a control panel checklist to document all testing completed above.
 - 3. Upon the successful completion of the control testing of the enclosure assembly, all applicable documentation (i.e. finalized drawing set, signed control checklist cover page, device data sheets, etc.) shall be placed in the drawing pocket of the enclosure.
- G. Control Enclosure:
- 1. The automatic controls shall be provided in a UL listed, NEMA Type 12 mild steel (12 gauge) floor mount enclosure that provides a degree of protection for electrical controls and components from dust, dripping water and external condensation of non-corrosive liquids. The enclosure is intended for indoor installation. Enclosure shall include gasketed overlapping doors with a 3-point latch mechanism operated by an oil tight key-lock handle. The enclosure shall have white polyester powder paint inside with ANSI 61 gray polyester powder paint outside over phosphatized surfaces. The enclosure shall include a painted white mild steel (10 gauge) sub-panel mounted with collar studs. Enclosure shall be manufactured by Hoffman or approved equal.
 - 2. The control enclosure shall be mounted remotely.
- H. Corrosion Inhibitor:
- 1. Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity. The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure.
 - 2. The corrosion inhibitor shall be Hoffman AHCI5E or approved equal.
- I. Circuit Breaker:
- 1. All single phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker. Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed. Supplementary and branch protection circuit breakers shall be Merlin Gerin Multi 9 or approved equal.
- J. Fuse:
- 1. Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse. Fuses shall be rated up to 250 VAC and be Littelfuse or approved equal. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps. Fuse holders shall be Allen Bradley 1492 or approved equal.
- K. High Frequency Noise Filter:
- 1. A UL listed active tracking filter shall be provided to protect the PLC and HMI power feeds from high-frequency noise and low-energy transients. It shall be designed for a single phase input voltage of 120/240 VAC operating at 50/60 Hz. The unit shall provide

surge capacity of 25,000 amps and provide transient protection in all modes (Line to neutral, line to ground and neutral to ground). The noise filter shall be a SolaHD STFV or approved equal.

L. Ground Fault Duplex Receptacle:

1. A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g. programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20 A/120 VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

M. 24 Volt DC Power Supply:

1. A UL listed, industrial grade, compact power supply shall be supplied to provide 24 VDC power to such rated components. The power supply shall be DIN rail mounted and functional with input voltage of 100 to 240 VAC (single-phase) incoming control power. The power supply shall have a green LED which shall be illuminated when output voltage is "OK". The power supply shall be an Allen Bradley 1606 or approved equal.

N. Control Relay:

1. UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120 VAC coil, 10 A contact rating (thermal), 250 VAC insulation rating and 5 million mechanical life cycles. Relays shall be Allen Bradley 700-HK, Square D, or approved equal.

O. Terminal Block

1. Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections. All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall carry a 600V AC/DC voltage rating. Terminal blocks shall be Allen-Bradley 1492-J4 (35A max) and 1492-J16 (85A max) or approved equal.

2.9 PROGRAMMABLE LOGIC CONTROLLER

- A. Automatic operation of the AquaNereda system shall be controlled through a programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a power supply, CPU, discrete input and output modules and analog input and output modules. The processor unit shall include built-in USB and two (2) Ethernet IP communication ports. All input and output points supplied (including unused) shall be wired to terminal blocks. Processor design characteristics shall include: 2.0MB user memory size, real-time clock and calendar, battery backed RAM and an operating temperature range between 32 °F and 140 °F. The PLC processor shall be an Allen-Bradley CompactLogix 1769-L36ER or approved equal.

- B. Modular equipment shall be provided to complete the PLC system. These Allen-Bradley components include: 1769-PA4 – Power Supply, 1769-IA16 – Discrete input (16 point) modules, 1769-OW16 – Discrete output (16 point) modules and 1769-IF8 – Analog input (8 point) modules, 1769-OF4 – Analog output (4 point) modules.
- C. PLC Power Supply:
 - 1. Input voltage range of 85-265/170-265 VAC, 47-63 Hz, maximum inrush current of 30 amps, backplane output current of 4 amps @ 5 V or 2 amps @ 24 V, internal fuse protection, ambient operating temperature of 32 °F to 140 °F, Class I, Division 2 hazardous location certified, UL Listed.
- D. Discrete Input Module:
 - 1. Operating voltage of 79 to 132 VAC at 47 to 63 Hz, backplane current draw at 5 VDC = 115 mA, off-state current 2.5 mA maximum, maximum inrush current 250 mA, LED status indication of each point, ambient operating temperature of 32 °F to 140 °F, UL Listed.
- E. Discrete Output Module:
 - 1. Operating voltage of 5 to 265 VAC at 47 to 63 Hz/5 to 125 VDC, backplane current draw at 5 VDC = 205 mA, at 24 VDC = 180 mA, off-state current leakage is 1.0 mA, LED status indication of each point, ambient operating temperature of 32 °F to 140 °F, UL Listed.
- F. Analog Input Module:
 - 1. Backplane current draw at 5 VDC = 120 mA, at 24 VDC = 70 mA, LED status indication of each point, ambient operating temperature of 32 °F to 140 °F, UL Listed.
- G. Analog Output Module:
 - 1. Backplane current draw at 5 VDC = 120mA, at 24 VDC = 170 mA, LED status indication of each point, ambient operating temperature of 32 °F to 140 °F, UL Listed.
- H. Ethernet Switch:
 - 1. An Ethernet switch shall be provided inside the control enclosure to provide connectivity between the PLC, operator interface and plant networking. The switch shall support both 10 and 100 Mbit/s operation and provide for store and forward switching mode. The switch shall have five (5) 10/100Base-T ports with RJ-45 sockets and shall support auto-crossing, auto-negotiation and auto-polarity. Maximum distance between devices shall be 100 m.
 - 2. The unit shall be DIN rail mounted and require 24 VDC/100 mA power. Diagnostic LEDs for power, link status, data, and data rate shall be provided. The Ethernet switch shall be UL listed and manufactured by Allen-Bradley Stratix 2000 1783-US5T, or approved equal.
- I. Remote Ethernet Access Gateway:

1. A cULus marked, remote access VPN gateway shall be supplied to securely connect to a PLC via the Internet using an Ethernet port and a secure VPN tunnel. The gateway can be DIN rail or wall screw mounting and shall provide WAN/LAN 10/100 Mb Ethernet ports. The gateway shall be a Ewon Cosy + ETH.
- J. Human Machine Interface:
 1. The operator interface shall be a NEMA Type 12, 13, 4X rated, 12.1" diagonal, color touchscreen display with Ethernet and serial communications. The interface shall be a liquid crystal display (LCD). The display type shall be color active matrix thin-film transistor (TFT) with 1280 x 800 pixel resolution. The rated operating temperature shall be 32 °F to 131 °F (0 °C to 55 °C). The operator interface shall be an Allen Bradley PanelView Plus 7 Performance 12".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify layout, type, and orientation of connections.

3.2 INSTALLATION

- A. Install AGS system where indicated on Drawings and according to supplier instructions.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Testing:
 1. Test equipment at start-up and record voltage, current, and other significant parameters. The supplier shall provide a formal test procedure and forms for recording data. Only factory certified service personnel shall perform start-up service. Proof of certification shall be required prior to equipment approval.
- D. Supplier Services: The AGS system supplier shall furnish the services of a factory trained representative for a minimum of three (3) trips and (8) eight-hour days at the jobsite to inspect the installing contractor's equipment installation, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance, and provide process assistance.

E. Startup and Performance Testing:

1. The test runs on the mechanical equipment shall be undertaken with water in the tanks filled up to the high water elevation shown on the Drawings. The Contractor shall be responsible for providing sufficient water, or treated wastewater for filling the tanks for the test runs on the aerators. The test runs on the mechanical equipment shall confirm acceptable normal operating conditions.
2. Instruments and other devices that require calibration and checkout will be carried out after the contractor has the equipment installed and verified continuity. Instruments and devices shall be configured and demonstrated to function prior to start-up. A document indicating the set points and calibration shall be furnished for documentation records.

F. Equipment Acceptance:

1. Adjust, repair, modify, or replace system components that fail to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of supplier's representative.

END OF SECTION 46 53 54

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SECTION 46 61 23 - DISC CLOTH TERTIARY FILTRATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Disc cloth filters

B. Related Requirements:

1. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electrical connections to equipment specified by this Section.
2. Section 26 29 23 - Variable-Frequency Motor Controllers: Drive unit for filter shaft.

1.2 DEFINITIONS

A. ABS: Acrylonitrile butadiene styrene.

B. FRP: Fiberglass-reinforced plastic.

1.3 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.4 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with Work of other Sections.

1.5 SCHEDULING

A. Section 01 31 00 – Project Management and Coordination: Requirements for scheduling.

1.6 SUBMITTALS

A. Manufacturer shall provide, at a minimum, the following information in accordance with Section 01 33 00 Submittals.

1. Product Data/Information
2. Calculations verifying the effective filtration surface area.

3. Hydraulic profile through the filter showing influent and effluent weir lengths, elevations, and nappe at design and peak flow.
4. Shop Drawings
5. Maintenance Instructions
6. Installation Instructions
7. Wiring Diagrams
8. Parts List
9. Qualification Data
10. Sample Warranty

B. Manufacturer shall provide Operations and Maintenance Data.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Spare Parts:

1. Two (2) frame and cloth assemblies
2. One (1) backwash/solids waste valve and actuator
3. One (1) Viton V-ring effluent port/centertube seal
4. At least 1 of each fuse(s), control relay(s), and indicating light replacement bulb(s).
5. Furnish any other spares parts recommended by Manufacturer.
6. Furnish a complete list of Manufacturer's recommended spare parts.

C. Tools: Furnish special tools and other devices required for Owner to maintain equipment.

1.8 QUALITY ASSURANCE

A. The Contractor shall assign full responsibility for the functional operation of all components of the cloth media filtration to a Single Source Supplier. This Supplier shall be responsible for all engineering necessary in order to select, furnish, inspect the installing Contractor's equipment installation and connections, calibrate, and place into operation the aforementioned systems along with all other equipment and accessories as specified herein.

B. The Manufacturer shall have experience in the design and manufacture of cloth media filters for a minimum of ten (10) years and shall be able to demonstrate a minimum of fifty (50) installations within the United States in municipal wastewater applications with cloth media.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store and protect materials according to manufacturer instructions.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. The Manufacturer shall provide a written warranty against defects in materials and workmanship. Manufacturer shall warrant the goods provided by the Manufacturer to be free from defects in materials and workmanship under normal conditions and use for a period of one (1) year from the substantial completion, or eighteen (18) months from shipment of equipment, whichever first shall occur. This warranty shall not apply to any goods or parts which have been altered, applied, operated or installed contrary to the Manufacturer's instructions or subject to misuse, chemical attack/degradation, negligence or accident.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Disc cloth filters shall be provided by the manufacturers below:
 - 1. Aqua-Aerobic
 - 2. Or Pre-Approved Equal
 - a. Specifications and equipment arrangements for the Disc Cloth Filters are based on Aqua-Aerobic. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

2.2 SCHEDULE

- A. FTR5200
- B. FTR5300

2.3 GENERAL

- A. Each filter unit shall include:
 - 1. Tank Assembly
 - 2. Drive Assembly
 - 3. Centertube Assembly with Cloth Media Disks
 - 4. Backwash System
 - 5. Backwash/Waste Pump Assembly(ies)
 - 6. Valves
 - 7. Pressure Transmitter
 - 8. Float Switch
 - 9. Vacuum Transmitter
 - 10. Electrical Controls with Internal Components

- B. Each filter unit will be shipped fully assembled and wired from the factory, unless noted otherwise herein.
- C. Design Criteria:
 - 1. The three (3) filters (1 existing, 2 new) shall be capable of filtering effluent from a Secondary process. Each filter shall have average design flow of 2.0 MGD and max design flow of 4.0 MGD.
 - 2. Filter influent total suspended solids (TSS) concentration shall be 10 mg/l daily average and 15 mg/l maximum at average daily flow rate.
 - 3. Filter effluent total suspended solids concentration shall not be greater than 5 mg/l based on a monthly average.
 - 4. With the growing concern of microplastic pollution, Manufacturer shall provide certified third party testing or peer reviewed journal article demonstrating the ability of the filtration technology to remove greater than 90% of microplastics.
- D. Filter Disk Tank:
 - 1. Each tank assembly shall be painted steel. Entire tank construction shall have a minimum thickness of 10 gauge. Each tank shall have a rounded bottom to ensure deposition of solids does not occur in the corners of the tank. Due to concerns with solids deposit, tanks without rounded bottoms shall not be accepted. Each tank shall be provided with an integral solids waste collection manifold. Waste manifolds that are not integral to the tank shall not be accepted. Each tank drain shall be provided with a manually operated brass ball valve. Valve shall be provided loose for installation by the installing contractor. Tank interior shall be blasted per SSPC-10 and coated with one epoxy basecoat and one epoxy topcoat for a total DFT of 8-12 mils. Tank exterior shall be blasted per SSPC-6 and coated with two epoxy basecoats and one polyurethane topcoat for a total DFT of 8-12 mils. Coating shall be the color "safety blue", manufactured by Sherwin Williams or Tnemec.
- E. Drive Assembly:
 - 1. Each filter shall include an adjustable drive assembly with a gearbox, nylon drive sprocket, acetal drive chain with 304 stainless steel link pins, and a 304 stainless steel chain guard. The gearbox shall be parallel in-line helical type, AGMA Class 1 with a 3/4 HP drive motor rated for 460 volt, 3 phase, 60 Hz. Gear reducer shall be Nord or approved equal. Drive motor shall be Nord, Weg, Baldor, or approved equal.
 - 2. To reduce energy demand, the drive assembly shall rotate the disks only during backwash. Systems requiring constantly rotating disks during filtration will not be acceptable. Belt drive systems or systems with multiple drive units per filter will not be acceptable.
 - 3. If motors and gearboxes require routine maintenance, and are not accessible from the outside tank side walls, the equipment manufacturer shall provide an internal access platform between the tank side walls and motors and gearboxes.
- F. Centertube Assembly:
 - 1. Each centertube assembly shall include a minimum 3/16", 304 stainless steel centertube weldment, driven sprocket, wheel assemblies, 304 stainless steel disk segment rods, and frame and cloth assemblies. Each centertube assembly shall also include a Viton v-ring

effluent port seal which provides superior chlorine resistance. Materials other than Viton are not acceptable for seal materials. The driven sprocket shall be multi-segment, made of UHMW polyethylene. All fasteners shall be stainless steel.

G. Cloth Frame:

1. Each cloth disk assembly shall be comprised of six (6) individual segments, each consisting of a cloth media sock supported by an injection molded glass filled polypropylene frame with corrosion resistant assembly hardware. Cloth/frame assemblies shall be constructed such that each segment is easily removable from the centertube, without special tools, to allow for removal and replacement of the cloth at the point of installation. Systems requiring special tools and/or the return of media segments to the factory for replacement will not be considered.

H. Filter Media:

1. Each cloth disk assembly shall have a minimum of 53.8 square feet of effective submerged filtration area. Each disk shall be divided into no more than six (6) segments and shall be easily removable for service. If the wet weight of the filter disk segment is greater than 50 pounds, a lifting mechanism shall be provided.
2. Each basin shall include eight cloth disk assemblies.
3. Each filter unit shall have a total of: 430.4 square feet of minimum effective submerged filtration area.
4. Cloths shall be of fiber pile construction having a nominal filtration rating of 10 microns. Granular media and screens having structured identical openings shall not be allowed.
5. Cloth filter media must have obtained conditional acceptance under California Title 22 regulations. The approval letter associated with this acceptance must be included with submittals.
6. The cloth media shall have an active filter depth of 3 to 5 mm to provide additional collisions between solids particles and the media within the media depth, resulting in capture of solids across a broader particle range. The cloth depth shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss. Woven mesh or microscreen type media with no filtration depth are not acceptable.
7. Individual pile fibers shall be held in place by a support backing integral to the media. To facilitate proper flow of backwash water through the cloth, the medium's back side shall be of open construction consisting of 10% open area at least 50 times larger than the nominal filtration media in any direction. Media that uses sewn in support structures, which have the potential to prevent free flow through the media, shall not be allowed.
8. Cloth strength is critical to ensure long term performance of the media. Cloth media breaking strength and elongation shall be tested in accordance with ASTM Standard D5035 2R-E method by an ISO certified laboratory specializing in textile testing. Breaking strength shall be in excess of 200 lbf (890 N) in the warp and the weft direction. Elongation shall be less than 10% at 60 lbf (270 N) in the warp and the weft direction. Test reports shall be provided with submittals to demonstrate compliance with this requirement.
9. To avoid excessive media movement, deformation and folding during backwash, the maximum distance between cloth restraints must not exceed 36 inches.

I. Filter Hydraulics:

1. During filtration, the filter unit shall operate in a static condition with no moving parts. The filter system shall provide for the collection of filtered solids on the outside of the cloth media surface to allow for the direct contact of cleaning systems. Filtered effluent shall be used for backwashing. The filter flow path shall be from the outside of the cloth frame to the inside. Systems with flow paths from the inside to the outside of the cloth frame that collect filtered solids and plastic debris on the interior surfaces of the cloth frame will not be acceptable.
2. Only media area below the effluent weir elevation will be considered in the filtration area calculation since this is the only area that is submerged and available for filtration 100% of the time.
3. Submittal information shall include calculations that verify the effective filtration surface area. Media surface fused directly to support structure such that water cannot pass through the media shall not be included in these calculations
4. The operator shall be able to bring a drained filter on line by simply opening the influent isolation device. If the filter design is such that it must be filled with water before the influent isolation device is opened to prevent damage to the filter media, an automated process that sequentially brings the filter back on line with a single switch shall be provided to prevent accidental media damage. The automated process shall activate a minimum 6" diameter motorized valve to fill the filter with effluent or other clean water source in not more than five minutes, verify that the filter is full, and open the motorized influent isolation device.
5. Because of the frequency of the backwash and misting associated with spray systems, designs that utilize high pressure spray or a moving vacuum head as the sole means of solids removal will not be acceptable.

J. Backwash System:

1. The backwash function shall incorporate a pump that draws filter effluent through the cloth as the media rotates past the fixed backwash shoe, thereby removing accumulated solids from the cloth surface. Each disk shall be cleaned by a minimum of two backwash shoes, one on each side. The backwash shoes shall remain in a fixed position. Springs shall be used to maintain the proper tensioning of the backwash shoe against the media surface.
2. The backwash shoe shall be in direct contact with the cloth to ensure effective media cleaning. Systems utilizing media cleaning mechanisms that do not contact the filter media will not be acceptable. Neither the cloth / support assemblies nor the backwash shoes shall include any gridwork overlays or other interferences that would prevent direct contact of the backwash shoes with the cloth fibers.
3. The backwash system shall include 304 stainless steel backwash shoe supports with UHMW backwash shoes, 316 stainless steel springs reinforced PVC flexible hose with stainless steel hose clamps, 304 stainless steel backwash manifolds.
4. The backwash/waste pump(s) shall be a Gorman Rupp model 12B20-B, externally mounted centrifugal pump. Pump shall be provided with a 3 HP, 460 volt, 3 phase, 60 Hz motor and operate at 1750 RPM. Pump shall be rated for 130 gpm at 23.2 ft TDH with 12.2 ft allowable discharge head after losses in internal filter piping have been accounted for. Motor shall be Baldor, Teco, Weg or approved equal. Backwashing shall be initiated by tank water level, timer, or manually through the operator interface. Operator shall have the ability to specify backwash time interval elapses through the operator interface. The backwash water shall be pressurized by the filter's backwash/waste pump for discharging from the filter system. Systems utilizing non-

pressurized backwash flow will not be accepted. Backwash pumps using a belt drive shall not be acceptable due to routine tensioning and other maintenance requirements.

5. Pump manually operated 3" threaded gate valve shall be class 125 bronze with screw in bonnet, non-rising stem, and solid wedge. Valve shall conform to MSS SP-80 and shall be Nibco or approved equal.
6. The 3 inch threaded ball valves shall be a two-piece, full port, with a brass body. Valves and shall be Nibco or approved equal.
7. The vacuum gauge(s) shall have a minimum 2.5" dial with all stainless steel welded construction, 0-30" Hg vacuum range, liquid filled, 1/4" NPT process connection, 316 stainless steel bourdon tube and tip material, and bronze socket material, Ashcroft or approved equal.
8. The pressure gauge(s) shall have a 2.5" dial with a black painted steel case, 0-15 psi, heat resistant polycarbonate window, 1/4" NPT process connection, "C" shaped bronze bourdon tube, and brass socket material, Ashcroft or approved equal.
9. Filtering shall not be interrupted during normal backwashing and solids waste discharge.

K. Valves:

1. Each filter shall include four 2" backwash valve(s). Valve(s) shall be 3 piece, grooved end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, installed with painted cast iron Victaulic couplings, with a 115 volt, single phase, 60 Hz, open / close service electric actuator. Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal. Valve actuator shall include a compartment heater and limit switch feedback to the microprocessor in both the open and closed positions.
2. Because of fouling that can be caused by stringy material, non full port valves such as butterfly valves or plastic valves shall not be acceptable.
3. Each filter shall include one 2" solids waste valve. Valve shall be 3 piece, grooved end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, "installed with" painted cast iron Victaulic couplings, with a 115 volt, single phase, 60 Hz, open / close service electric actuator. Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal. Valve actuator shall include a compartment heater and limit switch feedback to the microprocessor in both the open and closed positions.
4. Each filter shall include a solids waste removal system in the floor of the filter tank. The manifold shall be designed to siphon settled solids waste for discharge through the backwash/waste pump. The operation of the solids waste removal system shall be automatic with user adjustable intervals and duration through the operator interface. Filters that are designed without a solids waste removal system will not be acceptable.

L. Influent Valve:

1. Each filter shall include one influent valve. Valve shall be 16" lugged style influent butterfly valve with a ductile iron body, aluminum bronze disk, stainless steel shaft and EPDM seat. Valve shall be Nibco, ABZ, or approved equal.
2. Valve shall include a gear operator and hand wheel.

M. Pressure Transducer:

1. A submersible pressure transducer shall be supplied for each filter basin. The pressure transducer shall have stainless steel wetted parts and provide a 4-20 mA signal over a

range of 0 psi to 5 psi. Units shall monitor the water level in the filter basin. Pressure transducer shall be provided with a mounting bracket and stainless steel anchors. A bellows providing vented gage atmospheric reference shall be supplied for contractor installation in junction box. The installing contractor shall provide junction box, bellows mounting and interconnecting wiring. Transducers shall be Keller Levelgage series or approved equal.

N. Float Switch:

1. A float switch shall be furnished to indicate emerging overflow level. The float switch shall be Anchor Scientific Model GSI 40NONC-STO or approved equal. The float shall contain a non-mercury switch, chemical resistant polypropylene casing and a PVC #18 AWG three conductor cable. Switch rating shall be minimum 4.5 amps non-inductive at 120 VAC.

O. Vacuum Transmitter:

1. The vacuum transmitter shall have stainless steel wetted parts and provide a 4-20 mA signal over a range of -30 to 0 inHg. Transmitter shall be an IFM Effector PX series or approved equal.

P. Control Panel Wiring and Assembly:

1. All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. Short circuit rating of control enclosure shall be 5 kA RMS symmetrical @ 480VAC maximum.
2. All control panel single conductor wire shall be 16 AWG multi-strand machine tool wire (MTW) minimum, with PVC insulation.
3. Wire colors are as follows:

a.	208 VAC or higher	-	Black
b.	120 VAC control power	-	Red
c.	Neutral	-	White
d.	Ground	-	Green with Yellow Stripe
e.	Power from remote source	-	Orange
f.	Neutral from remote source	-	White with Orange Stripe
g.	24 VDC (+)	-	Blue
h.	24 VDC (-)	-	White with Blue Stripe
i.	Intrinsically Safe	-	Light Blue
4. All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing. Wire markers shall be a thermal transfer printable type. The material shall be a self-laminating vinyl. Labels shall be Brady THT-9-427-10 or approved equal.
5. Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122° F (50°C). Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door.
6. Control components mounted internal and external to the enclosure shall be mounted with stainless steel hardware and clearly labeled with a plastic identification nametag. The tag shall be white with black lettering.

Q. Control Panel Quality Assurance:

1. All Control panels shall be UL certified. Testing by manufacturer's electrical engineering prior to releasing for shipment shall be completed. Testing shall consist of the following:
 - a. Point to point testing of all wiring prior to application of power
 - b. Intended supply voltage shall be applied to the enclosure
 - c. All components shall be tested for proper operation and calibration
 - d. The PLC and operator interface program shall be loaded and functionally checked
 - e. All components shall be checked to confirm proper mounting specifications have been followed
 - f. Enclosure shall be inspected for defects and repaired if necessary
 - g. All labeling of wires and devices are correct, properly installed and clean
2. The Manufacturer shall finalize the factory checkout by completing a control panel checklist to document all testing completed above.
3. Upon the successful completion of the control testing of the enclosure assembly, all applicable documentation (i.e. finalized drawing set, signed control checklist cover page, device data sheets, etc.) shall be placed in the drawing pocket of the enclosure.

R. Control Enclosure:

1. The automatic controls shall be provided in a UL listed, NEMA Type 4X 304 stainless steel (14 gauge) wall mounted enclosure that provides insulation and protection for electrical controls and components from highly corrosive environments indoors and outdoors. Enclosure shall include a seamless foam-in-place gasket to assure watertight and dust-tight seal. An internal 3-point latch and 316SS padlocking POWERGLIDE® handle shall be provided. Enclosures shall be unpainted, with a smooth #4 brushed finish. Enclosure shall include a painted white mild steel (12 gauge) sub-panel mounted with collar studs. Enclosure shall be manufactured by Hoffman or approved equal.

S. Enclosure Sun Shield:

1. A 304 10 gauge stainless steel sun shield shall be included. A sunshield shall over hang the front of the panel a minimum of 10".
2. The control panel will be factory installed, wired, tested then removed for shipping. The installing contractor shall mount the control panel and re-connect the wiring.

T. Corrosion Inhibitor:

1. Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity. The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure.
2. The corrosion inhibitor shall be Hoffman AHCI5E or approved equal

U. Air Conditioner:

1. A thermostat controlled air conditioner with noise suppression shall be supplied to protect control components mounted inside the enclosure from high temperatures, humidity and ambient air contaminants. The air conditioner shall be constructed of brushed finish stainless steel 304 material and provide NEMA 4X Type protection from outdoor and hose-down applications. The air conditioner unit shall use CFC-free or environmentally

safe refrigerant that is universally accepted. The air conditioner shall be manufactured by Hoffman or approved equal.

V. Main Disconnect Circuit Breaker:

1. A UL listed, automatic molded case 3-pole disconnect breaker shall be provided in the control enclosure(s). The primary function of the disconnect switch shall be to provide a means to manually open a circuit and automatically open a circuit under overload or short circuit conditions. The disconnect breaker shall have a door mounted operating mechanism with trip indication. Power distribution connectors shall be mounted integrally to the circuit breaker for multiple load connections. Integral connectors shall be provided. The disconnect circuit breaker shall be a Square D/HDL, JDL, LDL, MDL, PDL or approved equal.

W. Motor Starter:

1. A full voltage non-reversing Integrated Motor Starter-Controller shall be provided for motor applications up to 15 kW. Each starter shall provide control, protection and monitoring functions for the motor. The starter shall be IEC rated and shall have certifications according to UL and CSA standards and shall bear the CE marking. The starter shall have a maximum rated operational voltage of 690V and provide a 42kA @ 480 VAC rated breaking capacity on short circuit. The starter shall have a mechanical durability of 15 million operations. The starter shall provide short circuit trip, thermal overload trip with selectable tripping class, under current trip and phase imbalance trip.

X. Variable Frequency Drive:

1. UL Listed Variable Frequency Drives (VFD) shall be provided to control the pumps. The VFD's shall control pump speed via manual adjustment. The VFD output frequency shall be programmable. The VFD shall be provided in a NEMA Type 20 panel mount package and rated for an operating temperature of -4° to 122°F (-20° to 50°C). The VFD shall have a 65 kA maximum short circuit rating when protected with an Allen Bradley 140M motor circuit protector or Class CC/J fuse. The VFD shall be Allen-Bradley PowerFlex or approved equal.

Y. Elapsed Time Meter:

1. An elapsed time meter shall be mounted on the front of the control panel for each motor. The meter shall measure motor operation time in hours and tenths. The meter shall be non-resettable, electromechanical wheel type. The meter shall contain solid state electronic circuitry, a quartz crystal for accurate timing, shall be tamperproof and sealed against dirt and moisture, and includes gasket and mounting hardware for NEMA 4X and 12 rating. The meter shall be an ENM model T50B212 or approved equal.

Z. Transformer:

1. A step-down multi-tap transformer shall be supplied when there is a necessity to reduce incoming 3-phase power to 120 VAC single-phase. The transformer power wire connections (incoming and outgoing) shall be protected with a finger-safe cover to protect against accidental contact. Primary and secondary fuse protection shall be provided. Transformer shall be UL listed and of continuous wound construction with

vacuum impregnated with non-hygroscopic thermosetting varnish. Transformer shall be Square D 9070T or approved equal.

AA. Transformer Primary And Secondary Fuse:

1. Properly rated fuses and fuse blocks shall be provided for primary and secondary protection of the transformer. Each fuse shall be equipped with a thermoplastic cover to protect against accidental contact. Clip style fuse block shall be rated up to 600 VAC and 100 amps, dual element, time delay fuses shall be rated up to 600 VAC. Fuse blocks and fuses shall be UL listed. Fuses shall be Littelfuse Class CC or approved equal. Fuse blocks and fuse covers shall be manufactured by Marathon or approved equal.

BB. Circuit Breaker:

1. All single phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker. Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed. Supplementary and branch protection circuit breakers shall be Merlin Gerin Multi 9 or approved equal.

CC. Fuse:

1. Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse. Fuses shall be rated up to 250 VAC and be Littelfuse or approved equal. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps. Fuse holders shall be Allen Bradley 1492 or approved equal.

DD. Operator Device:

1. Operator devices (pushbuttons and selector switches) shall be mounted through the control enclosure door for manual operation of the filter. Transformer type pilot lights and illuminated pushbuttons shall be provided for indication of an operation status. Lights shall be a 6 VAC incandescent type lamp. Color coding shall be applied as required and is as follows:
 - a. Amber – Alarm active, caution
 - b. Green – Valve open, motor running
 - c. Red – Valve closed
 - d. White - Information
2. All operator devices shall be UL Listed, 30.5mm style, NEMA Type 4X rated, oil and water tight with finger safe guards located on the contact blocks to prevent accidental contact with wire connections. Operator device function shall be identified with an engraved white Gravoply nameplate with black letters. Operator devices shall be Square D 9001 or approved equal.

EE. High Frequency Noise Filter:

1. A UL listed active tracking filter shall be provided to protect the PLC and HMI power feeds from high-frequency noise and low-energy transients. It shall be designed for a single phase input voltage of 120VAC operating at 50/60 Hz. The unit shall provide

surge capacity of 25,000 amps and provide transient protection in all modes (Line to neutral, line to ground and neutral to ground). The noise filter shall be a SolaHD STFV or approved equal.

FF. Uninterruptible Power Supply:

1. A UL listed uninterruptible power supply suitable for location in a UL 508 panel shall be provided to protect the HMI and PLC from short power outages by switching to an emergency battery backup without data loss or downtime. Nominal input voltage and output voltage shall be 120VAC with an autosensing input frequency of 47 to 63 Hz. The output power capacity shall be 650W / 1000VA. The UPS shall be provided with an audible alarm and LED status indicators and operate from 32° to 122°F (0° to 50°C). The UPS shall be an Allen Bradley 1609-B1000N.

GG. Ground Fault Duplex Receptacle:

1. A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g. programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20A / 120VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

HH. 24 Volt DC Power Supply:

1. A UL listed, industrial grade, compact power supply shall be supplied to provide 24 VDC power to such rated components. The power supply shall be DIN rail mounted and functional with input voltage of 100 to 240 VAC (single-phase) incoming control power. The power supply shall have a green LED which shall be illuminated when output voltage is "OK". The power supply shall be an Allen Bradley 1606 or approved equal.

II. Control Relay:

1. UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating and 5 million mechanical life cycles. Relays shall be Allen Bradley 700-HK, Square D, or approved equal.

JJ. Terminal Block:

1. Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections. All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall carry a 600V AC/DC voltage rating. Terminal blocks shall be Allen-Bradley 1492-J4 (35A max) and 1492-J16 (85A max) or approved equal.

KK. Programmable Logic Controller:

1. Automatic operation of the Filter shall be controlled through an Allen Bradley MicroLogix 1400 programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a base unit, expansion I/O modules, and memory module. All input and output points supplied (including unused) shall be wired to terminal blocks. The PLC user memory shall consist of a minimum of 20K words of program and data. All PLC hardware shall be UL listed and operate at an ambient temperature of -4° to 140° F (-20° to 60° C).

LL. Base Unit

1. The base unit shall house embedded inputs, outputs, power supply, and communication (Ethernet, RS-232, RS-485) ports. The base unit shall also provide the interface to expansion I/O when required by an application.
2. The power supply input range shall be 100 to 240V AC at 47 to 63 Hz with a maximum power consumption of 100 VA.
3. The embedded discrete inputs shall be rated for 120V AC and the discrete (relay) outputs shall be rated for 265V AC/125V DC. Embedded analog I/O shall be voltage (± 10 V) inputs and outputs. Each I/O point shall have LED status indication.
4. The base unit shall have one (1) RS-232-C serial port, one (1) RS-485 serial port, and one (1) RJ-45 port which supports 10/100 Mbps EtherNet/IP. These ports shall be capable of local and remote programming, troubleshooting, and data manipulation.
5. The PLC base unit shall be an Allen Bradley 1766-L32AWAA or approved equal.

MM. Digital Expansion Input Module:

1. The expansion digital input module shall have an operating voltage of 79 to 132V AC at 47 to 63 Hz. The module shall have an LED status indication of each point. The digital expansion input module shall be an Allen Bradley 1762-IA8 or approved equal.

NN. Memory Module:

1. The controller shall be shipped with a memory module for user program and data backup. The memory module shall be an Allen Bradley 1766-MM1 or approved equal.

OO. Ethernet Switch:

1. An unmanaged Ethernet switch shall be provided inside the control enclosure to provide connectivity between the PLC, operator interface and plant networking. The switch shall support both 10 and 100 Mbit/s operation. The switch shall have five (5) 10/100Base-T ports with RJ-45 sockets and shall support auto-crossing, auto-negotiation and auto-polarity. Maximum distance between devices shall be 100m.
2. The unit shall be DIN rail mounted and require 24VDC power. Diagnostic LEDs for power and connection status shall be included. The Ethernet switch shall be UL listed and manufactured by Allen-Bradley Stratix 2000 1783-US5T, or approved equal.

PP. Human Machine Interface Overview:

1. The control system shall be equipped with a UL listed operator interface that provides control display screens. These screens shall be used by the operator to monitor and control filter status, setpoint and alarm information.

2. The Interface shall allow the Operator access to adjust the following operating parameters:
 - a. Backwash interval, Backwash duration, Sludge waste interval, Sludge waste duration, Number of backwashes between sludge wasting
3. The operator interface shall provide information to assist the Operator in assessing the status of the filter system. The interface screen shall display, at minimum, the following parameters:
 - a. Water level in the filter, Time since last Backwash, Time since last Sludge withdrawal, Elapsed time on the Drive Motor, Elapsed time on the Backwash Pump(s), Total backwash time and cycles, Total sludge withdrawal time and cycles.
4. The interface shall display the alarm history. The alarm history shall include the time and date of the most recent 25 alarms along with the description of the alarm.
5. The interface shall also display current alarms, including the date, time and a description of the alarm.
6. As a diagnostic aid to the Operator, the interface shall display the time between backwashes for the most recent 40 backwashes.

QQ. Human Machine Interface:

1. The operator interface shall be a NEMA Type 12, 13, 4X rated, 6.5" diagonal, color touchscreen display with Ethernet and serial communications. The interface shall be a liquid crystal display (LCD). The display type shall be color active matrix thin-film transistor (TFT) with 640 x 480 pixel resolution. The rated operating temperature shall be 32° to 131° F (0° to 55° C). The operator interface shall be an Allen Bradley PanelView Plus 7 Performance 7".

RR. Human Machine Interface Sun Shield:

1. A sun shield constructed of 304 stainless steel shall be mounted over the operator interface to provide protection and visibility of operator screens in outdoor applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. Install according to manufacturer instructions.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Manufacturer Services:
 - 1. The equipment manufacturer shall furnish the services of a factory trained representative for a maximum of one (1) trip and four (4) eight hour days at the jobsite to inspect the installing contractor's equipment installation, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance, and provide process assistance.
 - 2. If additional service is required due to the mechanisms not being fully operational, at the time of service requested by the contractor, the additional service days will be at the contractor's expense.
 - 3. The selected manufacturer shall have a free troubleshooting help line available 24 hours a day, 365 days per year for the life of the plant.
- C. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 46 61 23

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SECTION 46 66 56 - ULTRAVIOLET DISINFECTION EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Open-channel, low-pressure, high-intensity UV disinfection equipment and accessories. Rehabilitation of existing UV disinfection equipment.
- B. Related Requirements:
 - 1. Section 26 05 03 - Equipment Wiring Connections: Execution and product requirements for connecting equipment specified by this Section.
 - 2. Section 46 05 53 - Identification for Water and Wastewater Equipment: Nameplates for equipment specified in this Section.

1.2 REFERENCE STANDARDS

- A. American National Standards Institute:
 - 1. ANSI C82.4 - American National Standard for Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type).
- B. Federal Communications Commission (FCC):
 - 1. 47 CFR 15 - Radio Frequency Devices.
- C. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with Work of other Sections.
- C. Maintain flow of wastewater and its disinfection until proposed system is tested, approved, and fully operational.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Product Data: Submit manufacturer's information, including average UV intensity within each reactor, UV density, headloss caused by each bank of lamp modules, lamp module cross-sectional area, and aspect ratio of lamp bank.
- C. Shop Drawings:
 - 1. Indicate size and configuration of assembly, mountings, weights, and accessory connections.
 - 2. Indicate system materials and component equipment.
 - 3. Hydraulic calculations demonstrating compliance with requirements.
 - 4. Disinfection performance guarantee.
 - 5. Electrical schematics and layouts.
- D. Manufacturer's Certificate: Certify that system meets or exceed specified requirements.
- E. Test and Evaluation Reports: Submit installation certificate from equipment manufacturer's representative, as described in PART 3.
- F. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Manufacturer Reports:
 - 1. Certify that equipment has been installed according to manufacturer instructions.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of installed UV treatment equipment and accessories.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
 - 1. Low-Pressure, High-Intensity UV Lamps: 8 each.
 - 2. Quartz Lamp Sleeves and Seals: 8 each.
 - 3. Lamp Holder Seals: 8 each.
 - 4. Operator kit including face shield, gloves and cleaning solution: 2 each.
 - 5. Any other spare parts recommended by the Manufacturer.
- C. Tools: Furnish special tools and other devices required for Owner to maintain, service, repair and disassemble the equipment.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five (5) years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.9 WARRANTY

- A. The UV Manufacturer shall warrant all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from the substantial completion or 18 months after shipment, whichever comes first.
- B. UV lamps purchased are warranted for 12,000 hours of operation or three (3) years from shipment, whichever comes first. The warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp shall be provided at no charge.
- C. Electronic ballasts shall be warranted for five (5) years, pro-rated after one (1) year.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. UV disinfection equipment shall be provided by the following manufacturers:
 - 1. Trojan Technologies.
 - 2. Or Approved Equal.
 - a. Specifications and equipment arrangements for the UV Disinfection Equipment are based on Trojan Technologies Model UV3000 Plus. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing contractor. No change orders will be issued to the contractor for

modifications to the laying length, footprint, concrete layout, electrical mechanical, etc.

2.2 UV DISINFECTION EQUIPMENT

A. Description:

1. The scope shall include rehabilitation of existing UV disinfection equipment.
2. Outdoor, open-channel, gravity-flow, horizontally orientated UV disinfection system, consisting of following:
 - a. UV lamp module with support rack and bracket.
 - b. Instrumentation, controls, and power distribution.
 - c. UV monitoring system.
 - d. Elapsed time meter.
 - e. Lamp cleaning system.

B. Performance and Design Criteria:

1. Flow Rate:
 - a. Peak Hourly Flow (PHF): 14.0 MGD
 - b. Design Flow: 5.0 MGD
 - c. Start-Up Flow: 0.6 MGD
2. Max Headloss at PHF: 6.0 inches
3. TSS Concentration: 30 mg/L (30 Day Average, grab sample)
4. Wastewater temperature: 50 to 68 °F
5. Minimum UV transmittance: 68%
6. Disinfection Limit: 200 Fecal Coliform per 100 ml (30 Day Average, grab sample)
7. Design Dose: 30 mJ/cm² (bioassay validated)
8. Lamps:
 - a. Lamps per module: 8
 - b. modules per bank: 8
 - c. Type: Low pressure, high intensity
 - d. Number of banks: 2
 - e. Maximum power draw: 34.6 kW

C. Lamps:

1. Type:
 - a. High intensity, low pressure amalgam.
 - b. Design: Hot cathode, instant start.
2. Filament: Clamped design to withstand shock and vibration.
3. Module:
 - a. Description: Lamps placed in individual fused-quartz sleeves, and sealed and supported in NEMA 6P stainless-steel frames.
 - b. Wiring: Completely enclosed and protected from wastewater.
 - c. Base: Metal and ceramic.

- d. Replacement: Capability of replacing lamp without disassembling or removing sleeve.
- 4. Sleeves:
 - a. Description: Close one end of each sleeve and seal opposite end with lamp end seal and O-ring.
 - b. Material: Fused quartz, General Electric or equal
 - c. Seal: Stainless-steel nut and O-ring seal.
 - d. Configuration: Prevent lamp sleeve from touching steel components.
- 5. Ballasts:
 - a. Comply with ANSI C82.4.
 - b. Minimum Power Factor: 90.
 - c. Design: Modular, for quick disconnect and replacement.
 - d. Conducted and Radiated Emission: Comply with 47 CFR 15.
 - e. Power Output: Incremental steps from 30 to 100 percent of rated lamp power.
- D. Materials:
 - 1. Metal Components in Contact with Wastewater: Type 316 stainless steel.
 - 2. Components Exposed to UV Light: Type 316 stainless steel, quartz or PTFE.
- E. Level Control Weir Gate:
 - 1. Weir gate shall be installed at the discharge end of existing UV channel.
 - 2. Weir gate shall be provided by UV Manufacturer.
 - 3. Weir gate shall be designed to maintain the constant water level in UV channel as specified by UV Manufacturer and keep lamps submerged at all times.
 - 4. Weir gate shall be constructed of 304 stainless steel.
- F. Serpentine Weir:
 - 1. One (1) serpentine weir shall be installed to maintain a steady water level in the channel downstream of level control weir gate in order to keep reuse water pumps submerged at all times.
 - 2. Serpentine weir shall have a total length of 48.4 ft with six (6) fingers. Each finger shall be 4 ft in length along the channel and 1 ft in width.
 - 3. Serpentine weir shall be supplied by UV Manufacturer.
 - 4. Serpentine weir shall be constructed of stainless steel.
- G. Electrical:
 - 1. All applicable electrical components shall be UL-listed to ensure safety standards are met.
 - 2. Each UV lamp within a bank shall be powered from a Power Distribution Center.
 - 3. UV Equipment Supplier shall supply all cabling between lamps and drivers.
 - 4. Power factor shall not be less than 99% leading or lagging.
 - 5. Electrical supply to each Power Distribution Center (PDC) will be 480 V, 60 Hz, 3 Phase, 45 Amps, 36.8 kVA.
 - 6. Electrical supply to the Hydraulic System Center (HSC) will be 480 V, 60 Hz, 3 Phase, 2.5 kVA.

7. Electrical supply to the low water level sensor box will be from 120 V, 1 Phase. This supply shall come from PDC No.2 (PDC6200).
 8. Electrical supply to the System Control Center shall be 120 V, 60 Hz, 1 Phase, 15 Amps.
- H. Power Distribution Center (PDC6100, PDC6200):
1. The configuration of Power Distribution Centers shall be 144 lamps per PDC.
 2. PDC enclosure material shall be 304 Stainless Steel.
 3. All internal components shall be sealed from the environment.
 4. All Power Distribution Centers to be UL approved or equivalent.
 5. An internal heater shall be provided in the PDC to prevent condensation when the external temperature drops below the dew point.
 6. Each PDC shall be able to electrically isolate each bank of lamp drivers and safely replace a lamp driver without de-energizing any other operating banks.
- I. Hydraulic System Center (HSC6100):
1. The Hydraulic System Center (HSC) houses the components required to operate the automatic cleaning system.
 2. HSC enclosure material shall be 304 Stainless Steel (Type 4X, IP 66).
- J. Control and Instrumentation:
1. System Control Center:
 - a. The monitoring, operation and control of the UV System shall be managed at the System Control Center by a CompactLogix with a Beijer Electronics -15" (Outdoor 4X Rated) HMI screen.
 - b. The operator interface shall be positioned out of or away from direct sunlight and shall include a sunshade and shall be protected by a UL listed Type 4X hinged viewing window.
 - c. Alarms shall be provided to indicate to plant operators that maintenance attention is required or to indicate an extreme alarm condition in which the disinfection performance may be jeopardized. The alarms shall include, but not be limited to:
 - 1) Individual Lamp Failure
 - 2) Multiple Lamp Failure
 - 3) Low UV Intensity
 - 4) Bank Communication Alarm
 - d. The 100 most recent alarms shall be recorded in an alarm history register and shall be displayed when prompted.
 - e. Mode of operation for UV Banks shall be selectable as manual, automatic or remote.
 - f. Elapsed time of each bank shall be recorded and displayed on the display screen when prompted.
 - g. A 2-port fiber switch shall be provided for integration into the Plant SCADA System.
 2. Low Water Level Sensor:
 - a. The UV Manufacturer shall provide one (1) low water level sensor for the UV channel.

- b. During all modes of system operation (manual, automatic and remote), the water level sensor shall ensure that lamps extinguish automatically if the water level in the channel drops below an acceptable level.
- 3. UV Intensity Sensors:
 - a. A UV intensity sensor shall continuously monitor the UV intensity produced within each UV Bank (AE/AIT6101, AE/AIT6201).
 - b. The sensors shall measure only the germicidal portion of light emitted by the lamps.
 - c. The UV sensor shall be factory-calibrated to US National Institute for Standards and Technology (NIST).
 - d. The sensor shall be digitally calibrated to ensure calibration accuracy. Calibration certificate shall be submitted prior to the field testing and start-up of UV system.
 - e. To ensure continuous disinfection, the sensor shall be accessible without shutting down the system, lifting a bank/module or removing lamps.
 - f. Sensors shall be designed to provide UV intensity data for dose monitoring and control functions. Dose pacing program shall enable use of measured UV intensity along with flow rate and UVT to determine the delivered dose during operation.
 - g. Sensors shall be designed such that reference sensor readings can be taken without interrupting disinfection and without removing UV lamps, banks/modules or sleeves.
- 4. Dose-Pacing:
 - a. A dose-pacing system shall be supplied to modulate the lamp UV output in relationship to a 4-20 mA DC signal.
 - b. The system to be dose-paced such that as the flow and effluent quality change, the design UV dose is delivered while conserving power.
 - c. The dose-pacing system shall permit the operator to vary the design dose setting. Logic and time delays shall be provided to regulate UV Bank ON/OFF cycling.
 - d. Determine operation sequences based on plant design requirements and selected manufacturer.
- 5. Elapsed Time Meter:
 - a. Description: One (1) non-resettable elapsed time meter for each bank of lamp modules.
 - b. Operation: 0 to 99,999 hours.
- 6. Switches: Furnish one HAND-OFF-AUTO switch for each UV bank.
- 7. Alarms:
 - a. UV Power Failure.
 - b. Low UV Intensity Warning.
 - c. Low UV Intensity.
 - d. Individual Lamp Failure.
 - e. Two or More Adjacent Lamps Failure.
 - f. Multiple Lamps Failure.
 - g. Module Failure.
- 8. Disconnect Switch: Factory mounted in System Control Center (FCP6100).

2.3 ACCESSORIES

A. UV Transmittance Analyzer (AE/AIT6101, AE/AIT6201):

1. Description:
 - a. Analyzer, sensor, and sampler, each with a separate NEMA 250 Type 4 enclosure.
 - b. Continuously monitor percent UV transmittance of wastewater.
2. Range: 0 to 100% transmittance.
3. Accuracy: Plus and minus 1 percent of full scale.
4. Operating Temperature Range: 20 to 120 °F.
5. Alarms: HIGH, LOW, and OFF.
6. Display: LCD with 24-hour graph.

B. Cleaning System:

1. Description:
 - a. Automatic mechanical/chemical cleaning system, capable of cleaning lamps during disinfection and without removing lamps from unit.
 - b. Automatically wipe lamp sleeve surface while dowsing lamp sleeve surface with acidic solution.
2. Cleaning Cycle: Field adjustable by operator, from once per hour to once per month.
3. Manual Operation: Furnish operator interface.

C. Lamp Wipers:

1. Arms: Stainless steel.

D. Germicidal Sensors: One per lamp.

E. Anchor Bolts, Nuts, and Washers: Stainless steel.

F. Lifting Device:

1. Existing Davit crane shall remain in place and continue to be utilized for lifting UV banks out of channel.

2.4 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that facilities are ready to receive UV disinfection equipment.

3.2 INSTALLATION

- A. According to manufacturer instructions.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Inspection and Functional Testing:
 - 1. Operate UV system for minimum seven (7) consecutive days with plant wastewater.
 - 2. Test and Inspect:
 - a. Proper installation and alignment of UV support racks and frames.
 - b. Watertightness.
 - c. Electrical wiring and connections.
 - d. Instrumentation, alarms, and indicators.
 - e. ON-OFF and HAND-OFF-AUTO switches and ground fault circuit interrupters.
 - f. Lamp removal system.
 - g. Lamp cleaning system.
- C. Performance Testing:
 - 1. After installed UV equipment has been inspected and functional test has been completed, begin performance testing.
 - 2. Collect samples at or near peak flow rate.
 - 3. Analyze samples for following parameters:
 - a. Fecal coliform, MPN per 100 mL, immediately upstream of UV treatment equipment.
 - b. Fecal coliform, MPN per 100 mL, immediately downstream of UV treatment equipment.
 - c. TSS, immediately upstream of UV treatment equipment.
 - d. Percent UV transmittance (UVT) at 254 nm, immediately upstream of UV treatment equipment.
 - 4. Test for 14 continuous days, and collect and analyze samples three times in each 24-hour period.
 - 5. If sample results do not meet specified performance, retest for minimum two (2) additional consecutive days or until acceptable bacteriological results have been obtained.

D. Manufacturer Services:

1. Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than one (1) trip of four (4) days on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in maintenance of equipment.

E. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.

- F. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 46 66 56

SECTION 46 73 21 - AEROBIC DIGESTER EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Piping.
2. Valves.
3. Aeration diffusers.
4. Electrical appurtenances.
5. Floating decanters.
6. Digested sludge transfer pumps.
7. Blowers.

B. Related Requirements:

1. Section 09 96 00 – High Performance Coatings Painting requirements for equipment and components as specified in this Section.
2. Section 400506 - Couplings, Adapters, and Specials for Process Piping: Expansion joints.
3. Section 400507 - Hangers and Supports for Process Piping: Piping support requirements.
4. Section 400519 - Ductile Iron Process Pipe: Gas and sludge piping.
5. Section 400562 - Plug Valves: Plug valves as required by this Section.
6. Section 431133 – Rotary Lobe Blowers

1.2 REFERENCE STANDARDS

A. American Welding Society:

1. AWS D1.1/D1.1M - Structural Welding Code - Steel.

B. ASME International:

1. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

C. ASTM International:

1. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.

D. FM Global:

1. Product Certification and Testing.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends.

F. UL:

1. UL - Listing and Classification Marks.

1.3 PREINSTALLATION MEETINGS

- A. Section 013000 - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum two (2) weeks prior to commencing Work of this Section.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information describing materials of construction, fabrication, and protective coatings.
- C. Shop Drawings: Indicate materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and other details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions:
 1. Submit detailed instructions on installation requirements, including storage and handling procedures, anchoring, and layout.
 2. Submit installation, selection, and hookup configuration, with pipe and accessory elevations.
 3. Submit hanging and support requirements and recommendations.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
- H. Qualifications Statements:
 1. Submit qualifications for manufacturer and installer.
 2. Submit manufacturer's approval of installer.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
 - 1. Furnish one (1) set of spare parts as recommended by Manufacturer.
 - 2. Furnish a complete list of spare parts as recommended by Manufacturer.
- C. Tools: Furnish special tools and other devices required for Owner to maintain equipment.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five (5) years' experience.
- B. Installer: Company specializing in performing Work of this Section with three (3) years' experience and approved by Manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish one (1) year manufacturer's warranty for digester equipment.

PART 2 - PRODUCTS

2.1 AEROBIC DIGESTER TANK

A. Schedule:

1. Aerobic Digester No.3 (T7030)

B. Design Criteria:

1. Tank Diameter: 80 ft
2. Tank Wall Height: 20 ft
3. High Water Level: 18 ft
4. Min External Wall Thickness: 18 in
5. Min Slab Thickness: 12 in
6. Access to Top: Stairs to elevated platform

2.2 PIPING

A. Air:

1. Size: 10 in
2. Material: Stainless steel
3. End Connections: Flanged, Class 125.
4. Bolts and Nuts: Comply with ASTM A307, Grade B.

B. Sludge:

1. Pipe Size: 6 in (sludge drying beds); 4 in (digested sludge withdraw line)
2. Pipe Material: Ductile iron with P401 liner
3. As specified in Section 400519 - Ductile Iron Process Pipe.
4. Pressure Class 350.
5. End Connections: Flanged, Class 125.
6. Bolts and Nuts: Comply with ASTM A307, Grade B.

2.3 VALVES

A. Check: As specified in Section 400565.23 - Swing Check Valves.

B. Plug: As specified in Section 400562 - Plug Valves.

2.4 PIPING SPECIALTIES

A. Expansion Joints: As specified in Section 400506 - Couplings, Adapters, and Specials for Process Piping.

B. Pipe Hangers and Supports: As specified in Section 400507 - Hangers and Supports for Process Piping.

2.5 AIR DIFFUSERS

- A. Type: Coarse bubble diffusers.
- B. Manufacturers:
 - 1. SSI Aeration.
 - 2. EDI.
 - 3. Or pre-approved equal.
 - a. Specifications and equipment arrangements for the equipment referenced are based on SSI coarse bubble diffusers. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.
- C. Description:
 - 1. The diffuser scope shall include replacement of existing pipe diffusers in Digester No.2 and installation of new diffusers in new Digester No.3.
 - 2. Openings: Reseal when air is turned off, in a manner such that liquid does not flow back into air lines.
 - 3. Replaceable Module: Removable from air headers to facilitate replacement of individual diffuser.
 - 4. Air drop pipes, manifolds, and headers shall be included in the diffuser equipment package. The air drop pipe begins at approximately 6" above high water level of 725.50.
- D. Performance and Design Criteria:
 - 1. Air Flow per diffuser: 5 SCFM
 - 2. Diffuser Submergence: 18 ft
 - 3. Number of Diffusers per Tank: 352
 - 4. Diffuser Material: EPDM
 - 5. Diffuser Grid Clearance: 1.5 ft maximum from floor
 - 6. Diffuser shall close and seal automatically when air is turned off.
 - 7. Drop Pipe:
 - a. Quantity per Tank: 1
 - b. Size: 10 in
 - c. Length: ~ 20 ft; drop pipe shall start at minimum 6 in above water level
 - d. Material: 304 stainless steel
 - 8. Manifold:
 - a. Quantity per Tank: 1
 - b. Size: 10 in
 - c. Length: 78 ft; sufficient length for headers to cover whole tank
 - d. Material: PVC
 - 9. Header:
 - a. Quantity per Tank: 12
 - b. Size: 4 in
 - c. Total Length per Tank: 740 ft

- d. Material: PVC

2.6 FLOATING DECANTERS

A. Manufacturers:

- 1. Aqua-Aerobic Systems
- 2. Parkson
- 3. Fluidyne
- 4. Or Pre-Approved Equal

- a. Specifications and equipment arrangements for floating decanters are based on Aqua-Aerobic Systems floating decanter. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

B. Schedule:

- 1. Floating Decanter No.2 (FD7021)
- 2. Floating Decanter No.3 (FD7031)

- C. Description: When aeration is turned off and digested sludge settles, floating decanters shall withdraw the supernatant from top layer in digester and discharge to yard drain piping located between existing Digester No.2 and new Digester No.3.

D. Design Criteria:

- 1. Min Water Level: 13.3 ft
- 2. Max Water Level: 19 ft
- 3. Discharge Type: Hose
- 4. Discharge Size: 6 in
- 5. Capacity: 500 GPM
- 6. Weir Shape: Circular
- 7. Weir Material: 304 stainless steel
- 8. Float Shell Material: Fiber reinforced polyester (FRP)
- 9. Mooring Pylon: 2 per decanter
- 10. Mooring Pylon Diameter: 4 in
- 11. Pylon Material: Schedule 40 and galvanized steel
- 12. Base Plate Material: Galvanized steel
- 13. Floor Mounting: Adhesive anchors
- 14. Mooring Frame Material: Galvanized steel
- 15. Hose Flange Material: 304 stainless steel
- 16. Elbow Material: 304 stainless steel

E. Discharge Valve:

- 1. Floating decanter discharge shall be controlled by a manual plug valve provided by decanter Manufacturer.
- 2. Valve Size: 6 in
- 3. Plug valve shall conform to Section 40 05 62 - Plug Valves.

F. Operation:

1. Floating decanter shall withdraw supernatant from 4 – 6 in beneath liquid surface at any water level.
2. The decanting weir shall be circular and allow water to flow with no obstruction. Weir shall be constructed of stainless steel.
3. Each decanter unit shall be equipped with modular float filled with polyurethane foam. Float shall be sealed to prevent contact with ambient environment. Float shall provide sufficient buoyancy to keep decanter stable and support floatation at all time.
4. Each decanter shall include a 6” discharge hose to allow vertical movement of the unit and provide sufficient flow rate. A 90° elbow shall be provided with the decanter for wall penetration.
5. Steel mooring frame shall be provided to restrain the movement of decanter as water level rises and drops. Each decanter shall be moored with a restrained mooring system consisting of vertical pylons and supports with base plate constructed of steel. Each pylon shall be filled with concrete by Contractor.

2.7 BLOWER

- A. Existing blower for Digester No.2 shall continue service and connect to new diffuser grid.
- B. One (1) new blower shall be installed to provide mixing and aeration for new Digester No.3.
- C. Blower shall be provided in accordance with requirements in Section 43 11 33 – Rotary Lobe Blowers as part of digester equipment package by Contractor.

2.8 DIGESTED SLUDGE WITHDRAW QUICK DISCONNECT

- A. Install valves, piping, and accessories for a quick disconnect for hauler trucks to connect and withdraw digested sludge from the bottom of Digester No.2 and No.3.
- B. Accessories:
 1. Piping and fittings shall be installed on a concrete slab.
 2. Piping and fittings above finish grade shall have sufficient pipe support to stay stabilized while they are connected to a hauler truck.

2.9 FINISHES

- A. Painting: As specified in Section 09 96 00 – High Performance Coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

- B. Verify layout and orientation of equipment, accessories, and piping connections.

3.2 INSTALLATION

- A. According to manufacturer instructions and as indicated on Drawings.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Testing:
 - 1. Test for proper operation.
 - 2. Control System: Start by energizing system equipment and testing operation of hardware and process control logic under supervision of manufacturer's representative and in presence of Engineer.
- D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than two (2) days on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in operation and maintenance of equipment.
- E. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- F. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

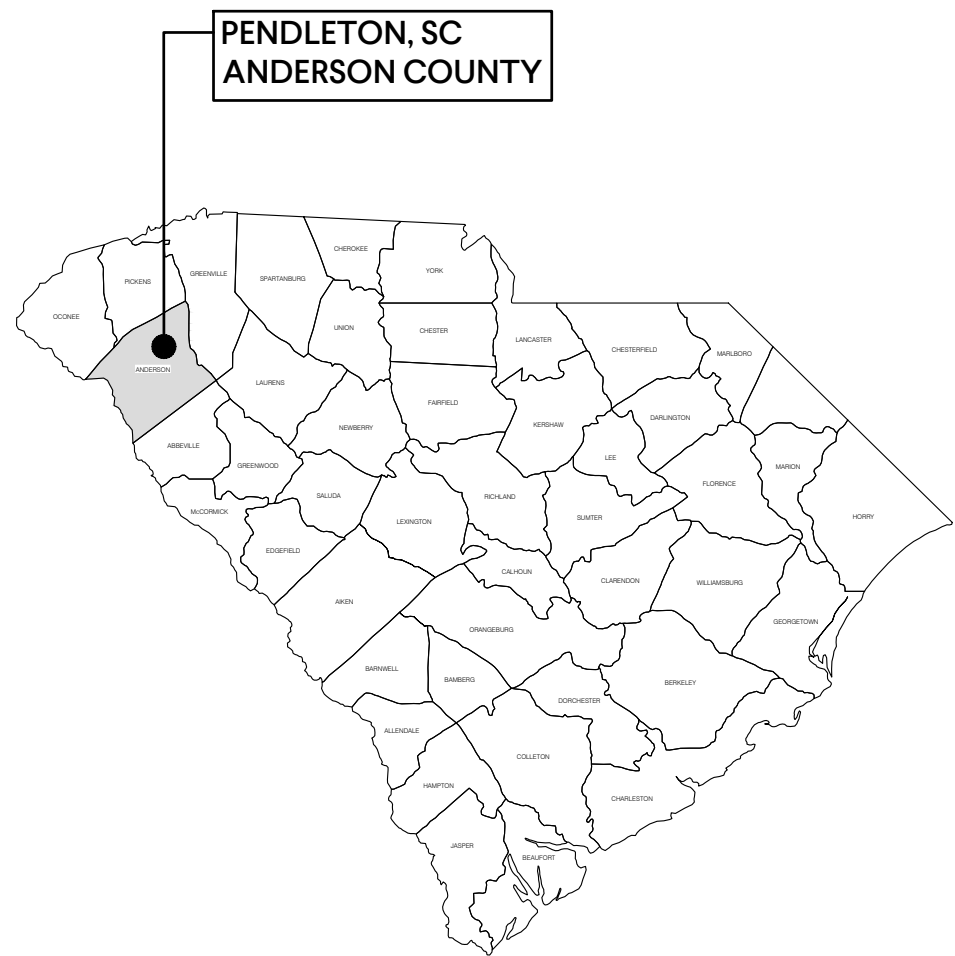
END OF SECTION 46 73 21

PENDLETON - CLEMSON REGIONAL WWTP EXPANSION



PENDLETON, SOUTH CAROLINA
GMC PROJECT #CGRE220027

Town of Pendleton
City of Clemson
Anderson County



LOCATION MAP:
STATE OF SOUTH CAROLINA



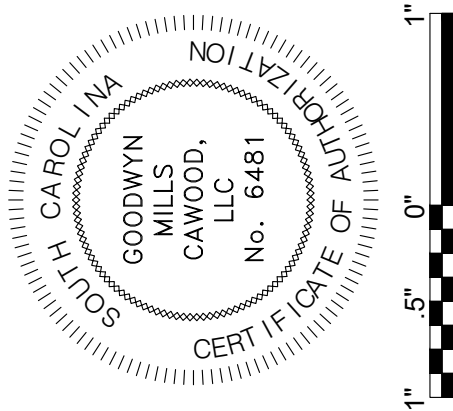
VICINITY MAP

MARCH 2024

100% DELIVERABLE

PROJECT TEAM

GOODWYN MILLS & CAWOOD, LLC	Civil, Electrical, & Process Engineering
DAY STRUCTURES	Structural Engineering



ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

TITLE SHEET

G-001

DRAWING FILE: T:\Projects\SC\Pendleton, Town of\CGREZ20027 - Pendleton-Clemson WWTP\0 DWG\CAD\01 BID DRAWINGS\01 GENERAL\G-002 INDEX.dwg
PLOTTED: Mar 12, 2024 - 8:22am

GENERAL		C-305	CIVIL SITE PLAN - ENLARGED YARD PIPING (4 OF 5)	D-101	INFLUENT PUMP STATION - LOWER PLAN	E-902	ELECTRICAL DETAILS (2 OF 3)
SHT #	SHEET TITLE	C-306	CIVIL SITE PLAN - ENLARGED YARD PIPING (5 OF 5)	D-102	INFLUENT PUMP STATION - UPPER PLAN	E-903	ELECTRICAL DETAILS (3 OF 3)
G-001	TITLE SHEET	C-601	CIVIL SITE PLAN - INITIAL EROSION CONTROL PLAN	D-103	INFLUENT PUMP STATION - SECTIONS	E-911	SWITCHGEAR ELEVATED VIEWS
G-002	DRAWING INDEX	C-602	CIVIL SITE PLAN - FINAL EROSION CONTROL PLAN	D-104	INFLUENT PUMP STATION - SECTIONS & ISOMETRIC	E-921	' MSB-A' ONE- LINE DIAGRAM
G-003	ABBREVIATIONS	C-901	CIVIL SITE PLAN - STORM DETAILS	D-111	HEADWORKS - LOWER PLAN	E-922	' MSB-B' ONE-LINE DIAGRAM
G-004	GENERAL NOTES, LEGENDS, & SYMBOLS	C-902	CIVIL SITE PLAN - EROSION CONTROL DETAILS (1 OF 2)	D-112	HEADWORKS - UPPER PLAN	E-923	EXISTING POWER DISTRIBUTION MODIFICATIONS
G-005	PROCESS FLOW DIAGRAM	C-903	CIVIL SITE PLAN - EROSION CONTROL DETAILS (2 OF 2)	D-113	HEADWORKS - SECTIONS (1 OF 5)	E-931	SWITCHGEAR SCHEDULES
G-006	EXISTING HYDRAULIC PROFILE (1 OF 2)	C-911	CIVIL DETAILS	D-114	HEADWORKS - SECTIONS (2 OF 5)	E-932	SWITCHGEAR AND SERVICE ENTRANCE FEEDER SCHEDULES
G-007	EXISTING HYDRAULIC PROFILE (2 OF 2)	DEMOLITION		D-115	HEADWORKS - SECTIONS (3 OF 5)	E-933	SHIELDED POWER SCHEDULE
G-008	NEW HYDRAULIC PROFILE (1 OF 2)	SHT #	SHEET TITLE	D-116	HEADWORKS - SECTIONS (4 OF 5)	E-934	WIRING SCHEDULE
G-009	NEW HYDRAULIC PROFILE (2 OF 2)	X-001	DEMOLITION SITE PLAN	D-117	HEADWORKS - ISOMETRICS (5 OF 5)	E-935	TCDB FEEDER AND MOTOR CIRCUIT SCHEDULE
G-010	PROCESS PIPING SCHEDULE	X-002	DEMOLITION ENLARGED SITE PLAN	D-121	EQUALIZATION BASIN - PLAN	E-936	PANELBOARD SCHEDULES (1 OF 2)
G-011	PROCESS DESIGN CRITERIA	X-101	INFLUENT PUMP STATION - PLANS	D-201	BIOLOGICAL NUTRIENT BIOREACTOR - FLOW CONTROL VALVE PLAN & SECTION	E-937	PANELBOARD SCHEDULES (2 OF 2)
G-101	GENERAL SITE PLAN CONTRACTOR'S DESIGNATED AREA	X-102	INFLUENT PUMP STATION - SECTIONS	D-301	BIOLOGICAL NUTRIENT BIOREACTOR - LOWER PLANS	E-938	LUMINAIRE AND TRANSFORMER SCHEDULES
INSTRUMENTATION		X-111	HEADWORKS STATION - PLANS	D-302	BIOLOGICAL NUTRIENT BIOREACTOR - UPPER PLANS		
SHT #	SHEET TITLE	X-112	HEADWORK STATION - SECTIONS	D-303	BIOLOGICAL NUTRIENT BIOREACTOR - ELEVATIONS		
I-001	P&ID ABBREVIATIONS, & NOTES	X-121	EQUALIZATION BASIN - PLAN	D-304	BIOLOGICAL NUTRIENT BIOREACTOR - SECTIONS		
I-002	P&ID LEGENDS	X-131	STATIONARY SCREENS - PLAN & SECTIONS	D-305	BIOLOGICAL NUTRIENT BIOREACTOR - SECTION & ELEVATIONS		
I-101	P&ID - COARSE SCREEN & INFLUENT PUMP STATION	X-301	AERATION BASIN - PLAN & SECTIONS	D-306	BIOLOGICAL NUTRIENT BIOREACTOR - ELEVATIONS		
I-111	P&ID - FINE SCREENS	X-331	RAS/WAS PUMP BUILDING - PLAN	D-311	SLUDGE BUFFER & LEVEL CORRECTION TANKS - PLAN		
I-112	P&ID - GRIT REMOVAL	X-401	CLARIFIER DISTRIBUTION BOX - PLAN & SECTION	D-312	SLUDGE BUFFER & LEVEL CORRECTION TANKS - ENLARGED PLAN & SECTIONS		
I-121	P&ID - FLOW EQUALIZATION BASINS	X-411	CLARIFIER #1 - PLAN & SECTION	D-321	BIOLOGICAL NUTRIENT BIOREACTOR BLOWERS - PLAN & SECTIONS		
I-201	P&ID - BNR FLOW CONTROL VALVE	X-412	CLARIFIER #2 - PLAN & SECTION	D-331	RAS/WAS PUMP BUILDING - PLAN		
I-301	P&ID - BIOLOGICAL NUTRIENT REMOVAL BASIN NO. 1	X-413	CLARIFIER #3 - PLAN & SECTION	D-401	POST EQUALIZATION BASIN - PLAN & SECTION		
I-302	P&ID - BIOLOGICAL NUTRIENT REMOVAL BASIN NO. 2	X-501	MIXING BASIN - PLAN & SECTION	D-402	POST EQUALIZATION BASIN - SECTION		
I-303	P&ID - BIOLOGICAL NUTRIENT REMOVAL BASIN NO. 3	X-601	DEMOLITION WEIR GATE	D-411	POST EQUALIZATION BASIN - FLOW CONTROL VAULT		
I-311	P&ID - LEVEL CORRECTION TANK	X-602	AERATION BASIN CASCADE - PLAN	D-501	FILTERS - PLAN		
I-312	P&ID - SLUDGE BUFFER TANK	X-711	SLUDGE DRYING BED - PLAN	D-502	FILTERS - SECTIONS & ELEVATIONS		
I-321	P&ID - BNR BLOWERS	STRUCTURAL		D-503	FILTERS - SECTIONS		
I-401	P&ID - POST EQUALIZATION BASIN	SHT #	SHEET TITLE	D-601	WEIR GATE - PLAN & SECTIONS		
I-501	P&ID - TERTIARY FILTER NO.1 & NO.2	S-001	STRUCTURAL NOTEAND TYPICAL DETAILS	D-602	AERATION BASIN CASCADE - PLAN		
I-502	P&ID - TERTIARY FILTER NO.3	S-002	TYPICAL DETAILS	D-701	AEROBIC DIGESTER - PLAN		
I-601	P&ID - UV DISINFECTION	S-003	SCHEDULE OF STRUCTURAL SPECIAL INSPECTIONS	D-702	AEROBIC DIGESTER - SECTIONS (1 OF 2)		
I-701	P&ID - AEROBIC DIGESTERS	S-101	INFLUENT PUMP STATION - PLAN	D-703	AEROBIC DIGESTER - SECTIONS (2 OF 2)		
I-711	P&ID - DIGESTED SLUDGE PUMPS	S-102	INFLUENT PUMP STATION - SECTIONS	D-711	SLUDGE DRYING BED - PLAN		
I-721	P&ID - SLUDGE DRYING BEDS	S-103	INFLUENT PUMP STATION - SECTIONS	D-801	REUSE WATER SYSTEMS - PLAN & SECTIONS		
I-801	P&ID - REUSE WATER SYSTEM	S-104	INFLUENT PUMP STATION - SECTIONS	D-901	PROCESS PIPE PENETRATION DETAILS		
I-901	INSTRUMENTATION DETAILS(1 OF2)	S-111	HEADWORKS - PLANS	D-902	PROCESS PIPE SUPPORT DETAILS		
I-902	INSTRUMENTATION DETAILS (2 OF 2)	S-112	HEADWORKS - SECTIONS (1 OF 4)	D-903	PROCESS PIPE SUPPORT DETAILS		
I-911	INSTRUMENTATION SCHEDULE (1 OF 2)	S-113	HEADWORKS - SECTIONS (2 OF 4)	D-904	PROCESS PIPE STRUCTURAL ATTACHMENTS DETAILS (1 OF 2)		
I-912	INSTRUMENTATION SCHEDULE (2 OF 2)	S-114	HEADWORKS - SECTIONS (3 OF 4)	D-905	PROCESS PIPE STRUCTURAL ATTACHMENTS DETAILS (2 OF 2)		
I-931	SCADA BLOCK DIAGRAM (1 OF 3)	S-115	HEADWORKS - SECTIONS (4 OF 4)	D-906	PROCESS DETAILS (1 OF 2)		
I-932	SCADA BLOCK DIAGRAM (2 OF 3)	S-501	FILTERS - PLAN	D-907	PROCESS DETAILS (2 OF 2)		
I-933	SCADA BLOCK DIAGRAM (3 OF 3)	S-502	FILTERS - SECTIONS	D-911	GATE SCHEDULE & ATTACHMENT DETAILS		
CIVIL		S-701	AEROBIC DIGESTER - PLAN	D-921	VALVE SCHEDULE (1 OF 2)		
SHT #	SHEET TITLE	S-801	MAIN ELECTRICAL BUILDING - PLAN	D-922	VALVE SCHEDULE (2 OF 2)		
C-001	CIVIL SITE PLAN - EXISTING CONDITIONS	S-802	MAIN ELECTRICAL BUILDING - PLAN	ELECTRICAL			
C-101	CIVIL SITE PLAN - GEOMETRIC CONTROLS	ARCHITECTURAL		SHT #	SHEET TITLE		
C-102	CIVIL SITE PLAN - ENLARGED GEOMETRIC CONTROLS	SHT #	SHEET TITLE	E-001	ELECTRICAL NOTES, ABBREVIATIONS, & LEGEND		
C-111	CIVIL SITE PLAN - GEOTECHNICAL EXPLORATION (1 OF 7)	A-001	ARCHITECTURAL SITE PLAN	E-002	KEY SITE PLAN		
C-112	CIVIL SITE PLAN - GEOTECHNICAL EXPLORATION (2 OF 7)	A-101	INFLUENT PUMP STATION - PLANS	E-003	SITE PLAN		
C-113	CIVIL SITE PLAN - GEOTECHNICAL EXPLORATION (3 OF 7)	A-111	HEADWORKS - PLAN	E-101	INFLUENT PUMP STATION - PLAN		
C-114	CIVIL SITE PLAN - GEOTECHNICAL EXPLORATION (4 OF 7)	A-112	HEADWORKS - ENLARGED PLANS & SECTIONS	E-111	HEADWORKS - UPPER PLAN		
C-115	CIVIL SITE PLAN - GEOTECHNICAL EXPLORATION (5 OF 7).	A-301	BIOLOGICAL NUTRIENT BIOREACTOR - PLAN	E-201	EQUALIZATION BASIN - PLAN		
C-116	CIVIL SITE PLAN - GEOTECHNICAL EXPLORATION (6 OF 7)	A-302	BIOLOGICAL NUTRIENT BIOREACTOR - ENLARGED PLANS & SECTIONS	E-301	BIOLOGIAL NUTRIENT BIOREACTOR - PLAN		
C-117	CIVIL SITE PLAN - GEOTECHNICAL EXPLORATION (7OF 7)	A-321	BIOLOGICAL NUTRIENT BIOREACTOR BLOWERS - PLANS	E-311	SLUDGE BUFFER & LEVEL CORRECTION TANKS - PLANS		
C-201	CIVIL SITE PLAN - OVERALL GRADING	A-501	FILTERS - PLANS	E-401	POST EQUALIZATION BASIN - PLAN		
C-202	CIVIL SITE PLAN GRADING - INFLUENT PUMP STATION	A-502	FILTERS - ENLARGED PLAN & SECTIONS	E-441	RAS/WAS PUMP BUILDING - DEMOLITION PLAN		
C-203	CIVIL SITE PLAN GRADING - HEADWORKS	A-701	AEROBIC DIGESTER - PLAN	E-442	RAS/WAS PUMP BUILDING - PLAN		
C-204	CIVIL SITE PLAN GRADING- FILTERS	A-801	MAIN ELECTRICAL BUILDING - PLANS	E-501	UV DISINFECTION - PLAN		
C-205	CIVIL SITE PLAN GRADING - BIOLOGICAL NUTRIENT BIOREACTOR AND AEROBIC DIGESTER	A-802	MAIN ELECTRICAL BUILDING - EXTERIOR ELEVATIONS	E-611	MAIN ELECTRICAL BUILDING 'EB-1' PLAN		
C-301	CIVIL SITE PLAN - YARD PIPING	A-803	MAIN ELECTRICAL BUILDING - WALL SECTIONS	E-612	MAIN ELECTRICAL BUILDING 'EB-1' - CABLE TRAY PLAN		
C-302	CIVIL SITE PLAN - ENLARGED YARD PIPING (1 OF 5)	A-804	MAIN ELECTRICAL BUILDING - SCHEDULE	E-621	PROCESS ELECTRICAL BUILDING 'EB-2' - PLAN		
C-303	CIVIL SITE PLAN - ENLARGED YARD PIPING (2 OF 5)	PROCESS		E-622	PROCESS ELECTRICAL BUILDING 'EB-2' - CABLE TRAY PLAN		
C-304	CIVIL SITE PLAN - ENLARGED YARD PIPING (3 OF 5)	SHT #	SHEET TITLE	E-701	AEROBIC DIGESTER - PLAN		
		D-001	PROCESS SITE PLAN	E-901	ELECTRICAL DETAILS (1 OF 3)		

DRAWING INDEX

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

G-002

GMC PROJECT #CGRE220027

30% Submittal
01.18.2023
60% Submittal
08.07.2023
90% Submittal
12.04.2023
100% Submittal
03.08.2024
Conformed Set
Project Manager:
Engineer:
Designer:
Drawn By:

ISSUE DATE

01.18.2023
08.07.2023
12.04.2023
03.08.2024
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GMC

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COMMON ABBREVIATIONS

A	AIR	DISTR	DISTRIBUTION	HORIZ	HORIZONTAL	NTS	NOT TO SCALE	RPBP	REDUCED PRESSURE BACKFLOW PREVENTER	ULT	ULTIMATE
AB	ANCHOR BOLT	DL	DEAD LOAD	HP	HORSEPOWER	OC	ON CENTER	RPM	REVOLUTIONS PER MINUTE	UN	UNION
AC	AIR CONDITIONING	DMJ	DUCTILE MECHANICAL JOINT	HR	HOUR	OD	OUTSIDE DIAMETER	RR	RAILROAD	UNGD	UNDERGROUND
ACP	ASPHALTIC CONCRETE PAVING	DN	DOWN	HS	HIGH STRENGTH	OF	OUTSIDE FACE OR OVERFLOW	RTN	RETURN	VB	VALVE BOX
ADDL	ADDITIONAL	DS	DOWN SPOUT	HVAC	HEATING, VENTILATION, AIR CONDITIONING	OPNG	OPENING	RWW	RAW WASTE WATER	VCP	VITRIFIED CLAY PIPE
ADDM	ADDENDUM	DWG	DRAWING	HW	HOT WATER	OPP	OPPOSITE	SALV	SALVAGE	VERT	VERTICAL
ADJ	ADJUSTABLE	EA	EACH	HWL	HIGH WATER LEVEL	OPT	OPTIONAL	SCFM	STANDARD CUBIC FEET PER MINUTE	VP	VENT PIPE
AFF	ABOVE FINISHED FLOOR	ECC	ECCENTRIC	HWY	HIGHWAY	PC	POINT OF CURVE OF PORTLAND CEMENT	SCH	SCHEDULE	VTR	VENT THROUGH ROOF
AFS	AIR FLOW SWITCH	EF	EACH FACE OR ELECTRICAL FAN	HYD	HYDRANT	P&C	PIN AND CAP	SCN	SCREENINGS	W/	WITH
AHU	AIR HANDLING UNIT	EJ	EXPANSION JOINT	ID	INSIDE DIAMETER	PCO	PRESSURE CLEAN OUT	SDR	STANDARD DIMENSION RATIO	W/O	WITHOUT
AL	ALUMINUM	EL	ELEVATION	IF	INSIDE FACE	PCP	PROGRESSIVE CAVITY PUMP	SE	SECONDARY EFFLUENT	WAS	WASTE ACTIVATED SLUDGE
ALT	ALTERNATE	ELEC	ELECTRICAL	INCL	INCLUDED	PCR	POINT OF CURVE RETURN	SECT	SECTION	WC	WATER CLOSET
APPROX	APPROXIMATE	ENGR	ENGINEER	INCR	INCREASER	PE	PLAIN END	SHLDR	SHOULDER	WCO	WALL CLEANOUT
ARCH	ARCHITECT(URAL)	EOA	EDGE OF ASPHALT	INF	INFLUENT	PERM	PERMANENT	SHT	SHEET	WD	WIDTH OR WOOD
ARV	AIR RELIEF VALVE	EOP	EDGE OF PAVEMENT	INSTL	INSTALLATION	PERP	PERPENDICULAR	SIM	SIMILAR	WDW	WINDOW
ASME	AMERICAN SOCIETY MECHANICAL ENGINEERS	EQ	EQUAL	INSTR	INSTRUMENT	PI	POINT OF INTERSECTION	SOTE	STANDARD OXYGEN TRANSFER EFFICIENCY	WF	WIDE FLANGE
ASPH	ASPHALT	EQUIP	EQUIPMENT	INSUL	INSULATION	PL	PLATE OR PROPERTY LINE	SP	SPACE (ING)	WH	WALL HYDRANT
ASSY	ASSEMBLY	EQUIV	EQUIVALENT	INV	INVERT	PLBG	PLUMBING	SPEC	SPECIFICATION	WL	WIND LOAD
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS	ESMT	EASEMENT	INT	INTERIOR	PLYWD	PLYWOOD	SQ	SQUARE	WP	WEIR PLATE
ATM	ATMOSPHERE	EST	ESTIMATE	INV EL	INVERT ELEVATION	PNT	PAINT	SQ FT	SQUARE FOOT	WS	WETTED SURFACE
ATS	AUTOMATIC TRANSFER SWITCH	EUH	ELECTRIC UNIT HEATER	ISA	INSTRUMENT SOCIETY OF AMERICA	POC	POINT ON VERTICAL CURVE	SQ IN	SQUARE INCH	WT	WEIGHT
AUTO	AUTOMATIC	EW	EACH WAY	JST	JOIST	POLY	POLYETHYLENE	SQ YD	SQUARE YARD	WWF	WELDED WIRE FABRIC
AVS	AUTOMATIC VALVE STATION	EWS	EQUIPMENT WATER STATION	JTS	JOINTS	PPM	PARTS PER MILLION	SRT	SOLIDS RETENTION TIME	WWTP	WASTEWATER TREATMENT PLANT
AWG	AMERICAN WIRE GAGE	EXP JT	EXPANSION JOINT	KO	KNOCKOUT	PREFAB	PREFABRICATED	SST	STAINLESS STEEL	X SECT	CROSS SECTION
BE	BELL END	EXST	EXISTING	KWY	KEYWAY	PREFIN	PREFINISHED	SST BT	STAINLESS STEEL BOLT	XMR	TRANSFORMER
BF	BOTTOM FACE	EXST GR	EXISTING GRADE	L	LEFT OR LITER	PRELIM	PRELIMINARY	ST	STREET	YCO	YARD CLEANOUT
BFD	BUTTERFLY DAMPER	EXT	EXTERIOR	LAB	LABORATORY	PREP	PREPARATION	STA	STATION	YH	YARD HYDRANT
BFV	BUTTERFLY VALVE	F/F	FACE TO FACE	LAV	LAVATORY	PROJ	PROJECT	STD	STANDARD		
BLDG	BUILDING	FA	FOUL AIR	LB(S)	POUND(S)	PROP	PROPERTY	STL	STEEL		
BLK	BLOCK	FAD	FOUL AIR DUCT	LEL	LOW EXPLOSIVE LIMIT	PRS	PRESSURE REDUCING STATION	STL JST	STEEL JOIST		
BLM	BUREAU OF LAND MANAGEMENT	FCA	FLANGE COUPLING ADAPTER	LF	LINEAR FOOT	PRV	PRESS. REDUCING VALVE OR PRESS. RELIEF VALVE	STL PL	STEEL PLATE		
BM	BENCH MARK	FCS	FLUSH CONTROL STATION	LL	LIVE LOAD OR LOOSE LINTEL	PS	PIPE SUPPORT	STRUCT	STRUCTURAL		
BOD	BIOCHEMICAL OXYGEN DEMAND	FD	FLOOR DRAIN	LOC	LOCATION	PSF	POUNDS PER SQUARE FOOT	SN	SUPERNATANT		
BOT	BOTTOM	FDN	FOUNDATION	LP	LOW PRESSURE OR LIGHT POLE	PSI	POUNDS PER SQUARE INCH	SV	SOLENOID VALVE		
BU	BELL UP	FES	FLARED END SECTION	LR	LONG RADIUS	PSIA	POUNDS PER SQUARE INCH ABSOLUTE	SVC	SERVICE		
BV	BALL VALVE	FF EL	FINISH FLOOR ELEVATION	LS	LICENSED SURVEYOR	PSIG	POUNDS PER SQUARE INCH GAGE	SWD	SIDE WATER DEPTH		
C/C	CENTER TO CENTER	FH	FIRE HYDRANT	LT	LIGHT	PSV	PRESSURE SUSTAINING VALVE	SYMM	SYMMETRICAL		
CCP	CONCRETE CYLINDER PIPE	FIN	FINISH	LT WT	LIGHTWEIGHT	PT	POINT OR POINT OF TANGENCY	SYS	SYSTEM		
CCW	COUNTER CLOCKWISE	FIN FL	FINISH FLOOR	LWL	LOW WATER LEVEL	PV	PLUG VALVE	T&B	TOP AND BOTTOM		
CFM	CUBIC FEET PER MINUTE	FIN GR	FINISH GRADE	MAINT	MAINTENANCE	PVC	POLYVINYL CHLORIDE OR POINT OF VERTICAL CURVE	T&G	TONGUE AND GROOVE		
CHKV	CHECK VALVE	FL	FLANGE	MAN	MANUAL	PVG	PAVING	T&P	TEMPERATURE AND PRESSURE		
CIP	CAST IRON PIPE	FLR	FLOOR	MATL	MATERIAL	PVI	POINT OF VERTICAL CURVE INTERSECTION	T	TEE		
CISP	CAST IRON SOIL PIPE	FPM	FEET PER MINUTE	MAX	MAXIMUM	PVMT	PAVEMENT	TB	TOP OF BEAM		
CJ	CONSTRUCTION JOINT	FPS	FEET PER SECOND	MCC	MOTOR CONTROL CENTER	Q AVG	AVERAGE DAILY FLOW	TBM	TEMPORARY BENCH MARK		
CL	CENTER LINE OR CHAIN LINK	FRP	FIBERGLASS REINFORCED PLASTIC	MECH	MECHANICAL	Q MAX	MAXIMUM DAILY FLOW	TE	TOP ELEVATION		
CLR	CLEAR	FT	FEET	MED	MEDIUM	Q PEAK	PEAK HOUR FLOW	TEMP	TEMPORARY		
CMP	CORRUGATED METAL PIPE	FTG	FOOTING OR FITTING	MFM	MAGNETIC FLOW METER	QTR	QUARTER	TFA	TO FLOOR ABOVE		
CMU	CONCRETE MASONRY UNIT	G	GAS	MFR	MANUFACTURER	QTY	QUANTITY	TFB	TO FLOOR BELOW		
CO	CLEAN OUT	GA	GAUGE	MG	MILLION GALLONS OR MILLIGRAMS	RAD	RADIUS	TFE	TOP OF FINISH FLOOW		
CONC	CONCRETE	GAL	GALLON	MGD	MILLION GALLONS PER DAY	RC	REINFORCED CONCRETE	TH	TEST HOLE		
CONN	CONNECTION	GALV	GALVANIZED	MGMT	MANAGEMENT	RCP	REINFORCED CONCRETE PIPE	THD	THREAD (ED)		
CONSTR	CONSTRUCTION	GND	GROUND	MH	MANHOLE	RD	ROOF DRAIN	THK	THICK		
CONT	CONTINUOUS(ATION)	GPD	GALLONS PER DAY	MIN	MINIMUM	RECT	RECTANGULAR	TJ	TOP OF JOIST		
COR	CORNER	GPM	GALONS PER MINUTE	MISC	MISCELLANEOUS	RED	REDUCER	TOA	TOP OF ASPHALT		
CPLG	COUPLING	GR	GRIT	MJ	MECHANICAL JOINT	RE:	REFER TO	TOC	TOP OF CONCRETE OR TOP OF CURB		
CPVC	CHLORINATED POLYVINYL CHLORIDE	GRC	GALVANIZED RIGID CONDUIT	ML	MIXED LIQUOR	REF	REFERENCE	TOE	THREADED ONE END		
CTR	CENTER	GSP	GALVANIZED STEEL PIPE	MNPT	MALE NATIONAL PIPE THREAD	REHAB	REHABILITATION	TOF	TOP OF FOOTING		
CV	CHECK VALVE	GV	GATE VALVE	MO	MASONRY OPENING	REINF	REINFORCE (D) (ING) (MENT)	TOS	TOP OF STEEL		
CW	COLD WATER	GW	GROUNDWATER	MRGB	MOISTURE RESISTANT GYPSUM WALL BOARD	REQD	REQUIRED	TOW	TOP OF WALL		
CY	CUBIC YARDS	GWB	GYPSUM WALL BOARD	MTG	MOUNTING	RESIL	RESILIENT	TP	TOP OF PAVEMENT		
DBIO	DEWATERED BIOSOLIDS	GYP	GYPSUM	NA	NOT APPLICABLE	RFCA	RESTRAINED FLANGED COUPLING ADAPTER	TSL	TOP OF SLAB		
DEMO	DEMOLITION	HB	HOSE BIBB	NIC	NOT IN CONTRACT	RH	RIGHT HAND	TSS	TOTAL SUSPENDED SOLIDS		
DIA	DIAMETER	HDWL	HEADWALL	NPL	NAMEPLATE	RM	ROOM	TYP	TYPICAL		
DIM	DIMENSION	HNDRL	HAND RAIL	NPT	NATIONAL PIPE THREAD	RO	ROUGH OPENING	UBC	UNIFORM BUILDING CODE		
DIP	DUCTILE IRON PIPE	HNDWL	HAND WHEEL	NRS	NON-RISING STEM	ROW	RIGHT OF WAY	UGE	UNDERGROUND ELECTRIC		

ABBREVIATIONS

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION

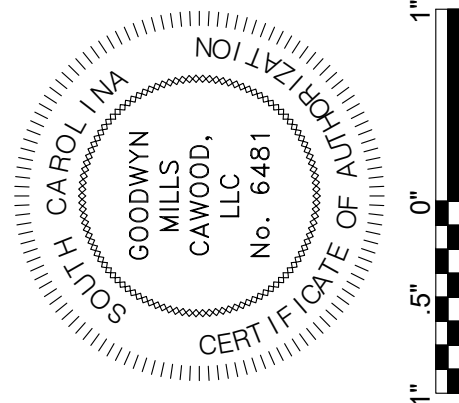
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

G-003

GMC PROJECT #CGRE220027

ISSUE DATE

30% Submittal	01/18/2023	CA POL I/A
60% Submittal	08/07/2023	GOODWYN MILLS CAWOOD, LLC No. 6481
90% Submittal	12/04/2023	NOI LZ21 30101
100% Submittal	03/08/2024	CERT IF DATE OF ADOPT
Conformed Set		
Project Manager:	WN	
Engineer:	TR	
Designer:	JX	
Drawn By:	HKD	

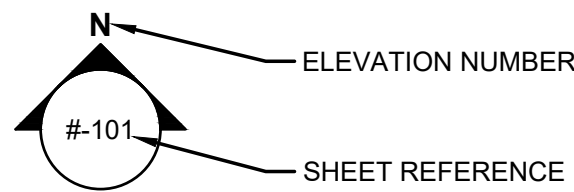


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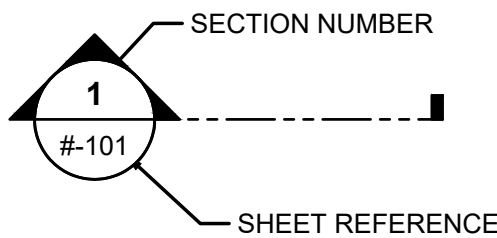
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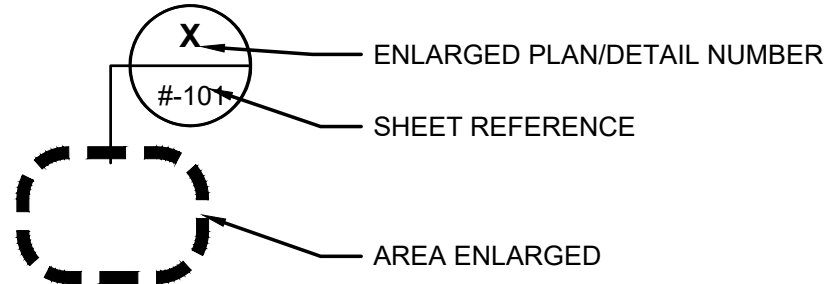
ELEVATION INDICATOR



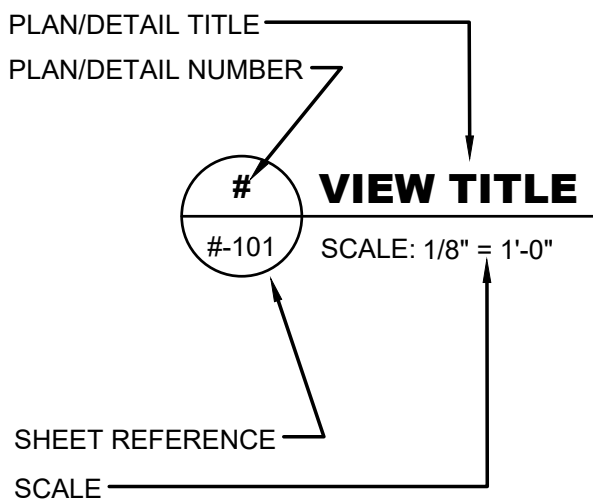
SECTION INDICATOR



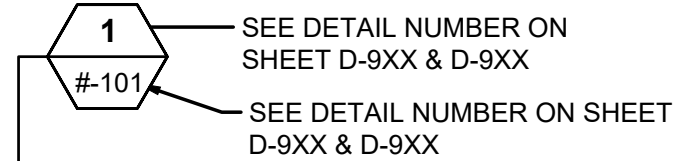
ENLARGED PLAN/DETAIL INDICATOR



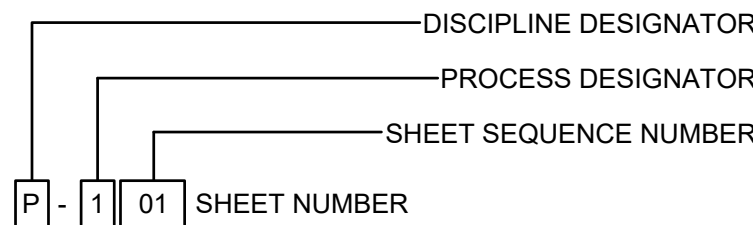
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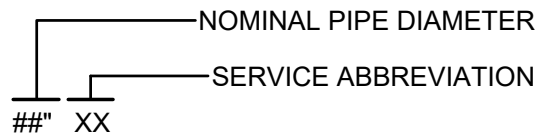
PIPE SUPPORT INDICATOR



SHEET NUMBERING



PIPE LINE IDENTIFICATION



PROCESS DESIGNATORS

PROCESS SHEETS (WASTEWATER)	DESIGNATOR
NOTES, LEGEND, ABBREVIATIONS, DEMOLITION, EXISTING CONDITIONS, ETC.	0
PRELIMINARY TREATMENT	1
PRIMARY TREATMENT	2
BIOLOGICAL TREATMENT	3
SECONDARY TREATMENT	4
TERTIARY TREATMENT	5
DISINFECTION AND EFFLUENT PUMPING	6
SLUDGE STORAGE AND PROCESSING	7
MISCELLANEOUS SYSTEMS	8
DETAILS / SCHEDULES	9

CIVIL DESIGNATORS

CIVIL	DESIGNATOR
NOTES, LEGEND, ABBREVIATIONS, DEMOLITION, EXISTING CONDITIONS, ETC.	0
SITE PLAN AND GEOMETRIC CONTROLS	1
GRADING AND DRAINAGE	2
UTILITIES/YARD PIPING	3
ROAD PLAN AND PROFILES (IF REQUIRED)	4
ROAD CROSS SECTIONS (IF REQUIRED)	5
SEDIMENT AND EROSION CONTROL	6
RESERVED	7
RESERVED	8
DETAILS / SCHEDULES	9

OWNER

DESCRIPTION	NAME	PHONE NUMBER	EMAIL ADDRESS
EXECUTIVE DIRECTOR			
SYSTEM ENGINEER			
OPERATOR			
INSPECTOR			

CONTRACTOR

DESCRIPTION	NAME	PHONE NUMBER	EMAIL ADDRESS
PROJECT MANAGER			
SUPERINTENDENT			

ENGINEER

DESCRIPTION	NAME	PHONE NUMBER	EMAIL ADDRESS
PROJECT MANAGER			
ENGINEER			
INSPECTOR			

PIPE SYMBOLS

DESCRIPTION	SINGLE LINE	DOUBLE LINE
EXISTING BURIED PIPE		
EXISTING ABOVE GRADE PIPE		
NEW BURIED PIPE		
NEW ABOVE GRADE PIPE		
WELDED JOINT		
FLANGED JOINT		
FLANGED ADAPTOR		
FLANGED COUPLING		
MECHANICAL JOINT		
JOINT		
EXPANSION JOINT		

HATCHING LEGEND

DESCRIPTION	EXISTING	PROPOSED
ASPHALT PAVING (PLAN)		
ALUMINUM GRATING		
CONCRETE (ELEVATION)		
CONCRETE (PLAN)		
CONCRETE (SECTION)		
CRUSHED STONE (SECTION)		
EARTH OR BACKFILL (SECTION)		
GRAVEL DRIVE (PLAN)		
GROUT FILL (PLAN & SECTION)		
LAKE, RIVER OR POND (PLAN)		
REMOVAL OR DEMOLITION (PLAN & SECTION)		
UNPAVED DRIVE (PLAN)		

DISCIPLINE DESIGNATORS

DISCIPLINE	DESIGNATOR
GENERAL	G
HAZARDOUS MATERIALS	H
INSTRUMENTATION	I
DEMOLITION	X
SURVEY/MAPPING	V
GEOTECHNICAL	B
CIVIL	C
LANDSCAPE	L
STRUCTURAL	S
ARCHITECTURAL	A
FIRE PROTECTION	F
MECHANICAL	M
PLUMBING	M
PROCESS	D
ELECTRICAL	E

GENERAL NOTES

- THE CONTRACTOR IS EXPECTED TO CAREFULLY EXAMINE THE PLANS, PROPOSAL AND SITE OF THE WORK. THEREFORE, IT WILL BE ASSUMED THAT THE BIDDER HAS SATISFIED HIMSELF AS TO THE CONDITIONS TO BE ENCOUNTERED IN REGARDS TO THE CHARACTER, QUALITY, AND QUANTITIES OF WORK TO BE PERFORMED AND MATERIALS TO BE FURNISHED, AND AS TO THE REQUIREMENTS OF THE PLANS, SPECIFICATIONS, SPECIAL PROVISIONS AND CONTRACT. THE SUBMISSION OF A PROPOSAL BY A BIDDER WILL BE CONSIDERED PRIMA FACIE EVIDENCE THAT THE BIDDER HAS MADE SUCH AN EXAMINATION.
- THE CONTRACTOR IS REQUIRED TO MAINTAIN AN AS-BUILT SET OF DRAWINGS DURING PROJECT CONSTRUCTION. THE COMPLETE AS-BUILT MAP WILL CONTAIN ALL INSTALLED ELECTRICAL, STRUCTURAL ENTITIES, LINES, VALVES, METERS, AND CONNECTIONS WITH REFERENCE DISTANCES TO PERMANENT ABOVE GROUND STRUCTURES.
- ALL EXISTING UTILITIES SHOWN ABOVE AND BELOW GROUND ARE APPROXIMATE AND ARE NOT NECESSARILY ALL THAT EXIST. THE DETERMINATION OF THE EXISTENCE, LOCATION, AND DEPTH OF ALL UTILITIES SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
- ALL MATERIALS AND WORKMANSHIP SHALL BE GUARANTEED BY CONTRACTOR FOR ONE YEAR AFTER ACCEPTANCE BY THE OWNER PER SPECIFICATION 1030.
- IN THE EVENT THAT THERE IS A DISCREPANCY BETWEEN THE CIVIL DRAWINGS AND THE ARCHITECTURAL/STRUCTURAL DRAWINGS, THE ARCHITECTURAL/STRUCTURAL DRAWINGS SHALL HAVE PRECEDENCE. THE CONTRACTOR SHALL ADVISE THE ENGINEER OF ANY CONFLICT IN THE PLANS/SPECS FOR CLARIFICATION PRIOR TO BID. SHOULD CONFLICTING DOCUMENTS NOT BE CLARIFIED AT THE REQUEST OF THE BIDDING CONTRACTOR, THE MORE COSTLY ALTERNATIVE AS IDENTIFIED IN THE PLAN & SPECS SHALL BE INCLUDED IN THE PRICE BID.
- ALL HAZARDOUS SUBSTANCES USED FOR THIS PROJECT, INCLUDING, BUT NOT LIMITED TO, PAINT, OIL, GREASE, AND OTHER PETROLEUM PRODUCTS SHALL BE STORED IN ACCORDANCE WITH "SPILL PREVENTION, CONTROL & COUNTERMEASURE" REGULATIONS. THESE SUBSTANCES SHALL BE STORED AWAY FROM STORM DRAINS, DITCHES, AND GUTTERS IN WATERTIGHT CONTAINERS. DISPOSAL OF THESE SUBSTANCES SHALL BE IN ACCORDANCE WITH STATE & FEDERAL AGENCY REGULATIONS. CONTRACTOR SHALL PROVIDE ADEQUATE TRASH CONTAINERS ON SITE FOR THE DISPOSAL OF CONSTRUCTION MATERIALS WASTE. CONTRACTOR SHALL BE RESPONSIBLE FOR PREVENTING ANY TRASH OR OTHER POLLUTANTS FROM ENTERING STORM DRAINS & WATERS OF THE STATE.

GENERAL NOTES,
LEGENDS, & SYMBOLS

G-004

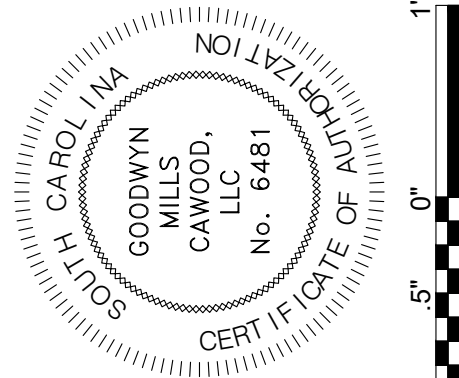
PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION

PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

ISSUE DATE

30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
100% Submittal	03/08/2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD



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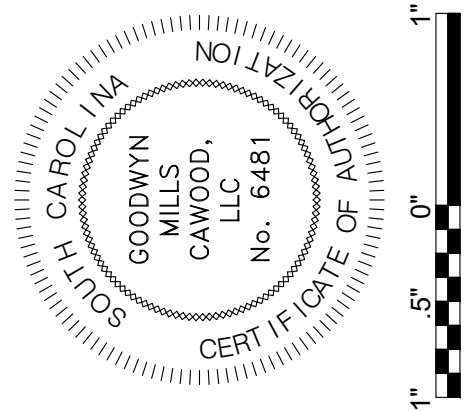
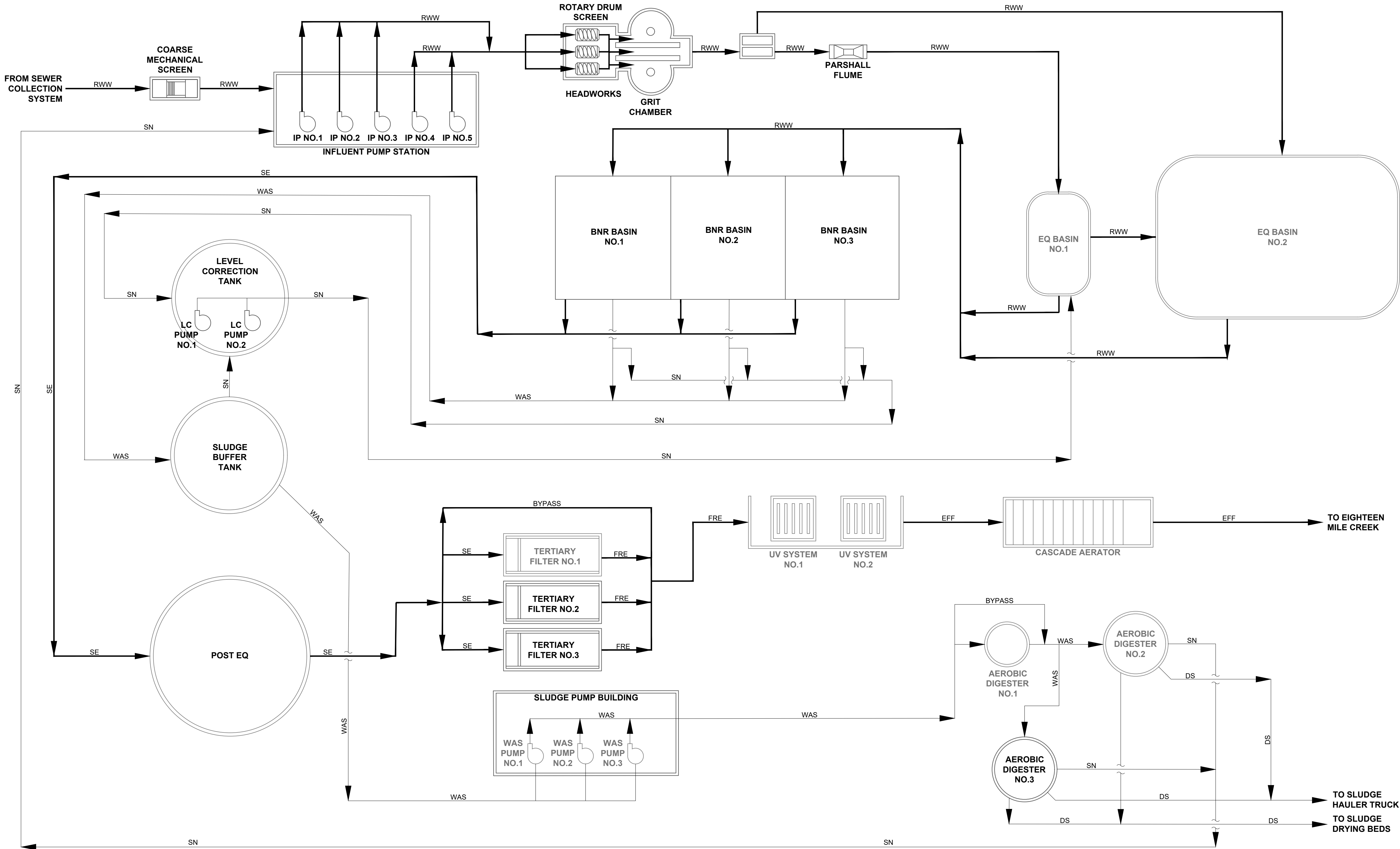
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PLOTTED: Mar 12, 2024 - 8:22am

FLOWS								
DESIGN FLOW	TREATMENT PROCESS	COARSE MECHANICAL SCREEN	INFLUENT PUMP STATION	ROTARY DRUM SCREENS	VORTEX GRIT CHAMBERS	INFLUENT PARSHALL FLUME	BNR BASINS	TERTIARY FILTERS
MAX MONTHLY FLOW (MGD)		-	-	-	-	-	5.0	-
MAX DAILY FLOW (MGD)		-	-	-	-	-	-	-
PEAK HOURLY FLOW (MGD)		15.0	15.0	15.0	15.0	15.0	-	12.0
								14.0

FLOW LINES	
	NEW PRIMARY FLOW PATH
	EXISTING PRIMARY FLOW PATH
	NEW SECONDARY FLOW PATH
	EXISTING SECONDARY FLOW PATH

PROCESS FLOW DIAGRAM NOTES:

- EQUIPMENT ARRANGEMENTS ARE BASED ON THE EQUIPMENT BASIS OF DESIGN IN THE SPECIFICATIONS. CHANGES TO THE LISTED BASIS OF DESIGN RESULTING IN DIFFERENCES OF THE SHOWN ARRANGEMENT SHALL BE THE CONTRACTORS RESPONSIBILITY. NO PAYMENT WILL BE ISSUED TO THE CONTRACTOR FOR MODIFICATIONS.
- THE CONFIGURATION SHOWN ON THE PROCESS FLOW SCHEMATIC SHALL NOT BE USED FOR CONSTRUCTION BECAUSE THE LAYOUT IN THE PROCESS FLOW DIAGRAM IS NOT TO SCALE AND IS NOT REPRESENTATIVE OF THE ACTUAL FIELD LAYOUT.



ISSUE	DATE
30% Submittal	01.18.2023
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90% Submittal	12.04.2023
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PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
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Anderson County

GMC PROJECT #CGRE220027

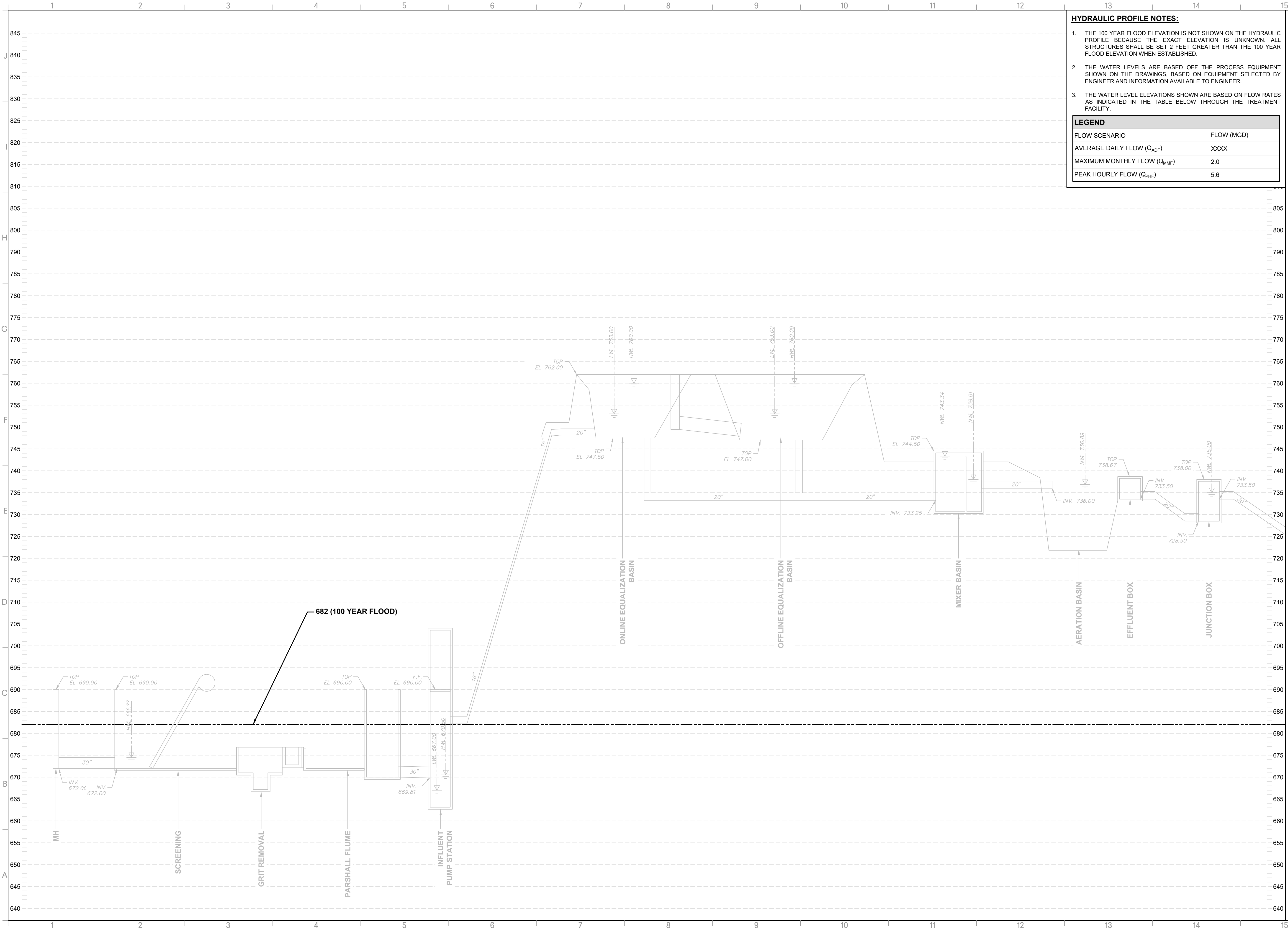
PROCESS FLOW
DIAGRAM

G-005

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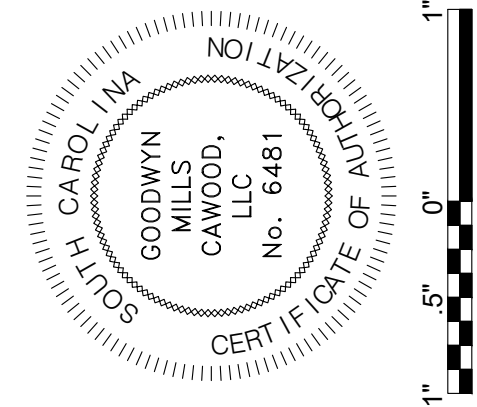


HYDRAULIC PROFILE NOTES:

1. THE 100 YEAR FLOOD ELEVATION IS NOT SHOWN ON THE HYDRAULIC PROFILE BECAUSE THE EXACT ELEVATION IS UNKNOWN. ALL STRUCTURES SHALL BE SET 2 FEET GREATER THAN THE 100 YEAR FLOOD ELEVATION WHEN ESTABLISHED.
2. THE WATER LEVELS ARE BASED OFF THE PROCESS EQUIPMENT SHOWN ON THE DRAWINGS, BASED ON EQUIPMENT SELECTED BY ENGINEER AND INFORMATION AVAILABLE TO ENGINEER.
3. THE WATER LEVEL ELEVATIONS SHOWN ARE BASED ON FLOW RATES AS INDICATED IN THE TABLE BELOW THROUGH THE TREATMENT FACILITY.

LEGEND

FLOW SCENARIO	FLOW (MGD)
AVERAGE DAILY FLOW (Q_{ADF})	XXXX
MAXIMUM MONTHLY FLOW (Q_{MMF})	2.0
PEAK HOURLY FLOW (Q_{PHF})	5.6



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PENDLETON - CLEMSON
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PENDLETON, SOUTH CAROLINA
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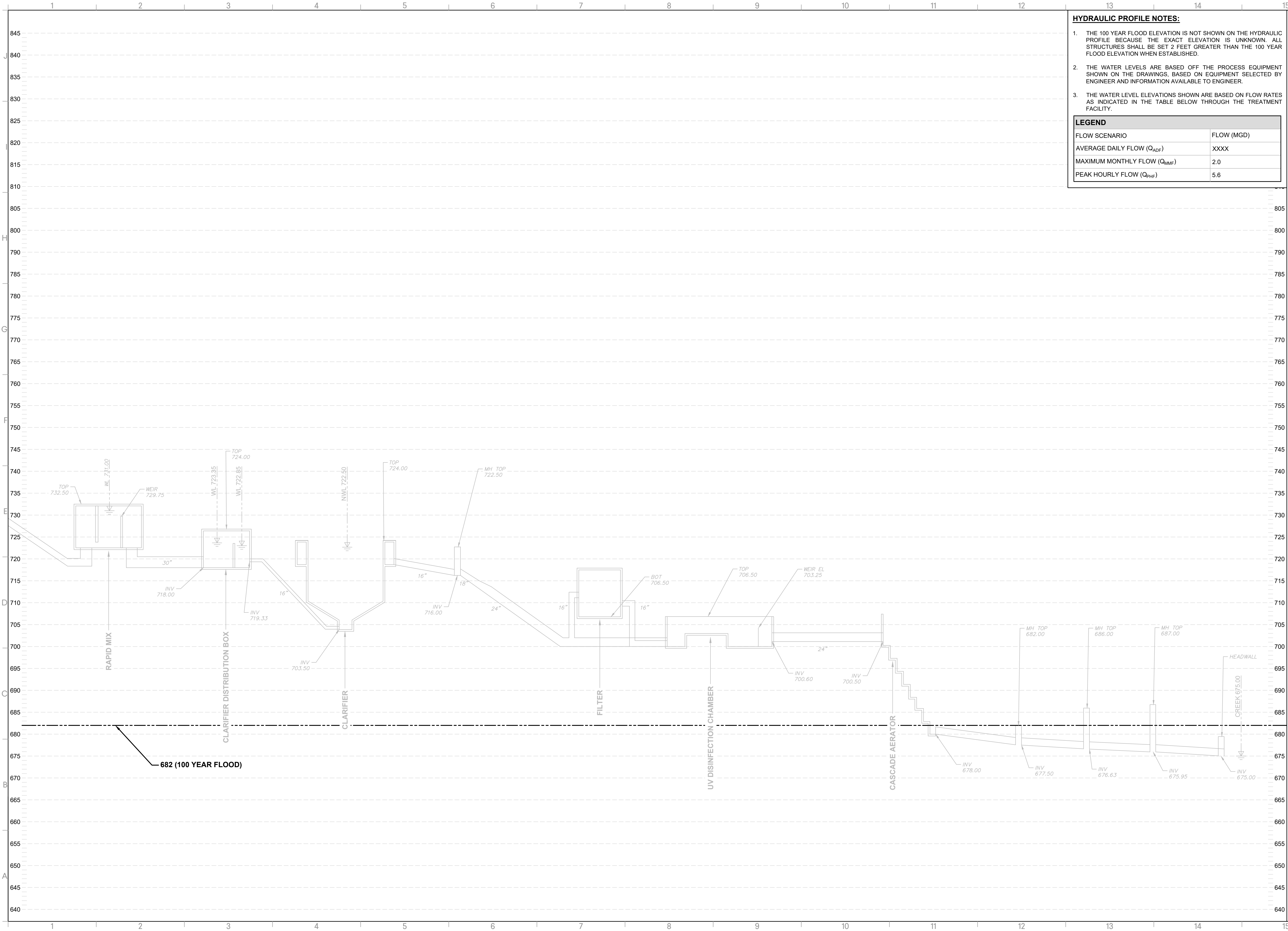
EXISTING HYDRAULIC
PROFILE (1 OF 2)

G-006

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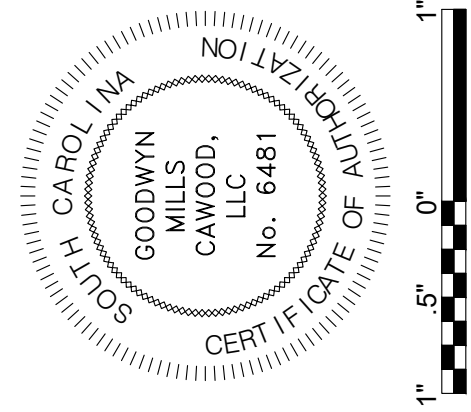


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3. THE WATER LEVEL ELEVATIONS SHOWN ARE BASED ON FLOW RATES AS INDICATED IN THE TABLE BELOW THROUGH THE TREATMENT FACILITY.

LEGEND

FLOW SCENARIO	FLOW (MGD)
AVERAGE DAILY FLOW (Q_{ADF})	XXXX
MAXIMUM MONTHLY FLOW (Q_{MMF})	2.0
PEAK HOURLY FLOW (Q_{PHF})	5.6



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100% Submittal	03.08.2024
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PENDLETON - CLEMSON
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PENDLETON, SOUTH CAROLINA
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City of Clemson
Anderson County

GMC PROJECT #CGRE220027

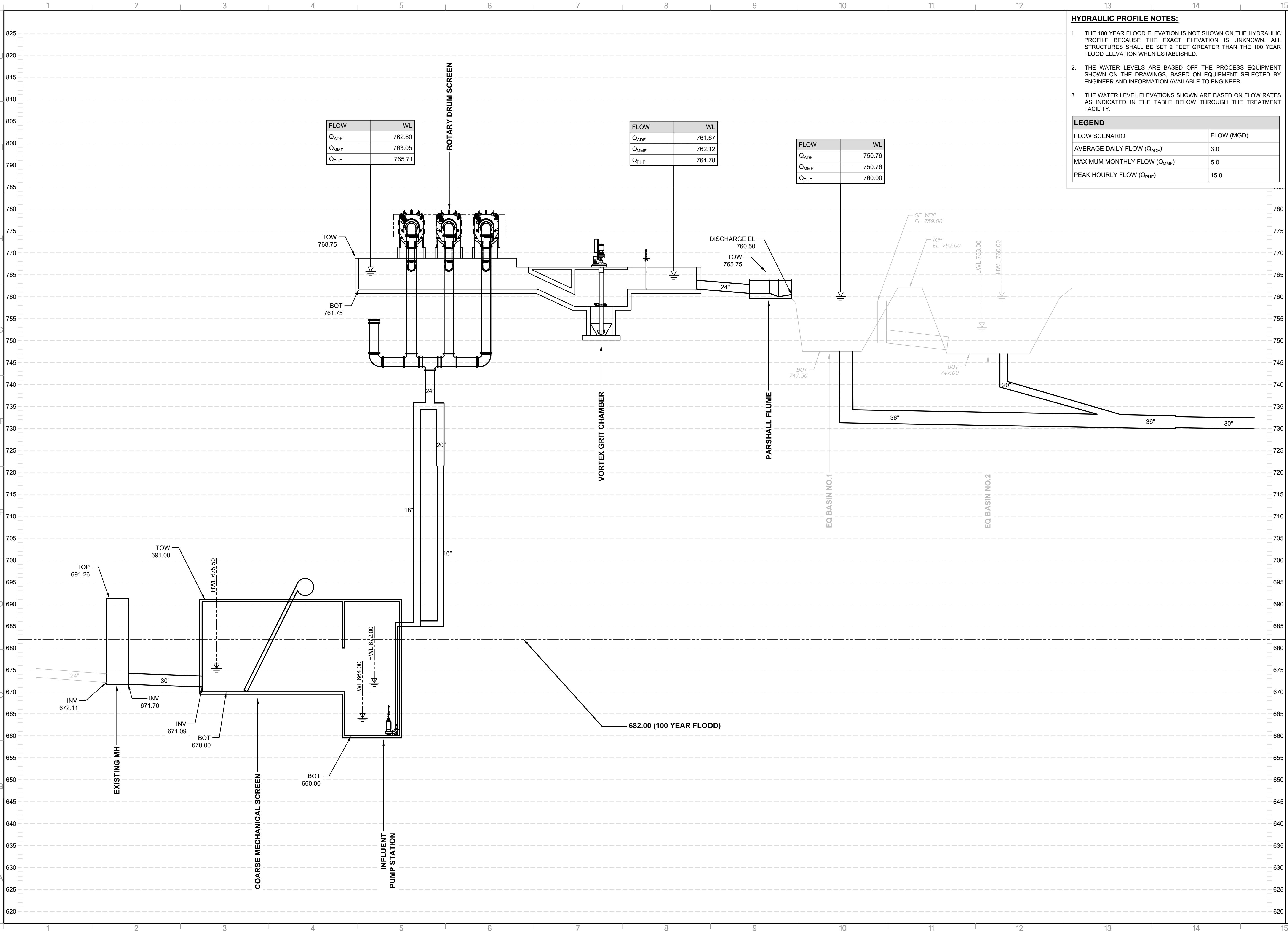
EXISTING HYDRAULIC
PROFILE (2 OF 2)

G-007

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PLOTTED: Mar 12, 2024 - 8:22am

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NEW HYDRAULIC
PROFILE (1 OF 2)

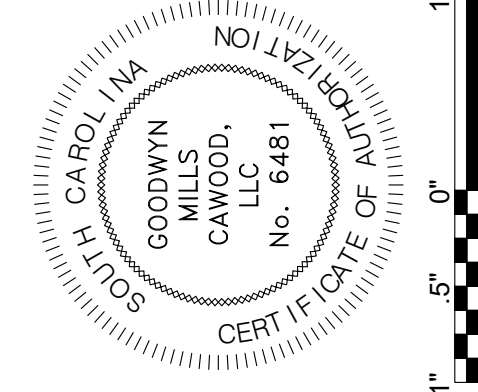
G-008

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION

PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

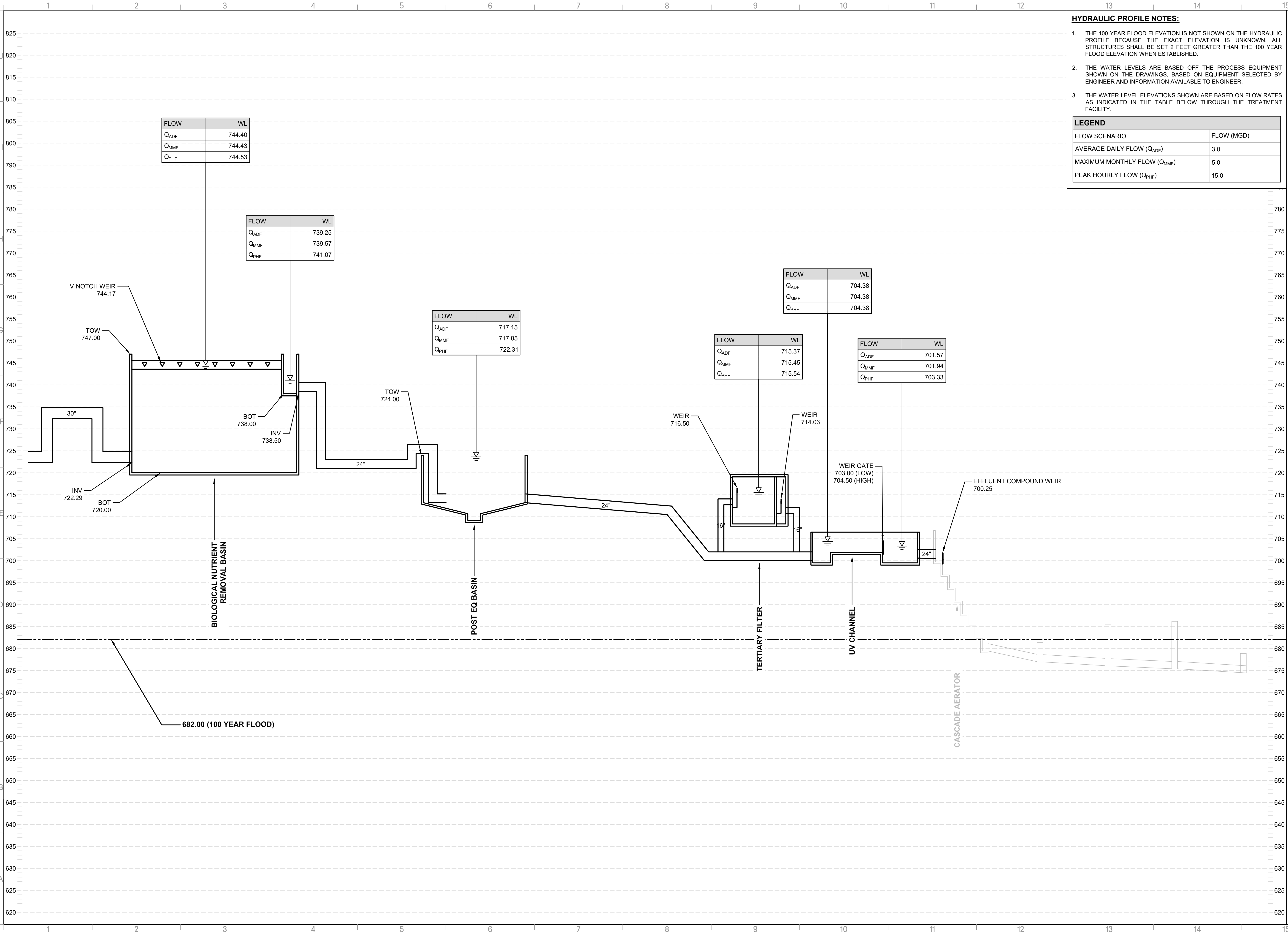
ISSUE	DATE
30% Submittal	01.18.2023
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Conformed Set	
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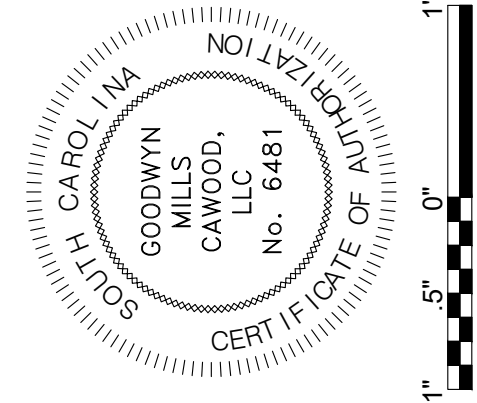


HYDRAULIC PROFILE NOTES:

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- THE WATER LEVEL ELEVATIONS SHOWN ARE BASED ON FLOW RATES AS INDICATED IN THE TABLE BELOW THROUGH THE TREATMENT FACILITY.

LEGEND

FLOW SCENARIO	FLOW (MGD)
AVERAGE DAILY FLOW (Q _{ADF})	3.0
MAXIMUM MONTHLY FLOW (Q _{MMF})	5.0
PEAK HOURLY FLOW (Q _{PHF})	15.0



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Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWT EXPANSION
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GMC PROJECT #CGRE220027

NEW HYDRAULIC
PROFILE (2 OF 2)

G-009

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PLOTTED: Mar 12, 2024 - 8:23am

PIPE SCHEDULE								
SERVICE ABBREVIATION	DESCRIPTION (SEE NOTE 1)	PIPE MATERIAL (SEE SCHEDULE TO RIGHT)				FIELD TESTING REQUIREMENTS (SEE NOTE 4 & DEVIATION TABLE)		
		EXPOSED PIPING (SEE NOTE 2)		BURIED PIPING (SEE NOTE 3)				
		3" DIA & SMALLER	4" DIA & LARGER	3" DIA & SMALLER	4" DIA & LARGER	MIN TEST PRESSURE (PSI)	TESTING MEDIUM	LEAKAGE ALLOWANCE
A	AIR	1, 8	3,5,8,11	1,8	3,5,11	25	AIR	NOTE 7,8
AL	ALUM	9	9	9	9	125	WATER	NOTE 7
BR	BRINE	-	-	-	-	-	-	-
BW	BACKWASH	-	4,5	-	4,5	NOTE 9	WATER	NOTE 7
BWW	BACKWASH WASTE	-	4,5	-	4,5	75	WATER	NOTE 7
C	CARBON	NOTE 11	NOTE 11	NOTE 11	NOTE 11	125	-	NOTE 7,11
CD	CHEMICAL DRAIN	10	10	10	10	NOTE 10	-	-
CEN	CENTRATE	-	4,5	-	4,5	7515	WATER	NOTE 7
CL	CHLORINE	4	1	4	1	0	AIR	NOTE 7
CLS	CHLORINE SOLUTION	9	9	9	9	125	WATER	NOTE 7
CPA	COMPRESSED AIR	7,13	2	13	2	200	AIR	NOTE 7,8
CWR	COOLING WATER RETURN	8,13	4,8	2,9,13	4,5	125	WATER	NOTE 7
CWS	COOLING WATER SUPPLY	8,13	4,8	2,9,13	4,5	125	WATER	NOTE 7
D	DRAIN	6	6	6	6	NOTE 10	-	-
DS	DIGESTED SLUDGE	-	4,5	-	4,5	125	WATER	NOTE 7
FE	FILTER EFFLUENT	2, 7, 13	4,5	2,13	4,5	25	WATER	NOTE 7
FG	FEED GAS	7	7	7	7	125	AIR	NOTE 7
GM	FORCE MAIN	-	5	-	5,12	125	WATER	NOTE 7
FNE	FINAL EFFLUENT	-	4,5	-	4,5	125	WATER	NOTE 7
FOG	FOUL AIR GAS	11	11	11	11	125	AIR	NOTE 7
GR	GRIT SLURRY	-	15	-	17	125	WATER	NOTE 10
HCl	HYDROCHLORIC ACID	9	9	9	9	125	WATER	NOTE 7
HOCL	SODIUM HYPOCHLORITE	9	9	9	9	125	WATER	NOTE 7
LS	LIME SYSTEM	NOTE 11	NOTE 11	NOTE 11	NOTE 11	125	-	NOTE 7
LSG	LOW PRESSURE SLUDGE GAS	7	7	7	7	125	AIR	NOTE 7
ML	MIXED LIQUOR	-	4,5	-	4,5	125	WATER	NOTE 7
NAOH	SODIUM HYDROXIDE (CAUSTIC)	1	1	1	1	125	WATER	NOTE 7
NG	NATURAL GAS	2,7,13	1	2,7,13	1	150	AIR	NOTE 7
NPW	NON-POTABLE WATER	-	4,5	2,9,13	4,5	125	WATER	NOTE 7
OF	OVERFLOW	4,5	4,5	4,5	4,5	NOTE 9	WATER	NOTE 7
OFG	OFF GAS	7	7	7	7	125	AIR	NOTE 7
PA	PLANT AIR	1	-	1	-	300	AIR	NOTE 7,8
PAC	POLY ALUMINUM CHLORIDE	9	9	9	9	125	WATER	NOTE 7
PD	PUMPED DRAIN	2,9	2,5	2,9	5,9	125	WATER	NOTE 7
PE	PRIMARY EFFLUENT	-	5	-	5	125	WATER	NOTE 7
POL	POLYMER SOLUTION	9	-	9	-	125	WATER	NOTE 7
PS	PRIMARY SLUDGE	-	15	-	1715	125	WATER	NOTE 7
PSC	PRIMARY SCUM	15	15	15		125	WATER	NOTE 7
RAS	RETURN ACTIVATED SLUDGE	-	5	-	5	125	WATER	NOTE 7
RCS	RECIRCULATED SLUDGE	-	5	-	5	125	WATER	NOTE 7
RUW	REUSE WATER	-	5	-	5	125	WATER	NOTE 7
RWW	RAW WASTEWATER	-	16	-	16	125	WATER	NOTE 7
SA	SAMPLE WATER	8,9,11,13	-	9,11,13	-	125	WATER	NOTE 7
SE	SECONDARY EFFLUENT	-	4,5	-9	4,5	125	WATER	NOTE 7
SN	SUPERNATANT	9	-		4,5	75	WATER	NOTE 7
SP	SODIUM PERMANGANATE	9	-	9	-	125	WATER	NOTE 7
SS	SANITARY SEWER	6	6	6	6	125	WATER	-
SSC	SECONDARY SCUM	15,17	15,17	15,17	15,17	125	WATER	NOTE 7
SSL	SECONDARY SLUDGE	-	5	-	5	125	WATER	NOTE 7
TD	TANK DRAIN	-	5	-	5	75	WATER	NOTE 7
TWAS	THICKENED WASTED ACTIVATED SLUDGE	-	5	-	5	125	WATER	NOTE 7
V	VENT	9	9	-	-	125	WATER	-
VAC	VACUUM	2,8	1/2	-	-	125	AIR	NOTE 7
W	WATER	2,7,13	3/4	2,9,13	4,5	125	WATER	NOTE 7
WAS	WASTE ACTIVATED SLUDGE	-	5	-	5	125	WATER	NOTE 7
WW	WASTE WASHWATER	-	$\frac{4}{5}$	-	4,5	125	WATER	NOTE 7

PROCESS PIPING MATERIAL SCHEDULE (NOTE 5, NOTE 6)				
GROUP NO.	PIPE MATERIAL	SPECIFICATION SECTION	FITTINGS	COMMENTS
1	STEEL, ASTM A53, SCH 40, BLACK, WELDED	40 05 24	3" AND SMALLER, MALLEABLE IRON, ANSIB16.3, THREADED BLASK 150 PSI OR STEEL ANSIB16.9 BUTT-WELDED 4" AND LARGER, CAST IRON, ANSIB16.1, FLANGED OR MECH COUPLING	
2	STEEL, ASTM A53, SCH 40, GALVANIZED	40 05 24	3" AND SMALLER, MALLEABLE IRON, ANSIB16.3, THREADED GALVANIZED 150 PSI 4" AND LARGER, CAST IRON, ANSIB16.1, FLANGED OR MECH COUPLING	
3	WELDED STEEL,AWWA C200, UNLINED	40 05 24	WELDED STEEL, AWWA C200 FABRICATED, UNLINED	
4	WELDED STEEL,AWWA C200,	40 05 24	WELDED STEEL, AWWA C200 FABRICATED,	
5	DUCTILE IRON, AWWA C151, 150 PSI, PUSH-ON, MECHANICAL JOINT OR 125 PSI FLANGED, UNLINED FOR AIR LINES	40 05 19	DUCTILE IRON AWWA 110, PUSH-ON, MECHANICAL JOINT 250 PSI (PR), 12" AND SMALLER, 150 SSI (PR). FLANGED JOINTS 125PSI ANSI B16.1	
6	CAST IRON SOIL PIPE ASTM A74, SERVICE WEIGHT, BELL & SPIGOT OR NO-HUB, SYSTEM 5 MAY BE SUBSTITUTED	40 05 19	CAST IRON ASTM A74, SERVICE WEIGHT, BELL & SPIGOT OR NO-HUB, SYSTEM 5 MAY BE SUBSTITUTED	
7	STAINLESS STEEL, TYPE 316, ASTM A312, SCHEDULE 40	40 05 23	STAINLESS STEEL TYPE 316, ANSI B16.3, THREADED, 150 PSI, ANSIB16.9, BUTT-WELDED SCH 40 OR 150 PSI FLANGED	
8	STAINLESS STEEL, TYPE 304, ASTM A312, SCHEDULE 10S	40 05 23	STAINLESS STEEL TYPE 304, ANSIB16.9, BUTT-WELDED SCH 10S OR 150 PSI FLANGED	
9	POLYVINYL CHLORIDE (PVC), SCHEDULE 80, ASTM D1785	40 05 31	PVC SCHEDULE 80, ASTM D2467 SOCKET SOLVENT WELD JOINTS	
10	POLYPROPYLENE, ASTMD2146, SCHEDULE 40, HEAT FUSED JOINTS	40 05 31	POLYPROPYLENE, SCHEDULE 40, DRAINAGE TYPE WITH HEAT FUSED SOCKET JOINTS	
11	FIBERGLASS REINFORCED PLASTIC (FRP), ASTMD2996, FILAMENT WOUND SOCKET AND SPIGOT JOINTS, ADHESIVE BONDED	40 05 36	FRP, FILAMENT WOUND, SOCKET ENDS, ADHESIVE BONDED OR FIBERGLASS FLANGES	
12	POLYVINYL CHLORIDE (PVC) PRESSURE PIPE ASTM D2241, WITH BELL & SPIGOT JOINTS	40 05 31	DUCTILE IRON, AWWA C110, CEMENT LINED, AWWA C104	
13	COPPER, ASTM B88, TYPE K, SOFT TEMPERED WHERE BURIED, HARD TEMPERED WHERE EXPOSED	40 05 17	WROUGHT COPPER ANSIB16.22 SOLDER JOINT, 150 PSI OR COMPRESSION FITTINGS (FOR COMPRESSED AIR USE TIN-ANTIMONY SOLDER)	
14	HDPE DR 9 FOR PRESSURE RATING 150 PSI OR MORE, OTHERWISE DR17	40 05 33	HDPE FABRICATED OR MOLDED	
15	DUCTILE IRON(GLASS LINED), AWWA C151, 150 PSI, PUSH-ON, MECHANICAL JOINT OR 125 PSI FLANGED	40 05 19	DUCTILE IRON AWWA 110, PUSH-ON, MECHANICAL JOINT 250 PSI (PR), 12" AND SMALLER, 150 SSI (PR). FLANGED JOINTS 125PSI ANSI B16.1	
16	DUCTILE IRON(CERAMIC EPOXY LINED), AWWA C151, 150 PSI, PUSH-ON, MECHANICAL JOINT OR 125 PSI FLANGED	40 05 19	DUCTILE IRON AWWA 110, PUSH-ON, MECHANICAL JOINT 250 PSI (PR), 12" AND SMALLER, 150 SSI (PR). FLANGED JOINTS 125PSI ANSI B16.1	
17	STEEL (GLASS LINED), AWWA C200, WELDED	40 05 19	WELDED STEEL, AWWA C200 FABRICATED, UNLINED	

DEVIATIONS FROM SCHEDULED TEST PRESSURES		
LOCATION	OPERATING PRESSURE (PSI)	TEST PRESSURE (PSI)

- NOTES:**
- THIS SCHEDULE INCLUDES SOME PROCESS DESIGNATIONS NOT USED IN THIS PROJECT.
 - EXPOSED PIPING SHALL BE COATED IN ACCORDANCE WITH THE SPECIFICATIONS. COLORS WILL BE SELECTED BY THE ENGINEER.
 - SEE SPECIFICATIONS FOR PIPE LINING AND COATING.
 - SEE SPECIFICATION SECTION 400513 FOR ADDITIONAL TESTING REQUIREMENTS.
 - DEVIATIONS FROM THIS SCHEDULE OF MATERIALS OR TESTING REQUIREMENTS ARE NOTED IN THE SPECIFICATIONS OR ADDITIONAL NOTATIONS ON THE DRAWINGS.
 - SEE VALVE SCHEDULE FOR VALVE TYPE FOR EACH SERVICE.
 - FOR PIPING THAT IS NOT ABLE TO BE PRESSURE TESTED, NO LEAKAGE SHALL SHOW AT MAXIMUM TANK WATER SURFACE ELEVATIONS. FOR PIPING THAT IS ABLE TO BE PRESSURE TESTED, LEAKAGE SHALL BE NO MORE THAN 0.02 GALLONS PER HOUR PER INCH DIAMETER PER 100 FEET OF BURIED PIPE.
 - LOSS OF PRESSURE SHALL BE LESS THAN 5 PERCENT.
 - PERFORM STATIC WATER TEST WITH SURFACE 5 FEET ABOVE HIGHEST POINT ON PIPE.
 - INSPECTION AND TESTING SHALL BE IN ACCORDANCE WITH THE APPLICABLE PLUMBING CODE.
 - PIPING MATERIAL SHALL BE ABRASION RESISTANT FLEXIBLE RUBBER HOSE & QUICK CONNECT COUPLINGS WITH SYSTEM 1 PIPING AT EQUIPMENT CONNECTIONS. PIPE SHALL SHOW ZERO LEAKAGE AT NORMAL OPERATING CONDITIONS.
 - ALL INSTRUMENT SENSING OR GAUGE PIPING SHALL BE 304 SS THREADED TUBING

30% Submittal
01.18.2023

60% Submittal
08.07.2023

90% Submittal
12.04.2023

100% Submittal
03.08.2024

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WN

Engineer:
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Designer:
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Drawn By:
HKD

ISSUE DATE

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12.04.2023

03.08.2024

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION

PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC

117 Welborn St.
Greenville, SC 29601
T 864.527.0460

GMC PROJECT #CGRE220027

PROCESS
PIPING
SCHEDULE

G-010

DRAWING FILE: T:\1 Projects\SC\Pendleton, Town of\CGRE220027 - Pendleton-Clemson WWTP\0 DWG\+CAD\01 BID DRAWINGS\01 GENERAL\G-01.dwg
PLOTTED: Mar 12, 2024 - 8:23am

INFLUENT CHARACTERISTICS	
PARAMETER	VALUE
FLOW (MGD)	
DESIGN	5.0
MAX DAY	10.0
PEAK HOURLY	15.0
BOD (MG/L)	250
TSS (MG/L)	300
NH3-N (MG/L)	35
TKN (MG/L)	55
TP (MG/L)	5
pH	7.0
SUMMER TEMPERATURE (°C)	24.0
WINTER TEMPERATURE (°C)	14.0

INFLUENT PUMP STATION - SCREEN	
PARAMETER	VALUE
COARSE SCREEN	
TOTAL CAPACITY (MGD)	15.0
CAPACITY PER SCREEN (MGD)	15.0
CHANNEL WIDTH (FT)	4
MAX WATER DEPTH (FT)	6
NUMBER OF CHANNEL	1
NUMBER OF SCREEN	1
TYPE OF SCREEN	MECHANICAL BAR
BAR SPACING (MM)	25
INSTALLATION ANGLE (°)	75
HEADLOSS @ 30% BLINDING (IN)	16
SCREENING CONVEYOR	
TYPE OF SCREENING CONVEYOR	SHAFTLESS SCREW
NUMBER OF SCREENING CONVEYOR	1
LENGTH (FT)	6
CAPACITY (FT3/HR)	125
BYPASS SCREEN	
TOTAL CAPACITY (MGD)	5.0
CAPACITY PER SCREEN (MGD)	5.0
CHANNEL WIDTH (FT)	4
MAX WATER DEPTH (FT)	6
NUMBER OF CHANNEL	1
NUMBER OF SCREEN	1
TYPE OF SCREEN	MANUAL BAR
BAR SPACING (MM)	51

INFLUENT PUMP STATION - PUMPS	
PARAMETER	VALUE
1FIRM CAPACITY (MGD)	15.0
NUMBER OF PUMPS	5
WETWELL	
LENGTH (FT)	20
WIDTH (FT)	18
LWL (FT)	664.00
HWL (FT)	672.00
WORKING VOLUME (GAL)	21542
INFLUENT PUMP NO.1/NO.5	
NUMBER OF PUMPS	2
TYPE OF PUMPS	SUBMERSIBLE
CAPACITY (GPM)	1736
DESIGN HEAD (FT)	130
DISCHARGE PORT SIZE (IN)	8
MOTOR (HP)	110
INFLUENT PUMP NO.2/NO.3/NO.4	
NUMBER OF PUMPS	3
TYPE OF PUMPS	SUBMERSIBLE
CAPACITY (GPM)	3472
DESIGN HEAD (FT)	130
DISCHARGE PORT SIZE (IN)	8
MOTOR (HP)	185
1FIRM CAPACITY = ONE (1) LARGER PUMP OUT OF SERVICE	

HEADWORKS - FINE SCREEN	
PARAMETER	VALUE
FINE SCREEN	
FIRM CAPACITY (MGD)	15.0
CAPACITY PER SCREEN (MGD)	7.5
EFFLUENT TROUGH WIDTH (FT)	4
EFFLUENT TROUGH DEPTH (FT)	6
NUMBER OF CHANNEL	1
NUMBER OF SCREENS	3
TYPE OF SCREENS	INTERNALLY FED ROTARY DRUM
PERFORATED OPENING SIZE (MM)	6
INLET PORT SIZE (IN)	24
OUTLET PORT SIZE (IN)	24
OVERFLOW PORT SIZE (IN)	16
WASHWATER FLOW (GPM)	75
WASHWATER PRESSURE (PSI)	75
SCREENING CONVEYOR	
TYPE OF SCREENING CONVEYOR	SHAFTLESS SCREW
NUMBER OF SCREENING CONVEYOR	1
NUMBER OF CONVEYOR INLET CHUTES	4
LENGTH (FT)	18
CAPACITY (FT3/HR)	125
MAX INSTALLATION ANGLE (°)	5
SCREENING WASHING COMPACTOR	
NUMBER OF SCREENING CONVEYOR	1
DISCHARGE HEIGHT (FT)	5
WASHWATER FLOW (GPM)	15
WASHWATER PRESSURE (PSI)	60
CAPACITY (FT3/HR)	125

HEADWORKS - GRIT REMOVAL	
PARAMETER	VALUE
TOTAL CAPACITY (MGD)	15.0
CAPACITY PER UNIT (MGD)	7.5
MAX HEADLOSS (IN)	12
TYPE OF GRIT REMOVAL UNIT	MECHANICALLY INDUCED VORTEX
NUMBER OF UNITS	2
REMOVAL RATE (ALL GRIT > 105 MICRON)	95%
TYPE OF GRIT PUMPS	SUCTION LIFT
NUMBER OF GRIT PUMPS	2
TYPE OF GRIT CLASSIFIERS	SCREW
NUMBER OF GRIT CLASSIFIERS	2

HEADWORKS - FLOW MEASUREMENT	
PARAMETER	VALUE
NUMBER OF DEVICE	1
TYPE	PARSHALL FLUME
THROAT SIZE (IN)	18
FLOW RANGE (MGD)	0 - 15.9

BIOLOGICAL NUTRIENT REMOVAL (BNR) BASINS	
PARAMETER	VALUE
BASINS	
NUMBER OF BASINS	3
VOLUME PER BASIN (GAL)	1200000
BASIN DIMENSION	
LENGTH (FT)	88
WIDTH (FT)	78.5
HEIGHT (FT)	27
SIDE WATER DEPTH (FT)	24.8
SLAB THICKNESS (IN)	18
EXTERNAL WALL THICKNESS (IN)	18
INTERNAL WALL THICKNESS (IN)	12
SRT (D)	23.7
HYDRAULIC RESIDENCE TIME (HR)	17.3
BLOWERS	
AIR FLOW RATE (SCFM)	3216
DISCHARGE PRESSURE (PSI)	11.7
BLOWER POWER RATING (HP)	250
NUMBER OF BLOWERS	3
LEVEL CORRECTION TANK	
NUMBER OF TANK	1
TANK VOLUME (GAL)	143000
TANK DIMENSION	
DIAMETER (FT)	45
DEPTH (FT)	12
NUMBER OF PUMPS	2
TYPE OF PUMPS	SUBMERSIBLE
PUMP POWER RATING (HP)	14
CAPACITY (GPM)	600
DESIGN HEAD (FT)	58
SLUDGE BUFFER TANK	
NUMBER OF TANK	1
TANK VOLUME (GAL)	143000
TANK DIMENSION	
DIAMETER (FT)	45
DEPTH (FT)	12
NUMBER OF PUMPS	2
TYPE OF PUMPS	CENTRIFUGAL
PUMP POWER RATING (HP)	11.5
CAPACITY (GPM)	220
DESIGN HEAD (FT)	102
BNR POST EQ BASIN	
NUMBER OF BASIN	1
TANK VOLUME (GAL)	254000
TANK DIMENSION	
DIAMETER (FT)	60
DEPTH (FT)	12

TERTIARY FILTERS	
PARAMETER	VALUE
FILTERS	
TYPE OF FILTERS	CLOTH MEDIA DISC
CAPACITY PER FILTER (MGD)	4.0
NUMBER OF FILTERS	3
EXISTING	1
NEW	2
BYPASS FLOW (MGD)	3.0
NUMBER OF DISCS PER FILTER	8
MAX FILTER INFLUENT TSS (MG/L)	15
FILTER EFFLUENT TSS (MG/L)	5
MAX HYDRAULIC LOADING (GPM/FT2)	6.5
BACKWASH PUMPS	
TYPE OF PUMPS	CENTRIFUGAL
NUMBER OF PUMPS PER FILTER	2
FLOW PER PUMP (GPM)	130
HEAD (FT)	23.2

UV DISINFECTION	
PARAMETER	VALUE
UV MODULES	
TOTAL CAPACITY (MGD)	14.0
CAPACITY PER BANK (MGD)	7.0
MAX TSS (MG/L)	30
DISINFECTION LIMIT (#/100 ML)	200
UV TRANSMITTANCE	68%
DESIGN DOSE (MJ/CM2)	31
NUMBER OF CHANNEL	1
CHANNEL DIMENSION (FT)	
LENGTH	25.3
WIDTH	6.0
DEPTH	5.2
NUMBER OF BANKS	2
NUMBER OF MODULES PER BANK	18
NUMBER OF LAMPS PER MODULE	8
LIFTING DEVICE	DAVIT CRANE
CONTROLS	
NUMBER OF PDC1	2
NUMBER OF SCC2	1
NUMBER OF HSC3	1
1PDC = POWER DISTRIBUTION CENTER	
2SCC = SYSTEM CONTROL CENTER	
3HSC = HYDRAULIC SYSTEM CENTER	

AEROBIC DIGESTERS	
PARAMETER	VALUE
NUMBER OF DIGESTERS	3
EXISTING	2
NEW	1
NEW AEROBIC DIGESTER	
TANK CONFIGURATION	CIRCULAR
DIAMETER (FT)	80
WALL HEIGHT (FT)	20.0
SIDE WATER DEPTH (FT)	18.0
VOLUME (GAL)	677000
DIFFUSER TYPE	COARSE BUBBLE
BLOWERS	
AIR FLOW RATE (SCFM)	1900
DISCHARGE PRESSURE (PSI)	9.5
BLOWER POWER RATING (HP)	125
NUMBER OF BLOWER PER DIGESTER	1
FLOATING DECANTERS	
NUMBER OF DECANTER PER DIGESTER	1
DESIGN FLOW (GPM)	500
SLUDGE DRYING BEDS	
NUMBER OF EXISTING DRYING BEDS	16
TO BE DEMOLISHED	6
TO BE RETAINED AND REHABILITATED	10
LENGTH PER DRYING BED (FT)	60
WIDTH PER DRYING BED (FT)	20

PROCESS
DESIGN
CRITERIA

G-011

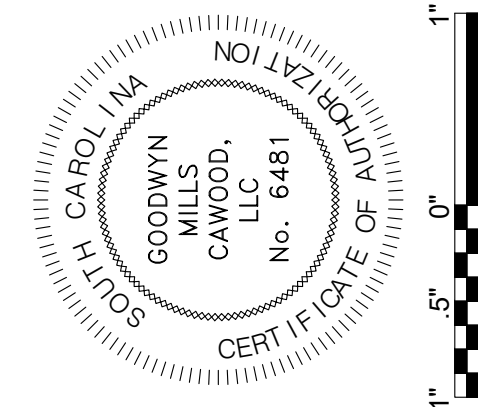
PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION

PENDLETON, SOUTH CAROLINA
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GMC PROJECT #CGRE220027

ISSUE DATE

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60% Submittal	08.07.2023
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100% Submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD



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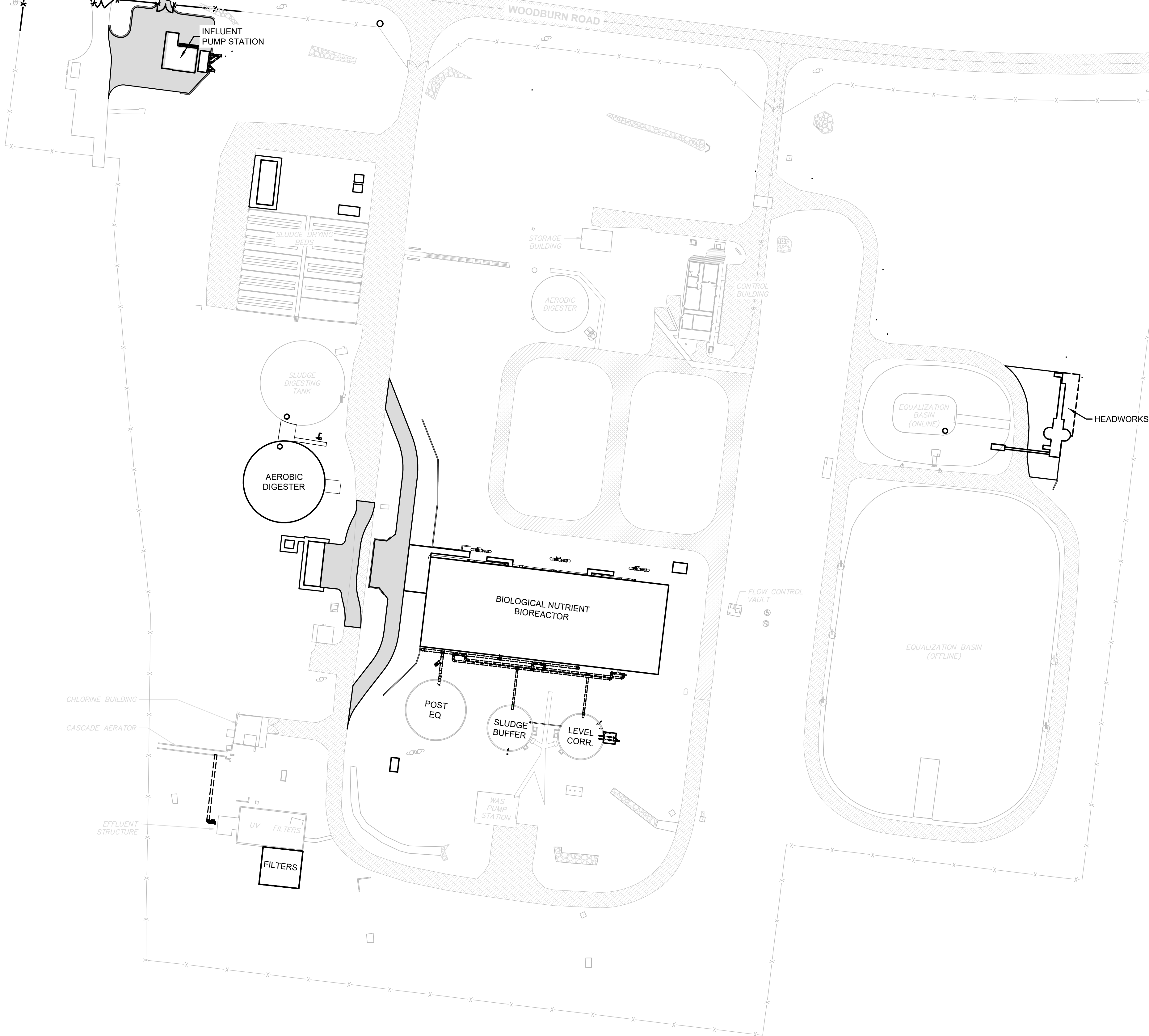


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G-101

SITE PLAN

SCALE: 1" = 60'-0"



CONTRACTOR NOTES:

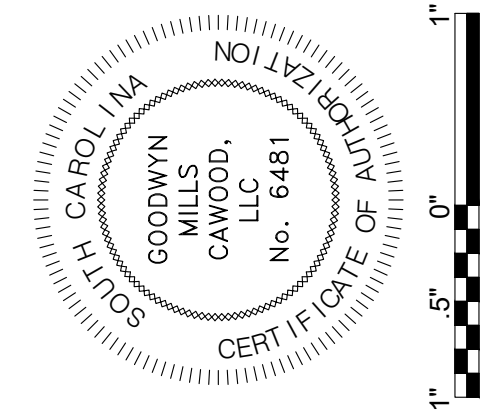
- IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PROVIDE EROSION CONTROL FOR DESIGNATED LAY DOWN AREAS DURING CONSTRUCTION.
- IT IS THE RESPONSIBILITY OF THE CONTRACTOR FOR CLEAN UP INCLUDING BUT NOT LIMITED TO GRADING, LEVELING & PERMANENT GRASSING OF DESIGNATED LAY DOWN AREAS AFTER CONSTRUCTION.
- CONTRACTOR SHALL PHOTOGRAPH AND/OR VIDEO PRECONSTRUCTION CONDITIONS. INFORMATION ACQUIRED SHALL BE USED TO DETERMINE IF STRUCTURE OR SITE CONDITION REPAIR AND CLEAN UP REQUIRED POST CONSTRUCTION ARE ACCEPTABLE.
- DO NOT UNREASONABLY ENCUMBER THE SITE WITH MATERIALS OR EQUIPMENT. CONFINE STOCKPILING OR MATERIALS AND LOCATION OF STORAGE SHEDS TO THE AREAS INDICATED. IF ADDITIONAL STORAGE IS NECESSARY, OBTAIN AND PAY FOR SUCH STORAGE OFFSITE.
- CONTRACTOR SHALL SUPPLY SAFETY FENCE AROUND MATERIALS STORAGE AREAS AND CONSTRUCTION AREAS AS REQUIRED TO PROTECT OCCUPANTS AND VISITORS OF THE SITE. ANY EXCAVATIONS SHALL BE SUITABLE MARKED AND PROTECTED BY FENCING ADEQUATE TO PROVIDE A SAFE ENVIRONMENT. THE CONTRACTOR SHALL MAINTAIN THE SOLE RESPONSIBILITY AND LIABILITY FOR IMPLEMENTATION, DESIGN AND MAINTENANCE OF ALL SAFETY FEATURES.
- CONTRACTOR SHALL COORDINATE ROUTES FOR HAULING, STAGING AND ANY ADDITIONAL CONTRACTOR PARKING AREAS NECESSARY WITH THE OWNER AND ENGINEER.
- CONTRACTOR SHALL SECURE ALL CONSTRUCTION LOCATIONS AT ALL TIMES.
- THE CONTRACTOR IS SOLELY RESPONSIBLE FOR THE SAFE USE OF PRODUCTS ON THE SITE. THE CONTRACTOR IS RESPONSIBLE FOR ALL MEANS AND METHODS TO PRODUCE THE WORK INCLUDING ALL SAFETY MEASURES AS NOTED PREVIOUSLY.
- CONTRACTOR SHALL PROVIDE DUST CONTROL MEASURES DAILY AS NECESSARY AND AS DIRECTED BY THE OWNER.
- THIS SHEET DOES NOT PURPORT TO SHOW ALL PROPOSED WORK IN THE CONTRACT.

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GENERAL SITE PLAN
CONTRACTOR'S
DISGNATED AREA
G-101

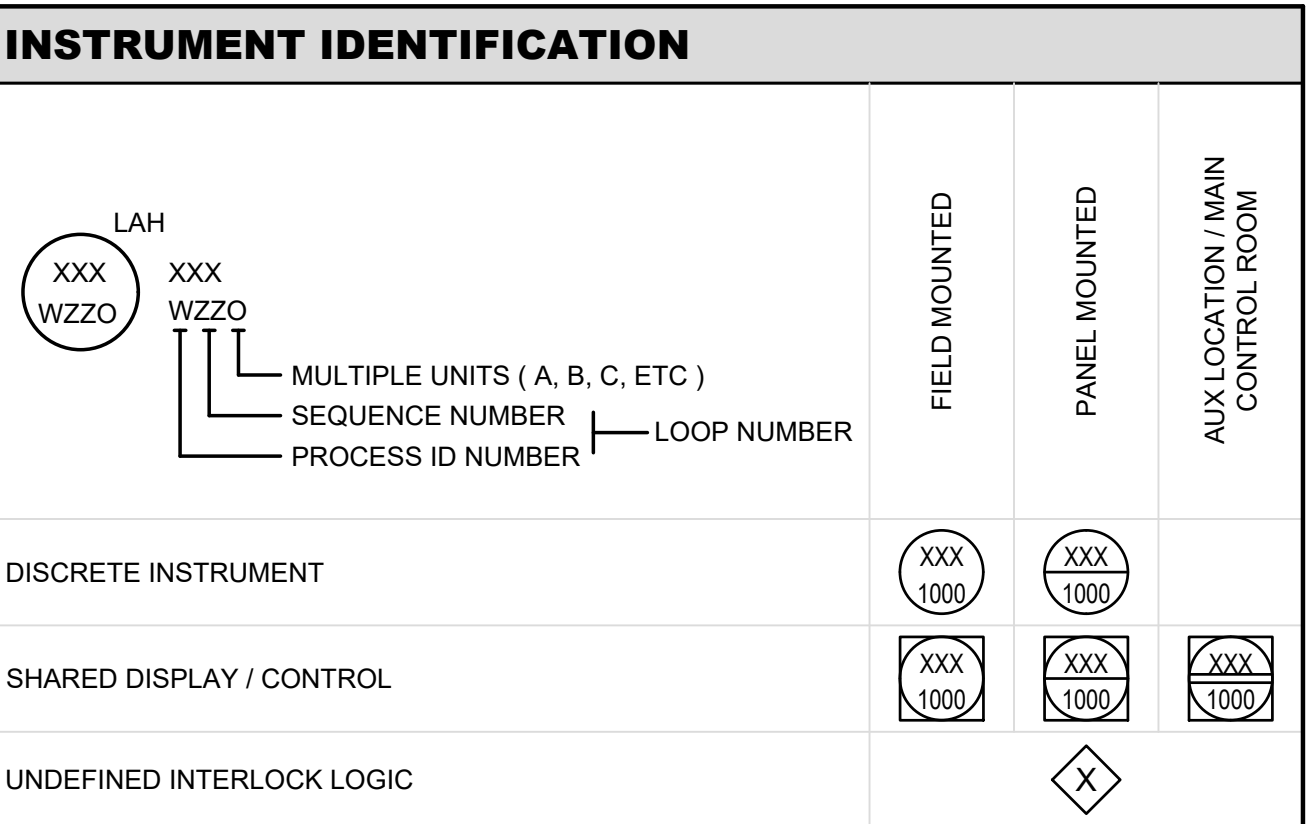


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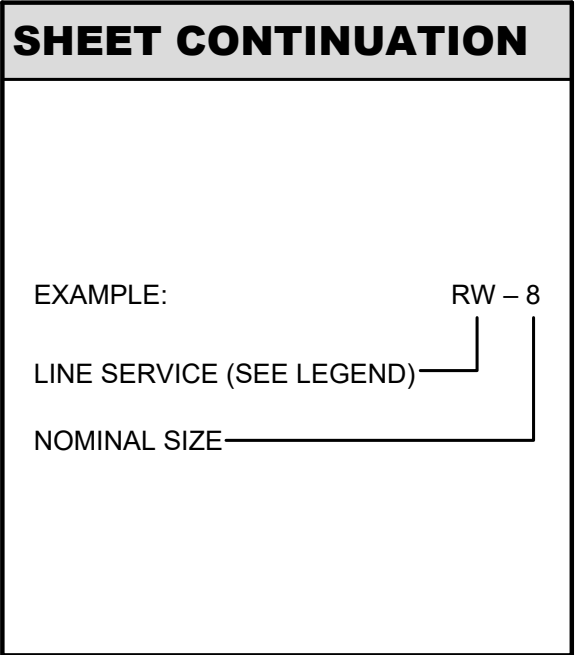
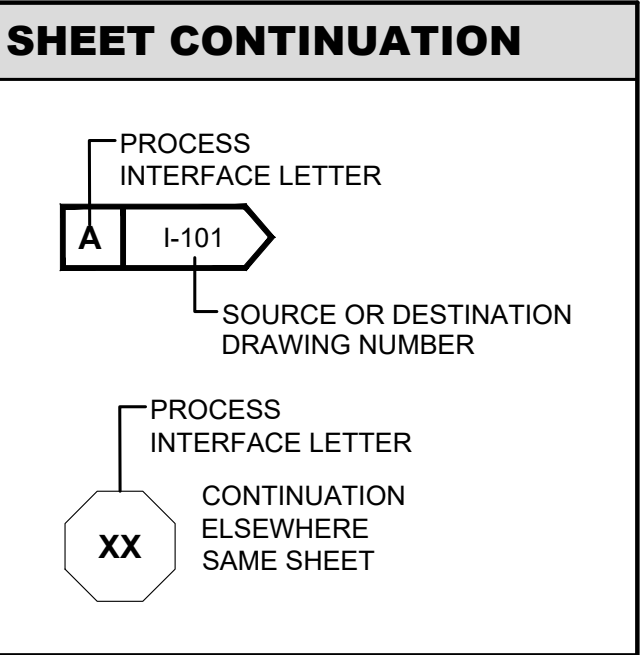
INSTRUMENT IDENTIFICATION LETTERS				
FIRST LETTER		SUCCEEDING LETTER		
MEASURED OR INITIATED VARIABLE		READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS	ALARM		
B	BURNER FLAME			
C	CONDUCTIVITY (ELECTRICAL)		CONTROL	CLOSE
D	DENSITY (MASS) OR SPECIFIC GRAVITY	DIFFERENTIAL		
E	VOLTAGE (EMF)	DELAY		
F	FLOW RATE	PRIMARY ELEMENT		
G	GAUGING			
H	HAND (MANUALLY INITIATED)			HIGH
I	CURRENT (ELECTRICAL)	GLASS		
J	POWER	INDICATE		
K	TIME OR SCHEDULE		CONTROL STATION	
L	LEVEL			
M	MOISTURE OR HUMIDITY	LIGHT (PILOT)		LOW
N	UNCLASSIFIED			MIDDLE OR INTERMEDIATE
O	UNCLASSIFIED			OPEN
P	PRESSURE OR VACCUM	ORIFICE (RESTRICTION)		
Q	QUANTITY	POINT (TEST CONNECTION)		
R	RADIOACTIVITY			
S	SPEED OR FREQUENCY	RECORD OR PRINT		
T	TEMPERATURE		SWITCH	
U	MULTIVARIABLE		TRANSMIT OR TRANSMITTER	
V	VIBRATION MECHANICAL ANALYSIS			
W	WEIGHT OR FORCE	MULTI FUNCTION	MULTIFUNCTION	MULTIFUNCTION
X	EVENT	WELL		
Y	UNCLASSIFIED		UNCLASSIFIED	
Z	POSITION		RELAY, COMPUTE, OR CONVERT	
			DRIVE, ARTICULATE OR UNCLASSIFIED FINAL CONTROL ELEMENT	

P&ID ABBREVIATIONS	
CONC	CONCENTRIC
CP	CONTROL PANEL
DO	DISSOLVED OXYGEN
ECC	ECCENTRIC
EL	ELEVATION
ES	EMERGENCY STOP
FC	FAIL CLOSE
FCP	FACTORY CONTROL PANEL (FURNISHED BY EQUIPMENT MANUFACTURER)
FI	FAIL INTERMEDIATE
FL	FAIL LOCKED
FLG	FLANGE
FO	FAIL OPEN
FOR	FORWARD/OFF/REVERSE (MAINTAINED)
FSR	FORWARD/STOP/REVERSE (MAINTAINED)
FWE	FURNISHED WITH EQUIPMENT
GPM	GALLONS PER MINUTE
HMI	HUMAN MACHINE INTERFACE
HOA	HAND/OFF/AUTO
HP	HIGH PRESSURE
LC	LOCKED CLOSE
LCP	LOCAL CONTROL PANEL (FURNISHED BY SYSTEMS INTEGRATOR)
LO	LOCKED OPEN
LOR	LOCAL/OFF/REMOTE
LP	LOW PRESSURE
LR	LOCAL/REMOTE
LT	LOW TEMPERATURE
MA	MANUAL/AUTO
MAX	MAXIMUM
MCC	MOTOR CONTROL CENTER
MCP	MAIN CONTROL PANEL
MIN	MINIMUM
MW	MANWAY
NC	NORMALLY CLOSED
NLL	NORMALLY LIQUID LEVEL
NO	NORMALLY OPEN
OC	OPEN/CLOSE
OCA	OPEN/CLOSE/AUTO
OCR	OPEN/CLOSE/REMOTE
OO	ON/OFF
ORIF	ORIFICE
ORP	OXIDATION REDUCTION POTENTIAL
OS	OPERATION SWITCH
PC	PARTICLE COUNT
pH	HYDROGEN ION CONCENTRATION
R	RESET
RED	REDUCER
RS	RUN/STOP (AUTO RESET/RUN @ POWER INTERRUPTION)
RSJ	RUN/STOP/JOG
S	SILENCE
SCN	SAMPLE CONNECTION
SC	STREAMING CURRENT
SCH	SCHEDULE
SD	SHUTDOWN
SLBL	SLUDGE BLANKET LEVEL
SP	SAMPLE POINT
SR	SAFE/RUN
SST	STAINLESS STEEL
SSR	START/STOP (MANUAL RESET @ POWER INTERRUPTION)
STD	STANDARD
T	TEST
TOR	TORQUE
TURB	TURBIDITY
TYP	TYPICAL
UD	UP/DOWN



EXAMPLE ALARMS OR ACTIONS	
HA	HIGH ALARM
LAH	LEVEL ALARM HIGH
LAHH	LEVEL ALARM HIGH HIGH
HOA	HAND/OFF/AUTO
LAL	LOW
LAU	LOW LOW
OO	ON / OFF

NOTES	
1	THE PROCESS AND INSTRUMENTATION DIAGRAMS (P&ID) ARE BASED ON PROCESS EQUIPMENT SELECTED BY THE ENGINEER, AS SHOWN ON THE DRAWINGS.
2	THE ARRANGEMENT OF PROCESS AND INSTRUMENTATION DIAGRAMS REPRESENTS THE BASIS OF DESIGN FOR EACH TYPE OF EQUIPMENT, AS DESCRIBED IN THE SPECIFICATIONS. CHANGES TO THE LISTED BASIS OF DESIGN THAT DIFFER FROM THE SHOWN ARRANGEMENT SHALL BE THE CONTRACTOR'S RESPONSIBILITY. HOWEVER, NO ADDITIONAL PAYMENT WILL BE MADE TO THE CONTRACTOR FOR SUCH MODIFICATIONS.
3	IF APPROVED BY THE ENGINEER, THE MANUFACTURER MAY ELECT TO MODIFY PROCESS AND INSTRUMENTATION DIAGRAM TO IMPROVE SYSTEM FUNCTION.
4	THE CONFIGURATION SHOWN ON THE PROCESS AND INSTRUMENTATION DIAGRAM SHALL NOT BE USED FOR CONSTRUCTION AS THE LAYOUT OF THE PROCESS FLOW DIAGRAM IS NOT TO SCALE AND IS NOT REPRESENTATIVE OF THE ACTUAL FIELD LAYOUT.
5	FOR PIPE SERVICE ABBREVIATIONS, SEE GENERAL SHEETS.
6	ALL DEVICES (SWITCHES, PLC, HMI, ETC) SHALL BE NETWORK COMPLIANT. THE STANDARD COMMUNICATION PROTOCOL FOR PROJECT SITE WILL BE ETHERNET/IP.



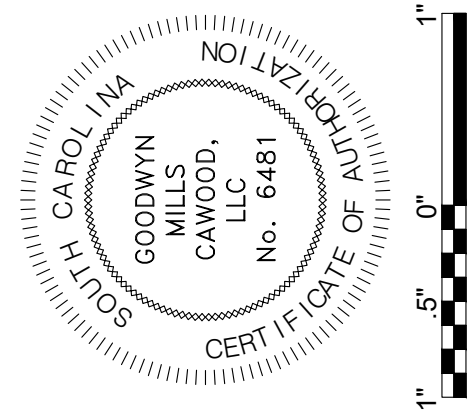
P & ID
ABBREVIATIONS
& NOTES

I-001

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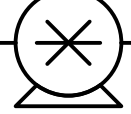
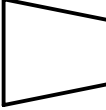
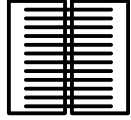
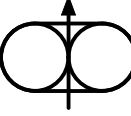
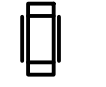
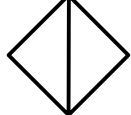
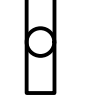
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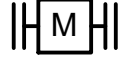
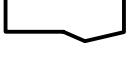


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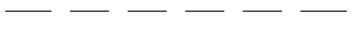
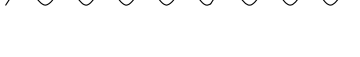
GENERAL EQUIPMENT			
	CENTRIFUGAL PUMP		HEAT EXCHANGER
	POSITIVE DISPLACEMENT PUMP		PERISTALTIC PUMP
	VERTICAL TURBINE PUMP		STATIC MIXER
	HORIZONTAL SPLIT-CASE PUMP		MIXER
	ROTARY SCREW COMPRESSOR		SILENCER
	PROGRESSIVE CAVITY PUMP		DRAIN
	GRINDER		VENT
	DIAPHRAGM PUMP		FLEXIBLE HOSE OR JOINT
	EDUCTOR		DIAPHRAGM OR LOAD CELL
	CENTRIFUGAL FAN / BLOWER		UNION
	BLOWER (POSITIVE DISPLACEMENT)		ANNULAR SEAL RING
	SPRAY NOZZLE		SINGLE ARCH EXPANSION JOINT
	FILTER/STRAINER		SLIDE GATE
	HEATER		HIGH-SPEED TURBO BLOWER

VALVES	
	GATE
	GLOBE
	CHECK
	DIAPHRAGM
	BALL
	FLOAT
	DUCKBILL CHECK
	NEEDLE
	BUTTERFLY
	SAFETY RELIEF
	PRESSURE REGULATING
	PLUG
	3-WAY
	AIR RELEASE
	MUD OR FOOT
	PINCH

INSTRUMENTS	
	FLOWMETER - MAG
	FLOWMETER - PROPELLER
	FLOWMETER - VENTURI
	FLOWMETER - THERMAL MASS
	ROTAMETER
	PARSHALL FLUME
	LEVEL ELEMENT (ULTRASONIC)
	FLOAT SWITCH
	VIBRATING FORK LEVEL SWITCH

GENERAL FITTINGS	
	REDUCER
	FLANGE/BOLTED
	END CAP
	RESTRICTING ORIFICE
	COUPLER CONNECTION

ACTUATORS	
	MOTOR OPERATOR
	SOLENOID
	PNEUMATIC ACTUATOR

LINE LEGEND	
	PRIMARY PROCESS LINE
	SECONDARY PROCESS LINE
	EXISTING
	ELECTRICAL SIGNAL
	ELECTRIC SUPPLY VOLTAGE/PHASE
	INSULATED
	HEAT TRACED
	ETHERNET
	PLANT AIR SUPPLY
	INSTRUMENT AIR SUPPLY
	NON-POTABLE WATER SUPPLY
	REUSE WATER SUPPLY
	BY VENDOR

P & ID
LEGENDS

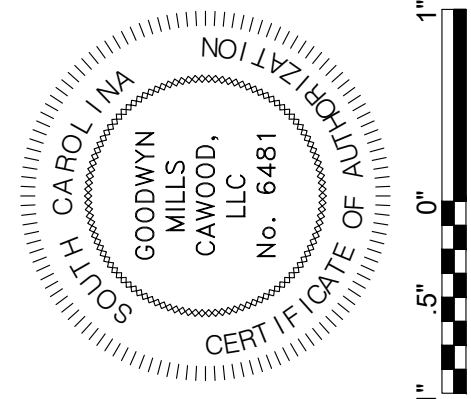
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Town of Pendleton
City of Clemson
Anderson County

I-002

GMC PROJECT #CGRE220027

ISSUE DATE

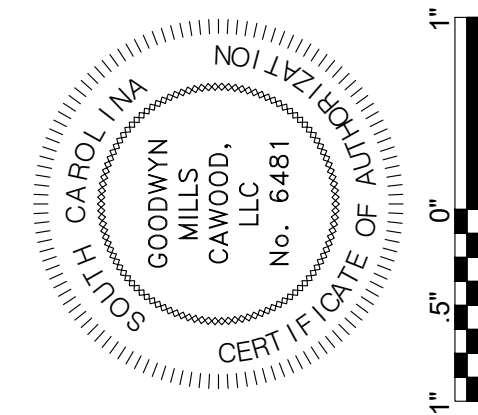
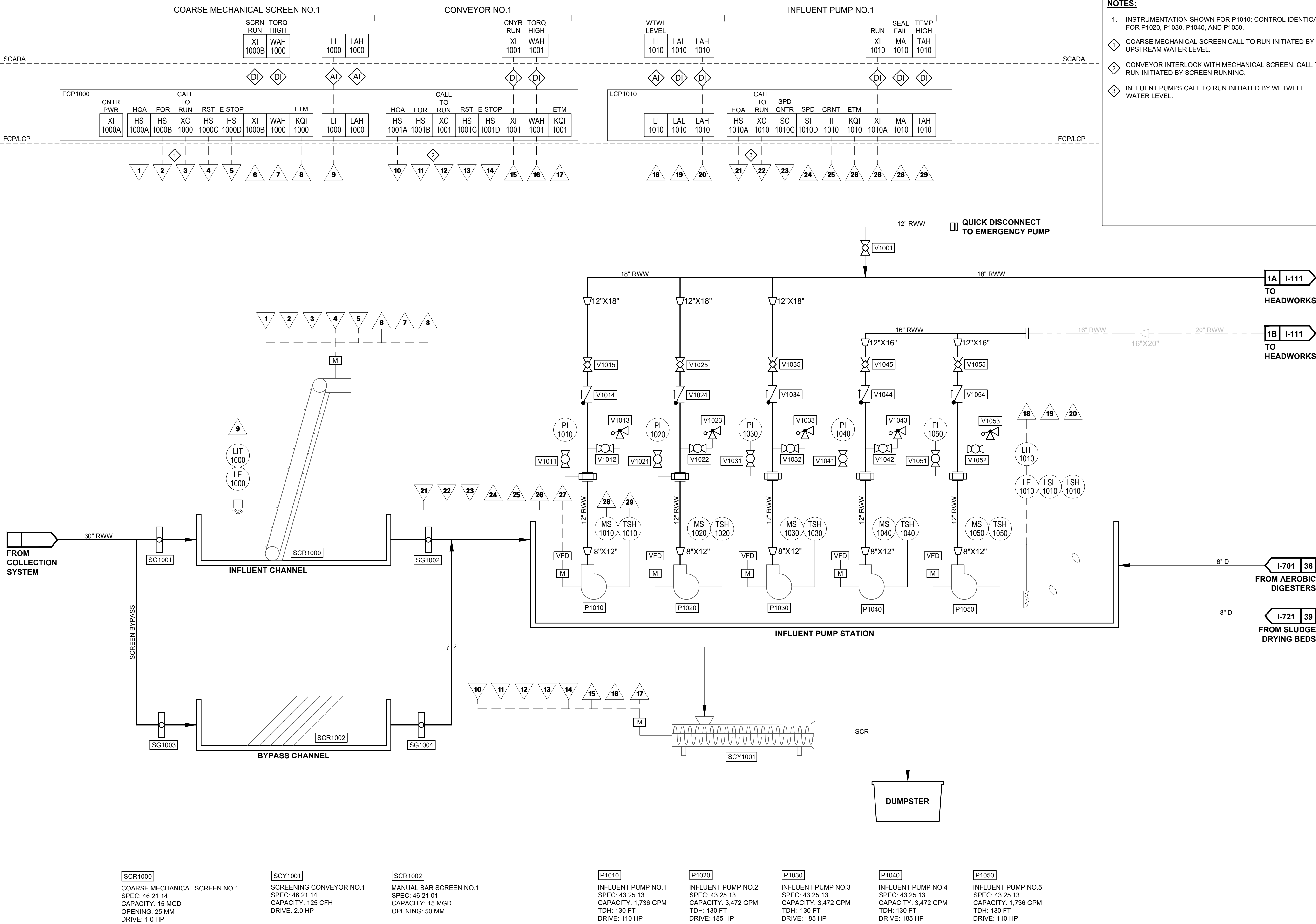
30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
100% Submittal	03/08/2024
Confirmed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD



GMC
117 Welborn St.
Greenville, SC 29601
T 864.527.0460

DRAWING FILE: T:\Projects\SCS\Pendleton, Town of\CGCRE220027 - Pendleton-Clemson WWTP\0 DWG\CG-CAD\0 BID DRAWINGS\02 INSTRUMENTATION\I-101 PCS PID.dwg
PLOTTED: Mar 11, 2024 - 5:19pm

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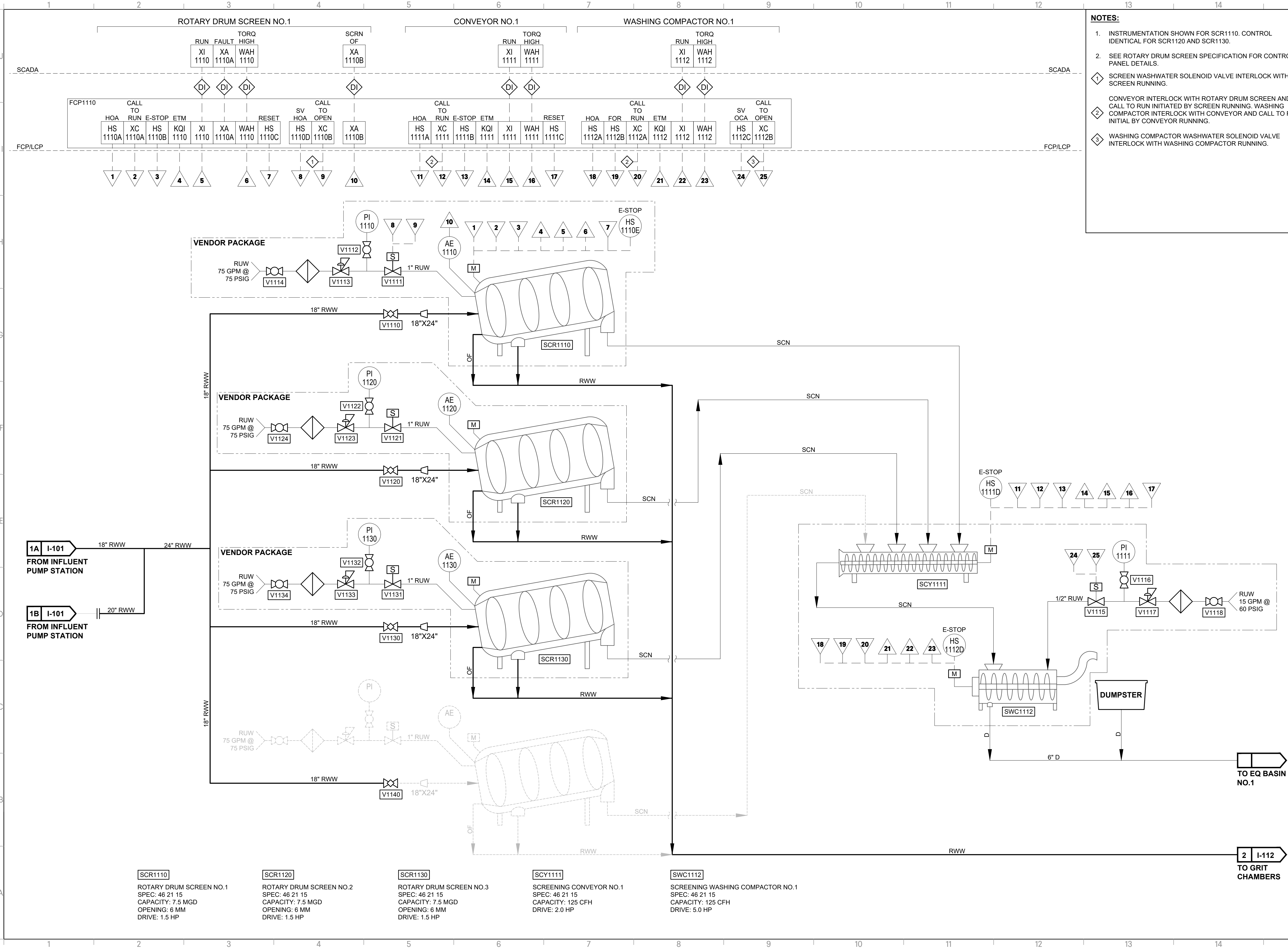
ISSUE	DATE
30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
100% Submittal	03/08/2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

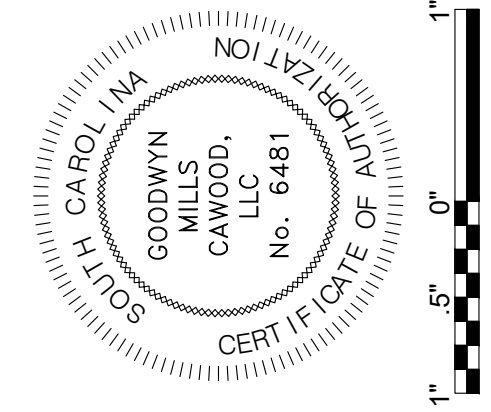
GMC PROJECT #CGCRE220027

P&ID
COARSE SCREEN
AND INFLUENT
PUMP STATION
I-101

DRAWING FILE: T:\Projects\SC-Pendleton, Town of\CGCRE220027 - Pendleton-Clemson WWTP\0 DWG\VCAD\01 BID DRAWINGS\02 INSTRUMENTATION\I-101 PCS PID.dwg
PLOTTED: Mar 11, 2024 - 5:59pm



- NOTES:**
1. INSTRUMENTATION SHOWN FOR SCR1110. CONTROL IDENTICAL FOR SCR1120 AND SCR1130.
 2. SEE ROTARY DRUM SCREEN SPECIFICATION FOR CONTROL PANEL DETAILS.
 3. SCREEN WASHWATER SOLENOID VALVE INTERLOCK WITH SCREEN RUNNING.
 4. CONVEYOR INTERLOCK WITH ROTARY DRUM SCREEN AND CALL TO RUN INITIATED BY SCREEN RUNNING. WASHING COMPACTOR INTERLOCK WITH CONVEYOR AND CALL TO RUN INITIAL BY CONVEYOR RUNNING.
 5. WASHING COMPACTOR WASHWATER SOLENOID VALVE INTERLOCK WITH WASHING COMPACTOR RUNNING.



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Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGCRE220027

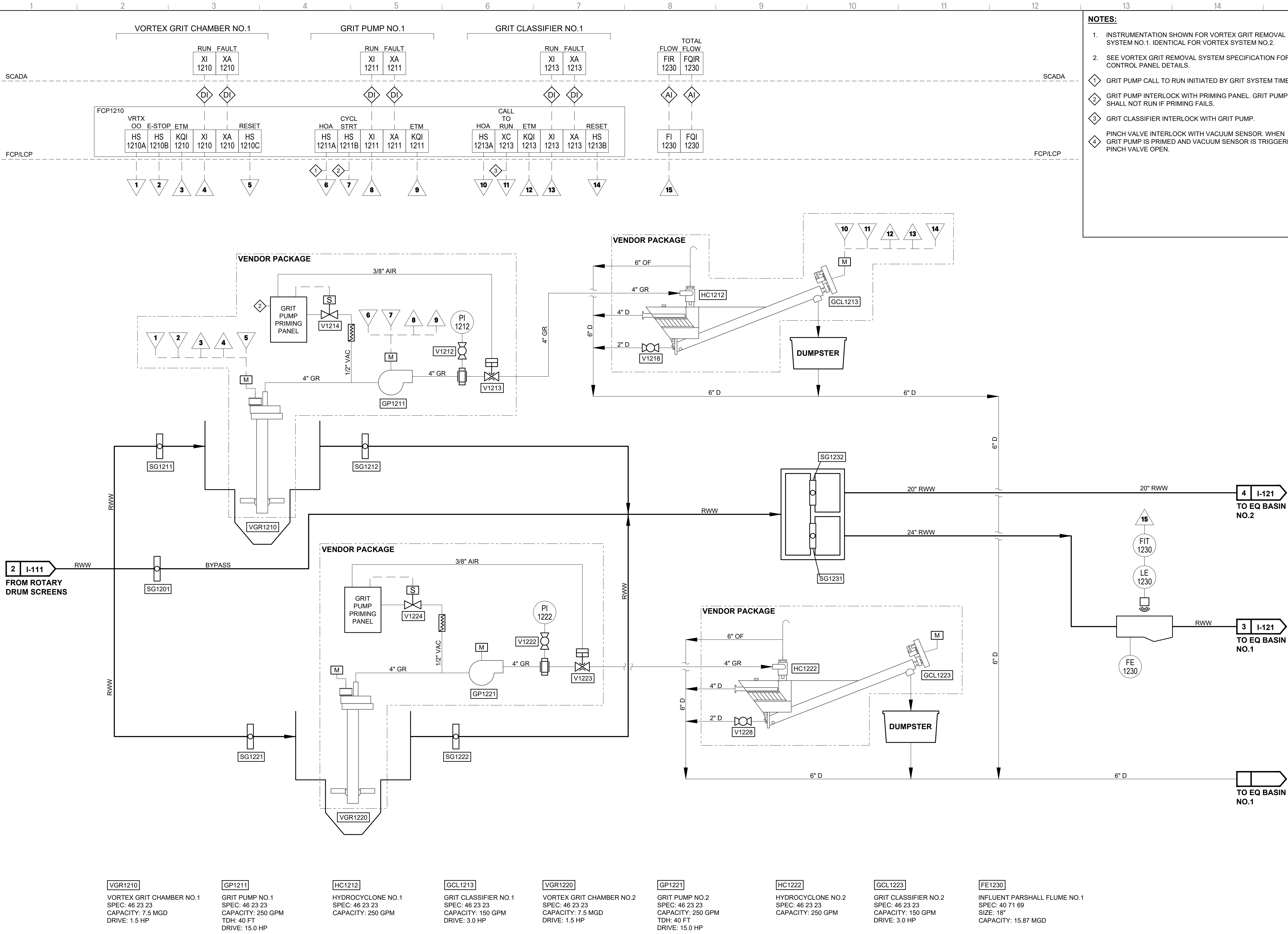
P&ID
FINE SCREENS

I-111

GMC
117 Welborn St.
Greenville, SC 29601
T 864.527.0460

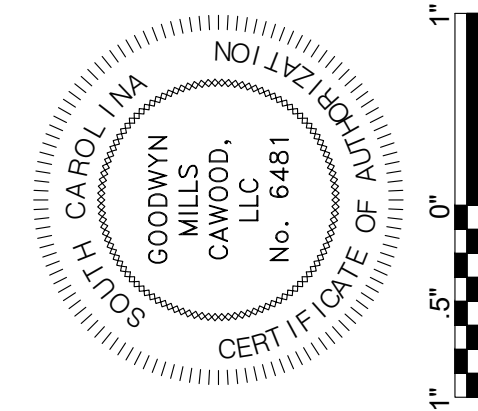
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PLOTTED: Mar 11, 2024 - 5:19pm

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NOTES:

- INSTRUMENTATION SHOWN FOR VORTEX GRIT REMOVAL SYSTEM NO.1. IDENTICAL FOR VORTEX SYSTEM NO.2.
- SEE VORTEX GRIT REMOVAL SYSTEM SPECIFICATION FOR CONTROL PANEL DETAILS.
- GRIT PUMP CALL TO RUN INITIATED BY GRIT SYSTEM TIMER.
- GRIT PUMP INTERLOCK WITH PRIMING PANEL. GRIT PUMP SHALL NOT RUN IF PRIMING FAILS.
- GRIT CLASSIFIER INTERLOCK WITH GRIT PUMP.
- PINCH VALVE INTERLOCK WITH VACUUM SENSOR. WHEN GRIT PUMP IS PRIMED AND VACUUM SENSOR IS TRIGGERED, PINCH VALVE OPEN.



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Project Manager:	WN
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Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGCRE220027

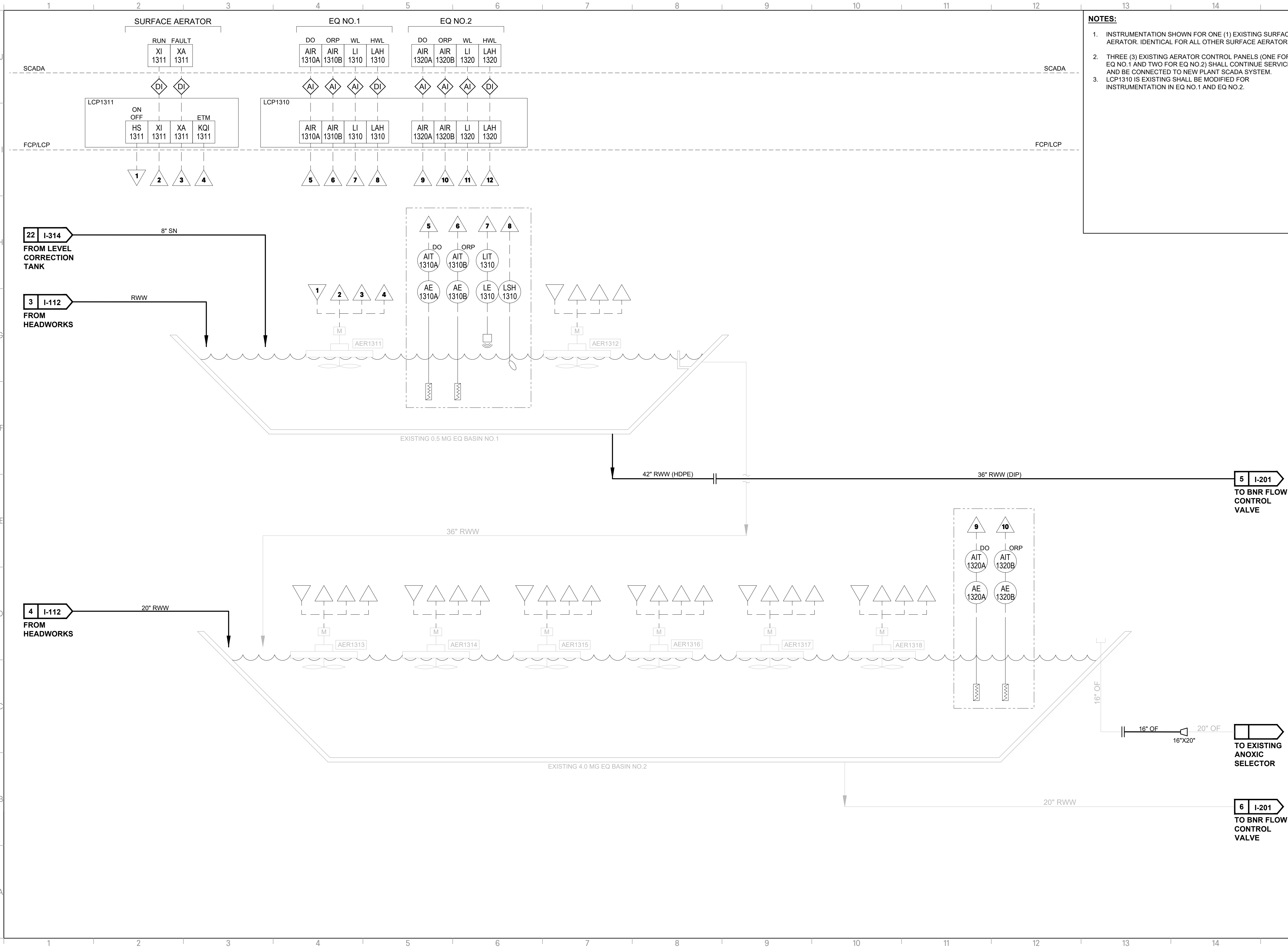
P&ID
GRIT REMOVAL

I-112

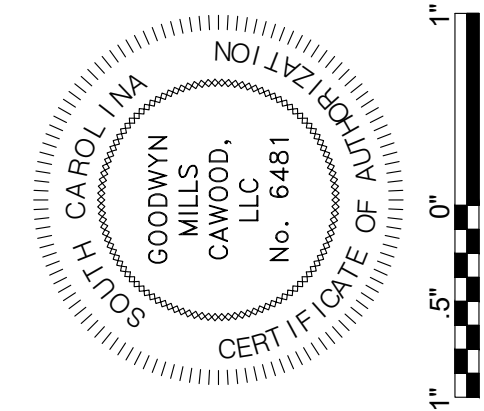
GMC
117 Welborn St.
Greenville, SC 29601
T 864.527.0460

DRAWING FILE: T:\Projects\SCS\Pendleton, Town of\CGCRE220027 - Pendleton-Clemson WWTP\0.DWG\CAAD\01 BID DRAWINGS\02 INSTRUMENTATION\I-101 PCB PID.dwg
PLOTTED: Mar 11, 2024 - 5:59pm

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- NOTES:**
1. INSTRUMENTATION SHOWN FOR ONE (1) EXISTING SURFACE AERATOR. IDENTICAL FOR ALL OTHER SURFACE AERATORS.
 2. THREE (3) EXISTING AERATOR CONTROL PANELS (ONE FOR EQ NO.1 AND TWO FOR EQ NO.2) SHALL CONTINUE SERVICE AND BE CONNECTED TO NEW PLANT SCADA SYSTEM.
 3. LCP1310 IS EXISTING SHALL BE MODIFIED FOR INSTRUMENTATION IN EQ NO.1 AND EQ NO.2.



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Engineer:	TR
Designer:	JX
Drawn By:	HKD

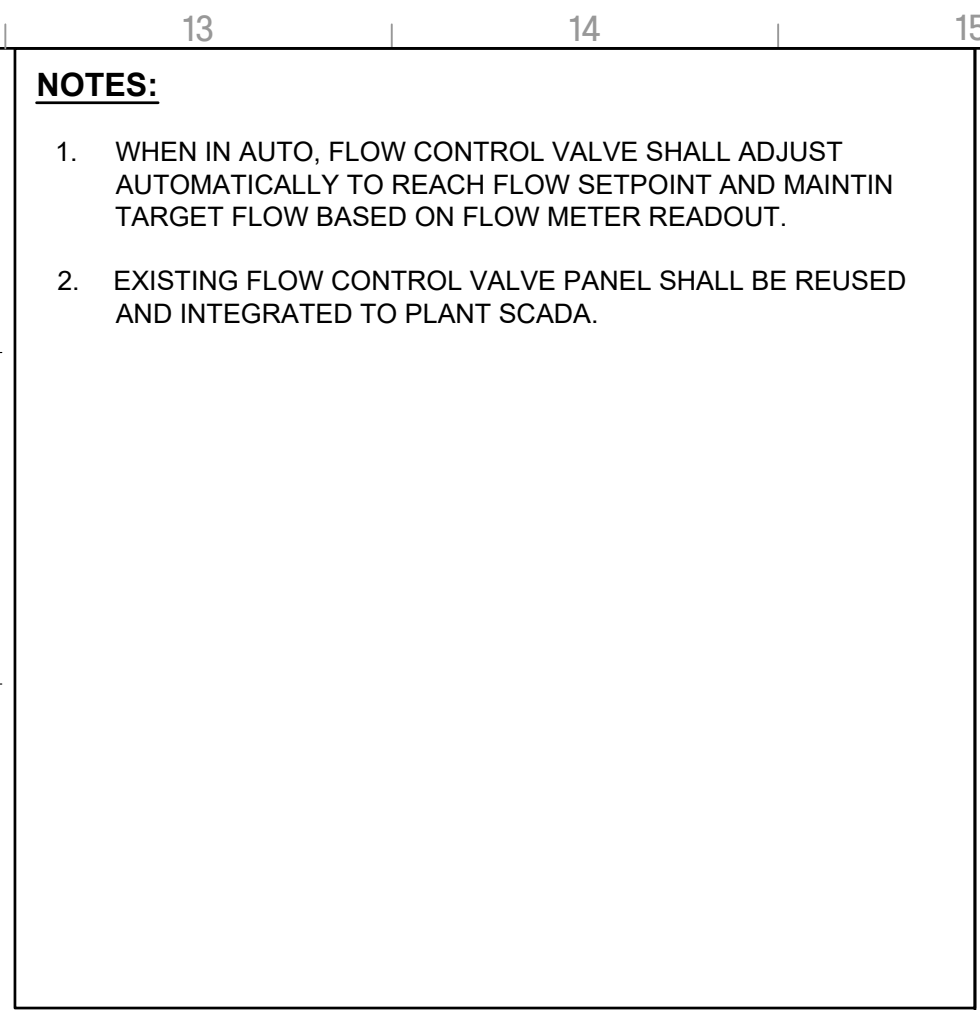
PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGCRE220027

P&ID
FLOW EQUALIZATION
BASINS

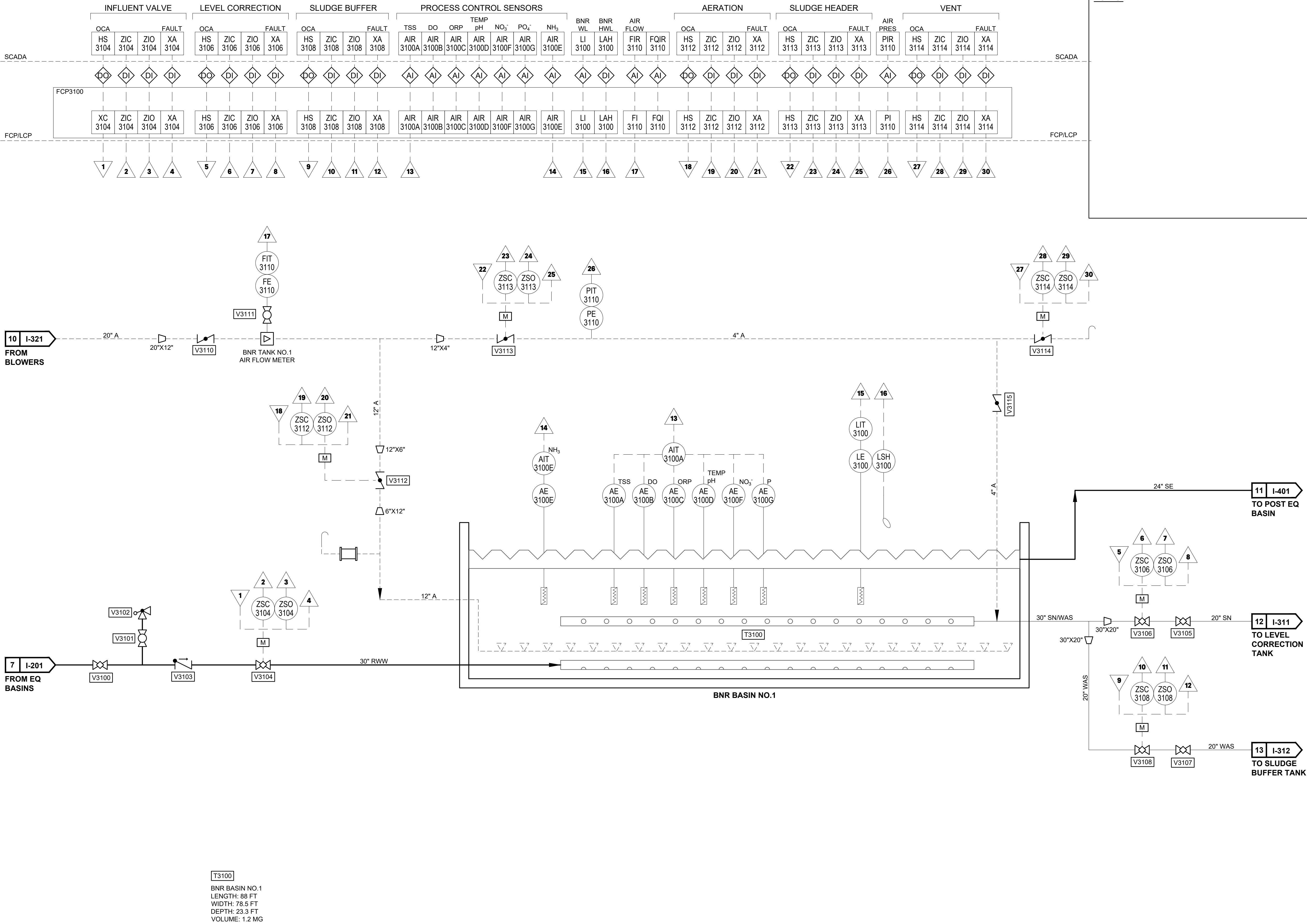
I-121

GMC
117 Welborn St.
Greenville, SC 29601
T 864.527.0460

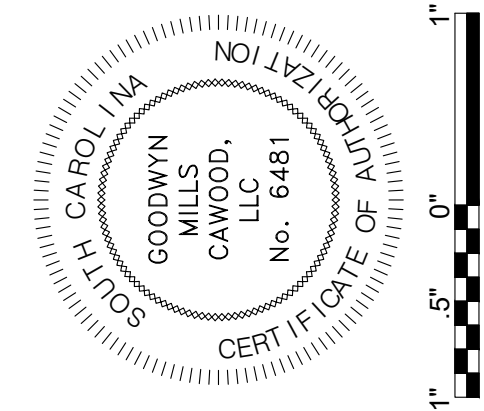


DRAWING FILE: T:\Projects\SCS\Pendleton, Town of\CGCRE220027 - Pendleton-Clemson WWTP\0. DWG\VCAD\01 BID DRAWINGS\02 INSTRUMENTATION\I-301 P&ID.dwg
PLOTTED: Mar 11, 2024 - 5:59pm

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NOTES:



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Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

P&ID
BIOLOGICAL NUTRIENT REMOVAL BASIN NO.1

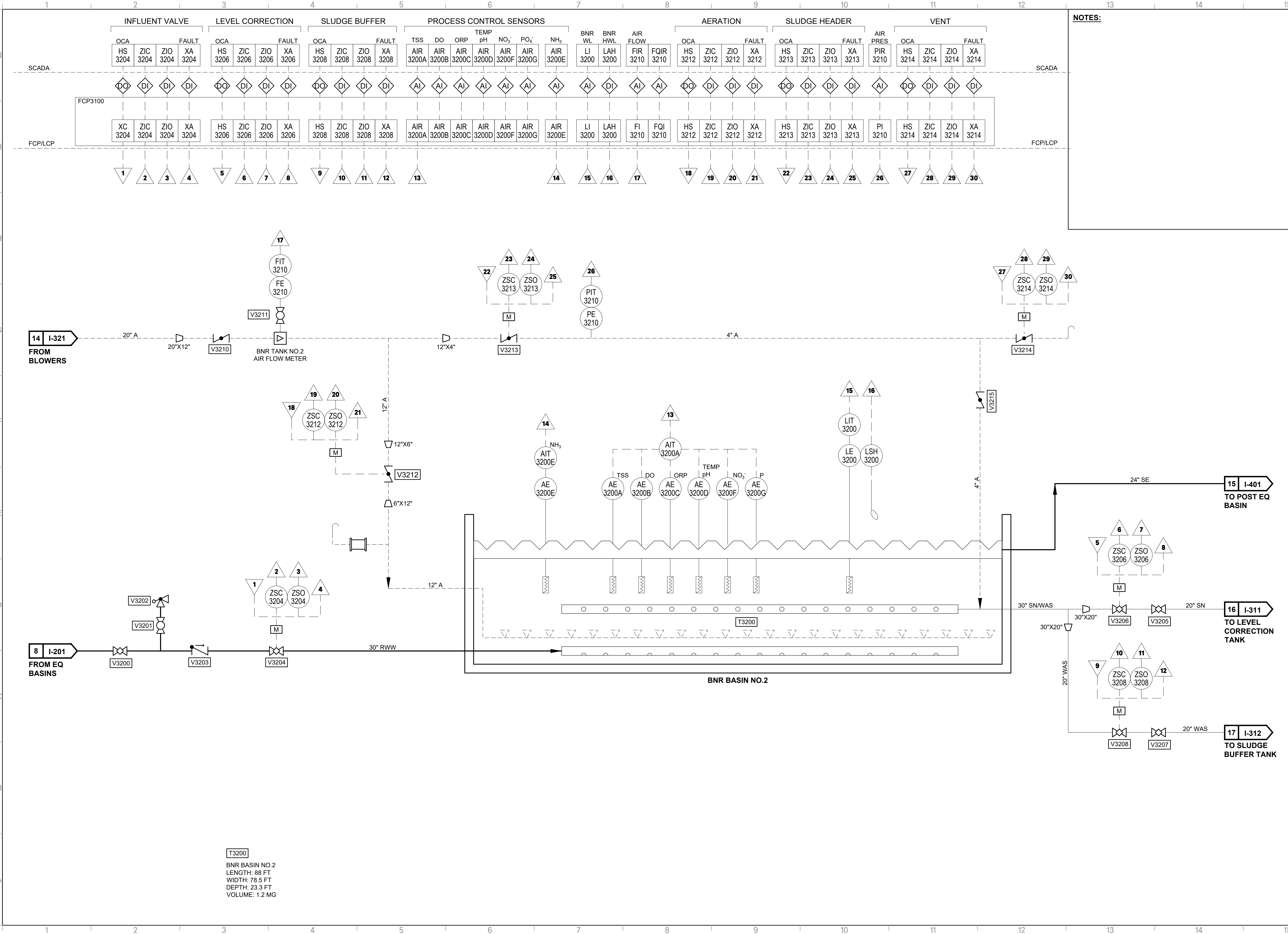
PENDLETON - CLEMSON REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGCRE220027

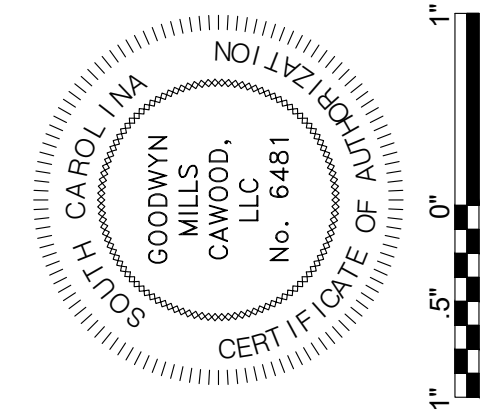
GMC
117 Welborn St.
Greenville, SC 29601
T 864.527.0460

I-301

DRAWING FILE: T:\Projects\SCS\Pendleton, Town of\CGCRE220027 - Pendleton-Clemson WWTP\0 DWG\VCAD\01 BID DRAWINGS\02 INSTRUMENTATION\I-301 PCR PID.dwg
PLOTTED: Mar 11, 2024 - 5:19pm



NOTES:



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Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGCRE220027

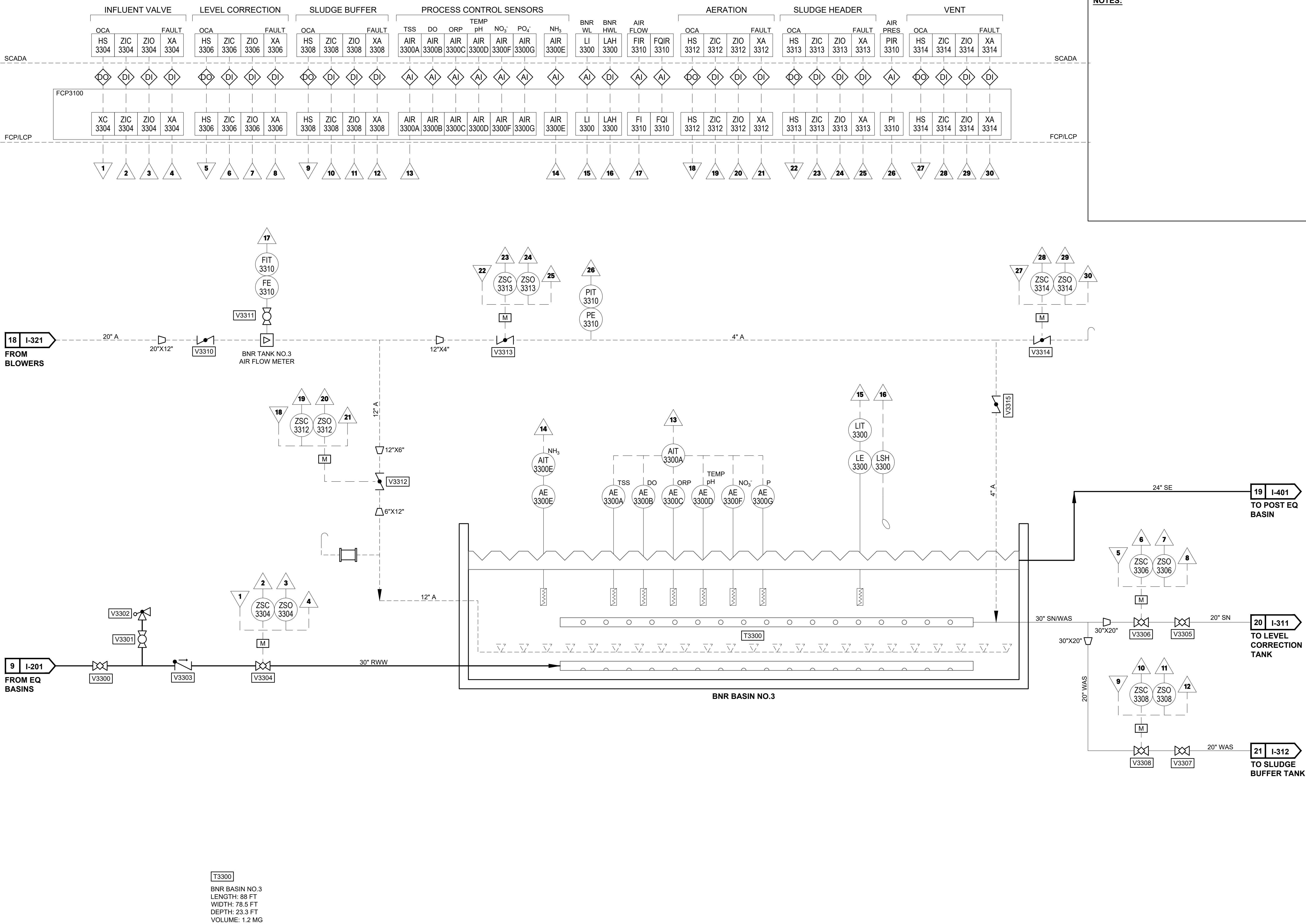
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BIOLOGICAL NUTRIENT
REMOVAL BASIN NO. 2

I-302

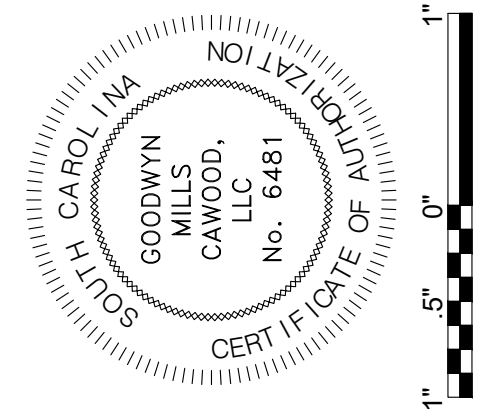
GMC
117 Welborn St.
Greenville, SC 29601
T 864.527.0460

DRAWING FILE: T:\Projects\SC-Pendleton, Town of\CGCRE220027 - Pendleton-Clemson WWTP\0. DWG\VCAD\01 BID DRAWINGS\02 INSTRUMENTATION\I-303 P&ID.dwg
PLOTTED: Mar 11, 2024 - 5:59pm

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NOTES:



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Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

P&ID

BIOLOGICAL NUTRIENT REMOVAL BASIN NO.3

PENDLETON - CLEMSON REGIONAL WWTP EXPANSION

PENDLETON, SOUTH CAROLINA

Town of Pendleton

City of Clemson

Anderson County

GMC PROJECT #CGCRE220027

GMC

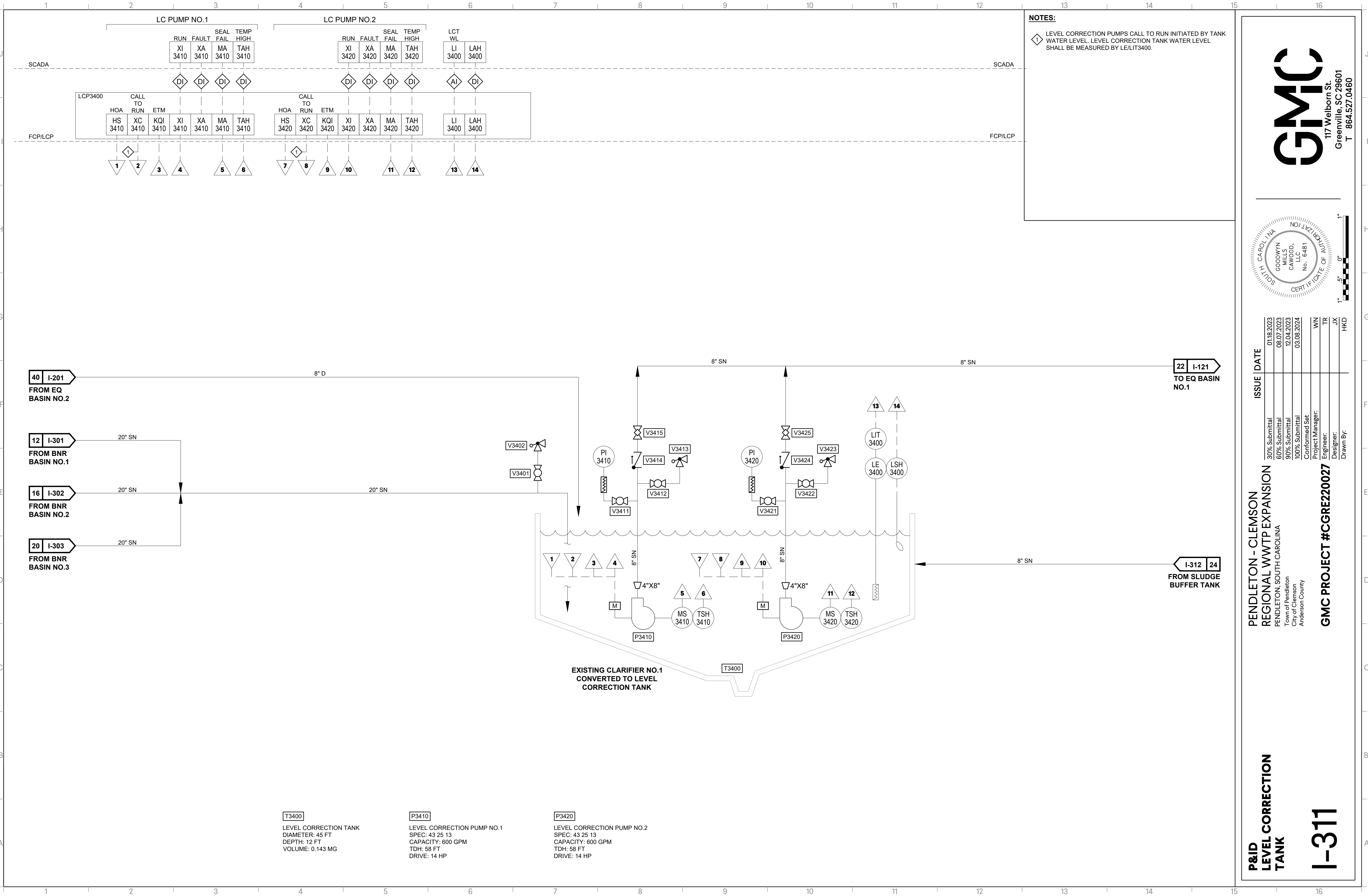
117 Welborn St.
Greenville, SC 29601

T 864.527.0460

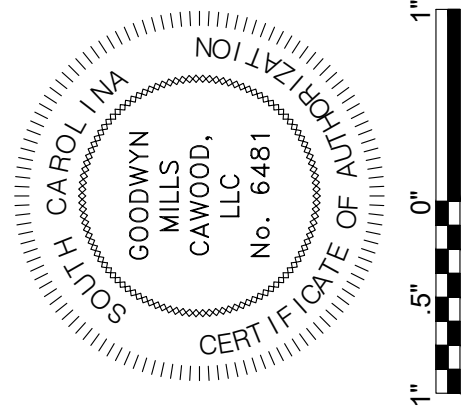
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PLOTTED: Mar 11, 2024 - 5:18pm

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NOTES:
1 LEVEL CORRECTION PUMPS CALL TO RUN INITIATED BY TANK WATER LEVEL. LEVEL CORRECTION TANK WATER LEVEL SHALL BE MEASURED BY LE/LIT3400.



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30% Submittal	01/18/2023
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100% Submittal	03/08/2024
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Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

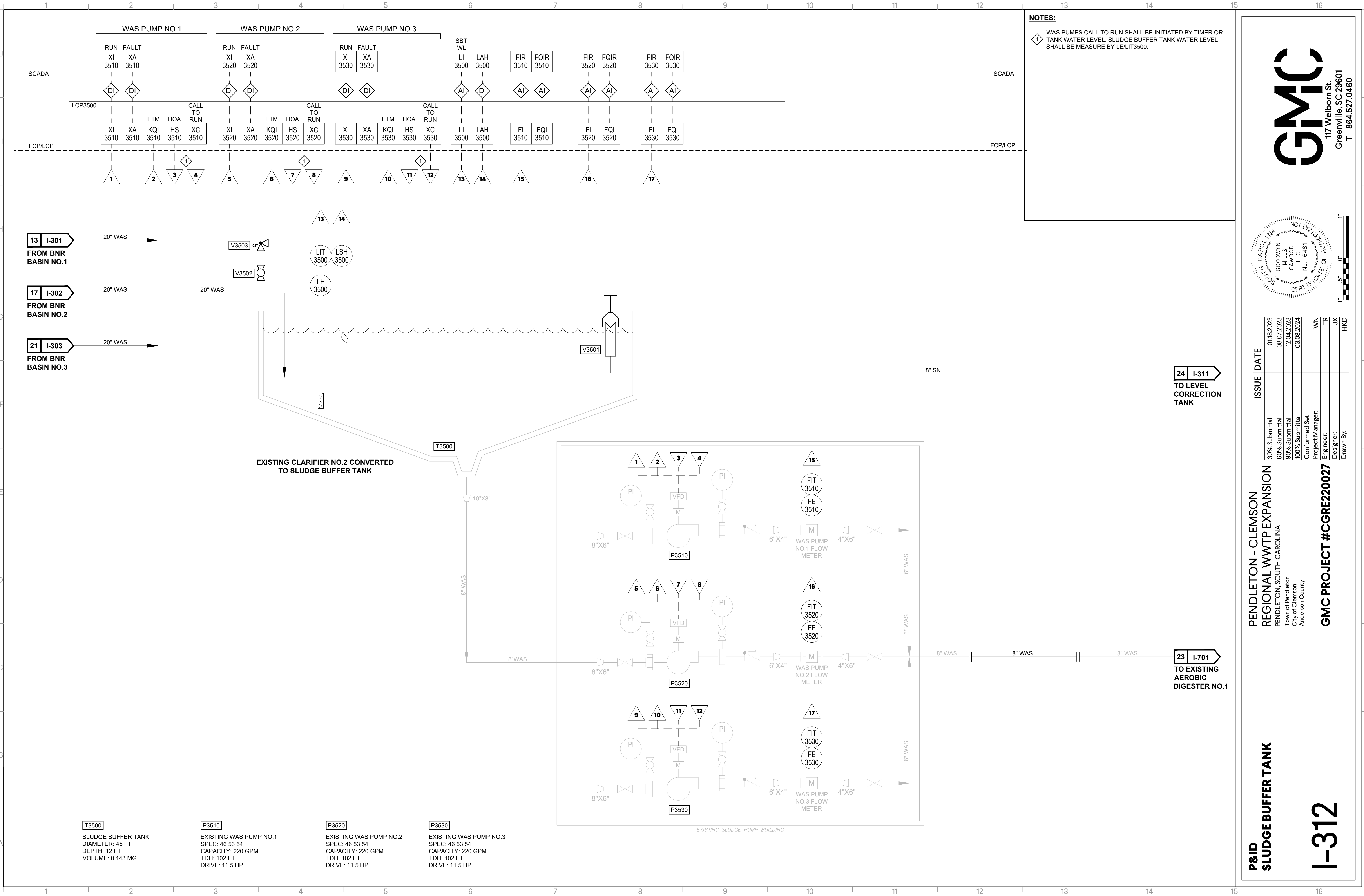
P&ID
LEVEL CORRECTION
TANK

I-311

GMC
117 Welborn St.
Greenville, SC 29601
T 864.527.0460

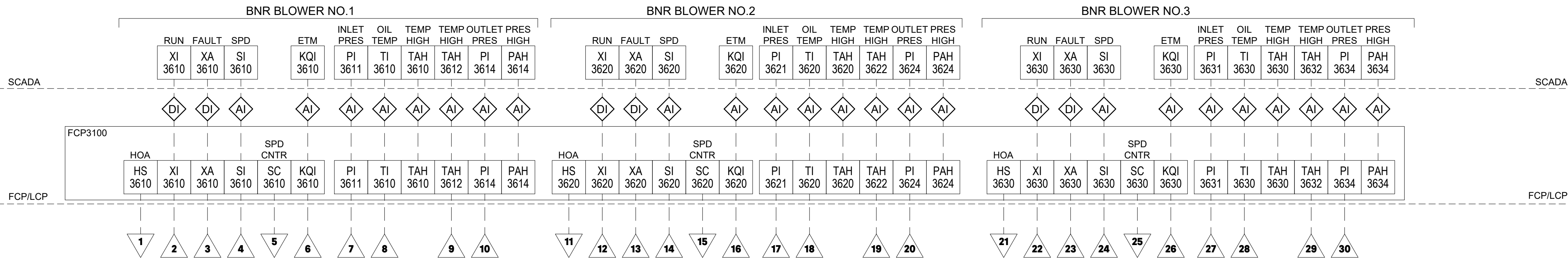
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PLOTTED: Mar 11, 2024 - 5:18pm

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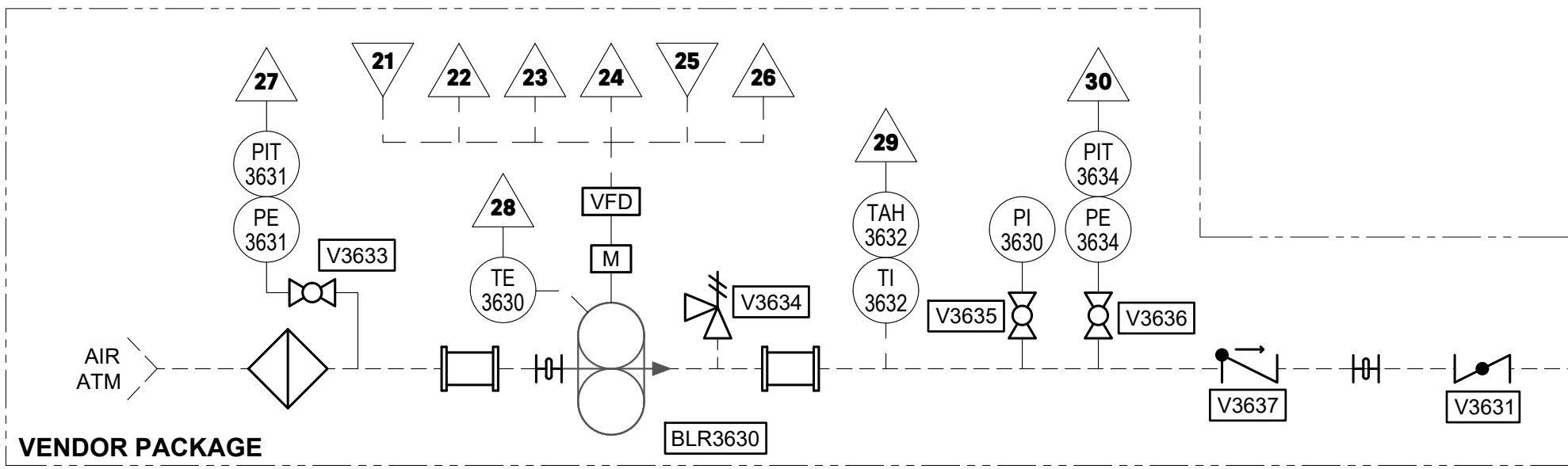
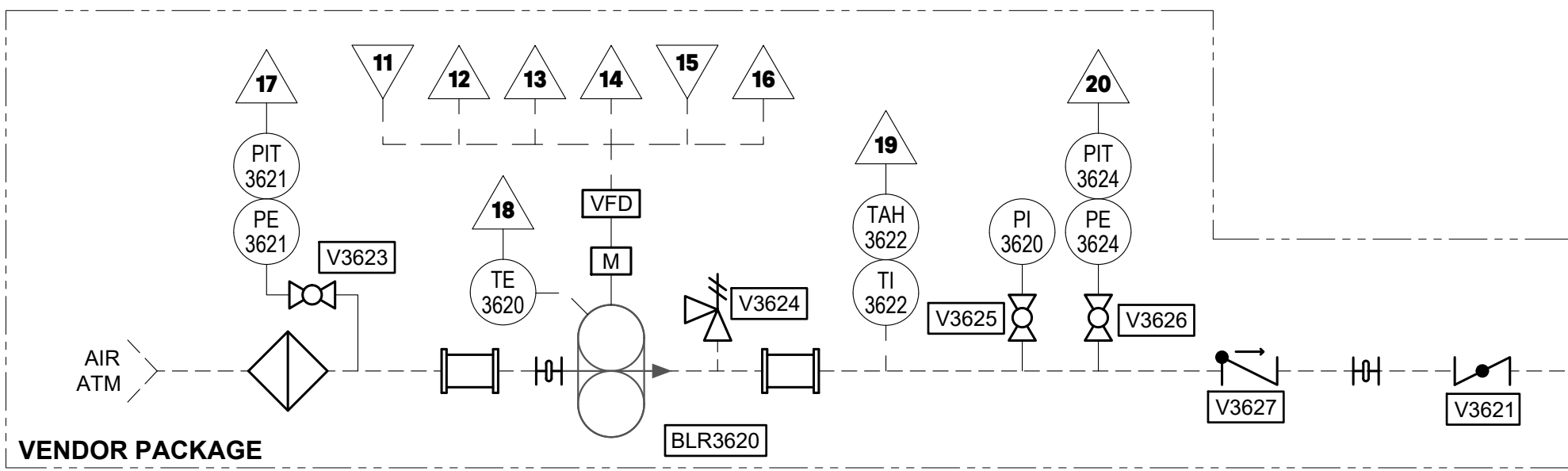
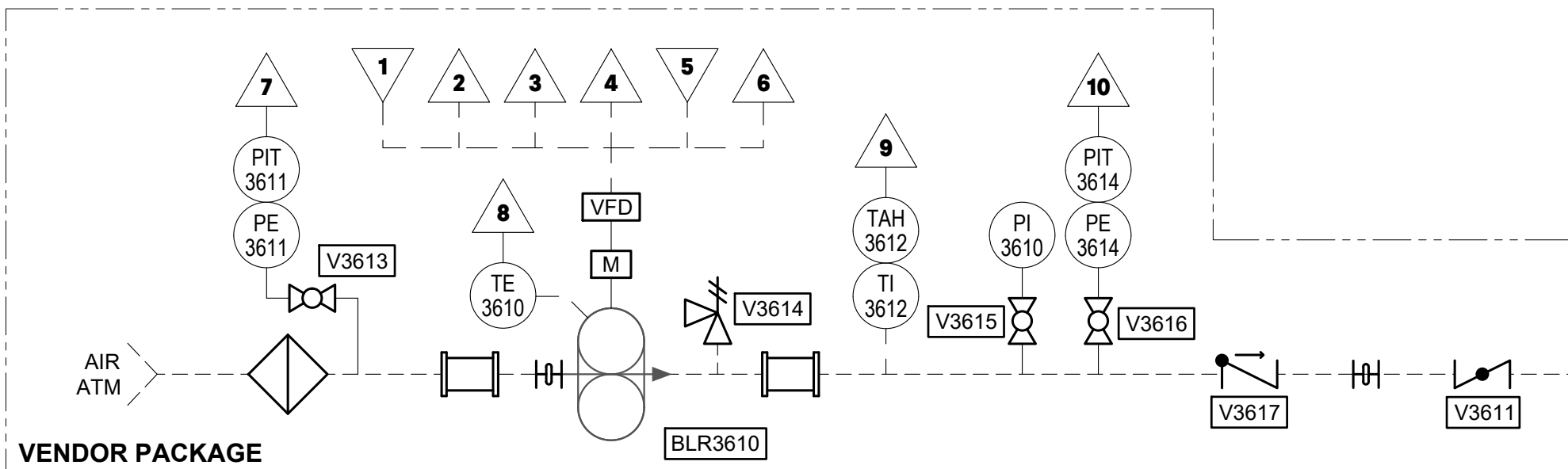


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PLOTTED: Mar 11, 2024 - 5:18pm

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NOTES:



BLR3610

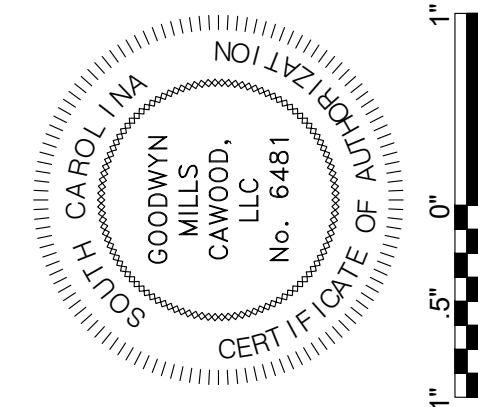
BNR BLOWER NO.1
SPEC: 46 53 54
CAPACITY: 3,241 SCFM
DISCHARGE PRESSURE: 11.7 PSIG
DRIVE: 250 HP

BLR3620

BNR BLOWER NO.2
SPEC: 46 53 54
CAPACITY: 3,241 SCFM
DISCHARGE PRESSURE: 11.7 PSIG
DRIVE: 250 HP

BLR3630

BNR BLOWER NO.3
SPEC: 46 53 54
CAPACITY: 3,241 SCFM
DISCHARGE PRESSURE: 11.7 PSIG
DRIVE: 250 HP



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Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

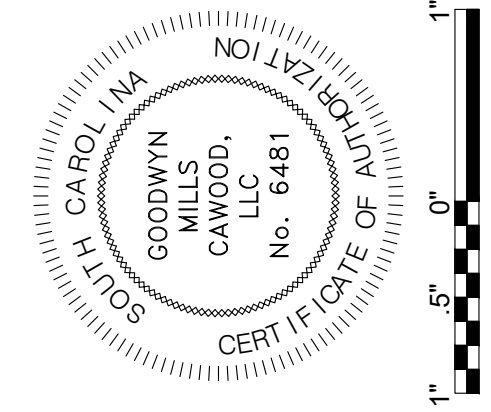
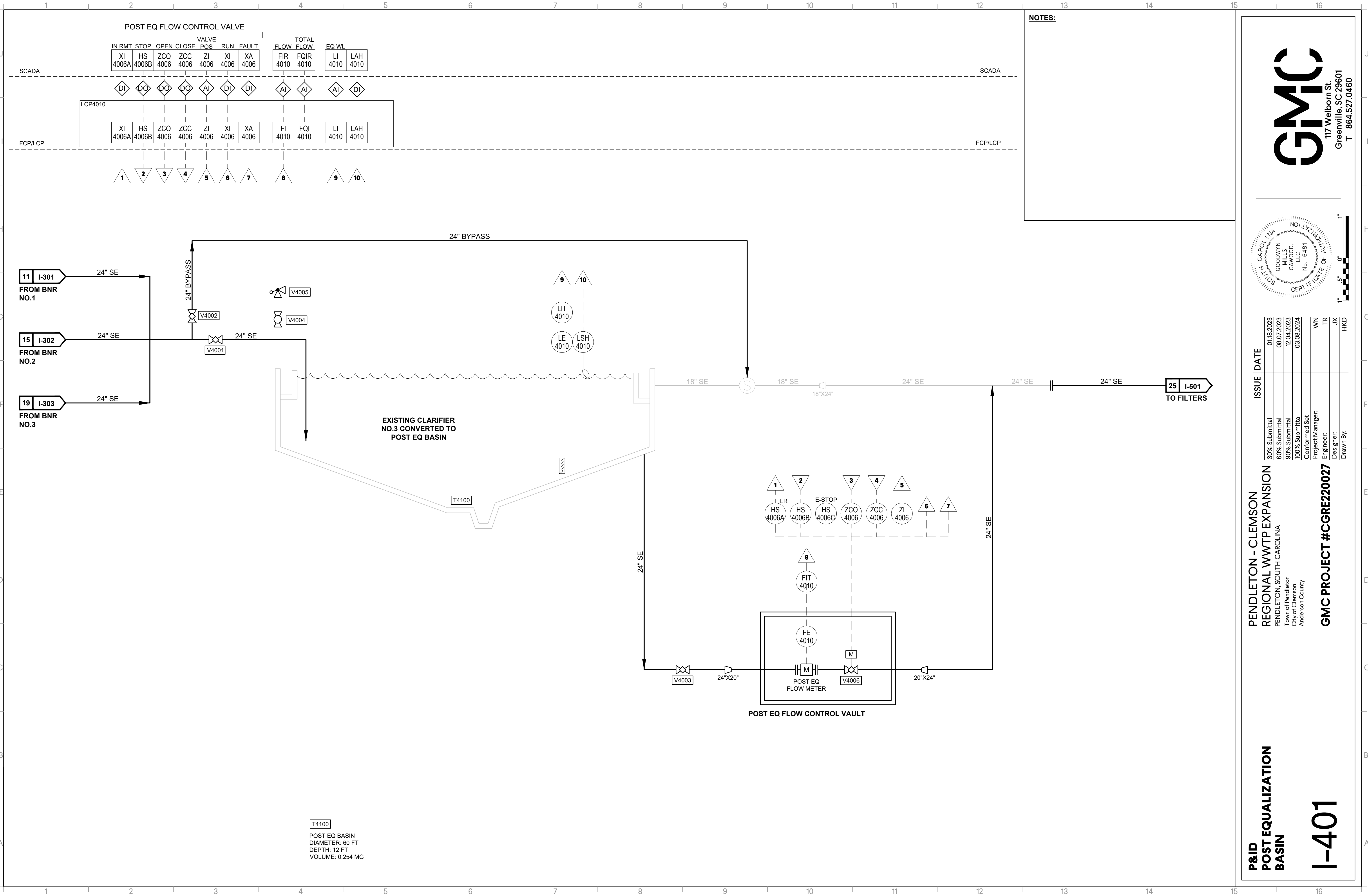
GMC PROJECT #CGCRE220027

P&ID
BNR BLOWERS

I-321

GMC
117 Welborn St.
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Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTp EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

P&ID
POST EQUALIZATION
BASIN

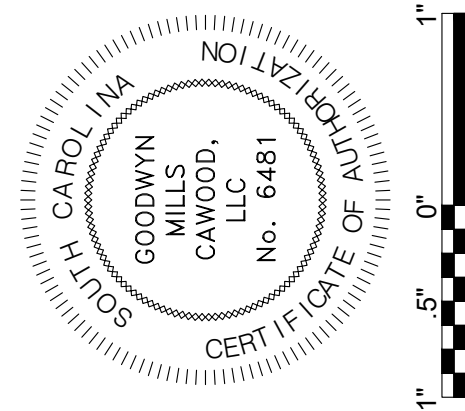
I-401

DRAWING FILE: T:\Projects\SCS\Pendleton, Town of\CGCRE220027 - Pendleton-Clemson WWTp\0.DWG\+CAD\01 BID DRAWINGS\02 INSTRUMENTATION\I-501 FCR PID.dwg
PLOTTED: Mar 11, 2024 - 5:18pm

CLOTH MEDIA DISC FILTER NO.2

NOTES:

1 BACKWASH VALVES CALLED TO OPEN INITIATED BY FILTER BASIN WATER LEVEL OR TIMER. BACKWASH PUMPS CALLED TO RUN INITIATED BY BASIN WATER LEVEL OR TIMER.



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100% Submittal	03/08/2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTp EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGCRE220027

P&ID
TERTIARY FILTER NO.1
AND NO.2

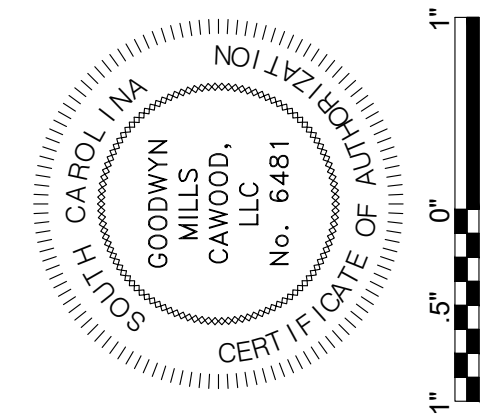
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DRAWING FILE: T:\Projects\SCS\Pendleton, Town of\CGCRE220027 - Pendleton-Clemson WWTP\0 DWG\VCAD\0 BID DRAWINGS\02 INSTRUMENTATION\I-501 FCR PID.dwg
PLOTTED: Mar 11, 2024 - 5:18pm

CLOTH MEDIA DISC FILTER NO.3

NOTES:

BACKWASH VALVES CALLED TO OPEN INITIATED BY
FILTER BASIN WATER LEVEL OR TIMER. BACKWASH
PUMPS CALLED TO RUN INITIATED BY BASIN WATER
LEVEL OR TIMER.



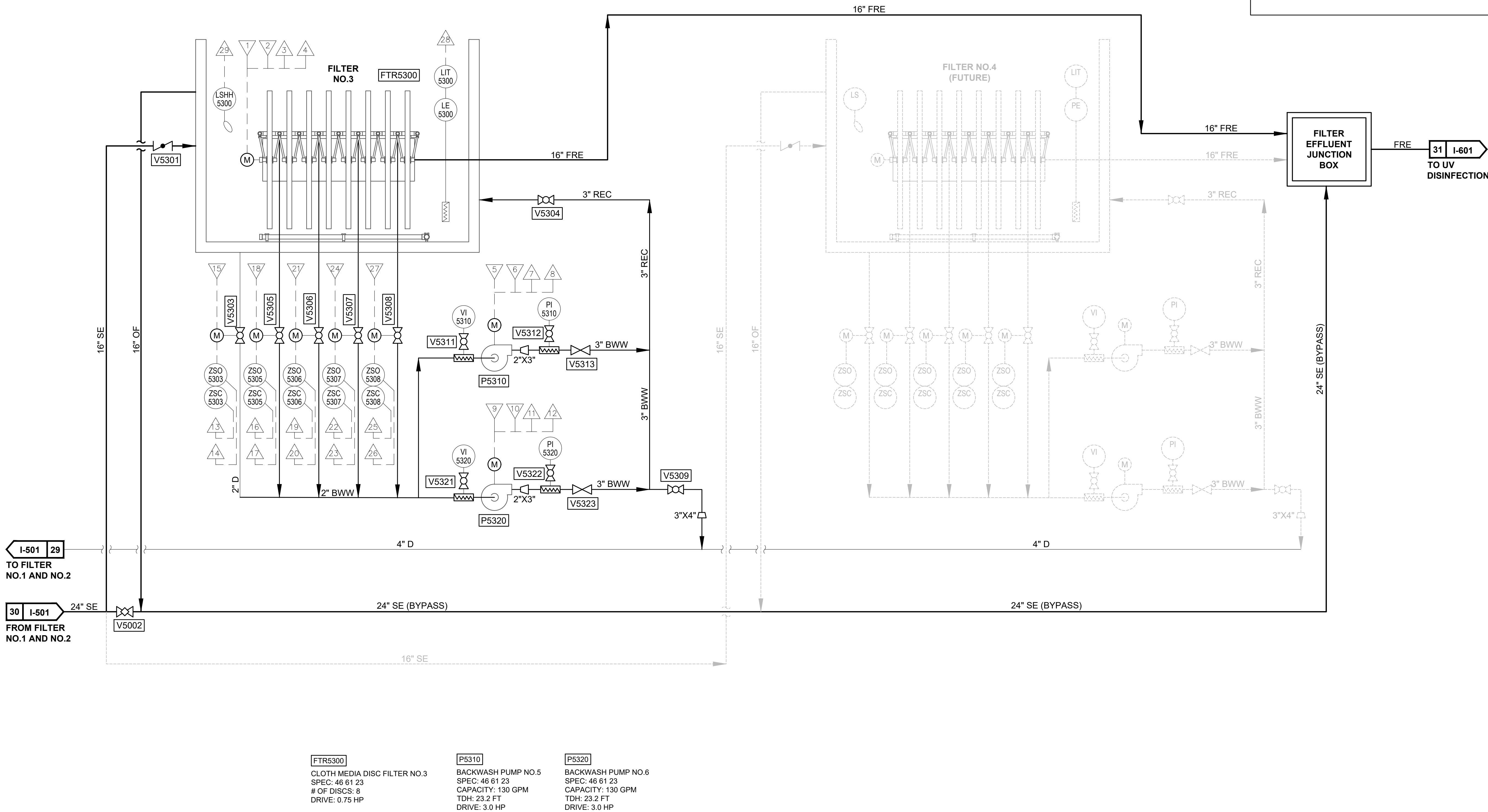
ISSUE	DATE
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90% Submittal	12/04/2023
100% Submittal	03/08/2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGCRE220027

P&ID
TERTIARY FILTER NO.3

I-502



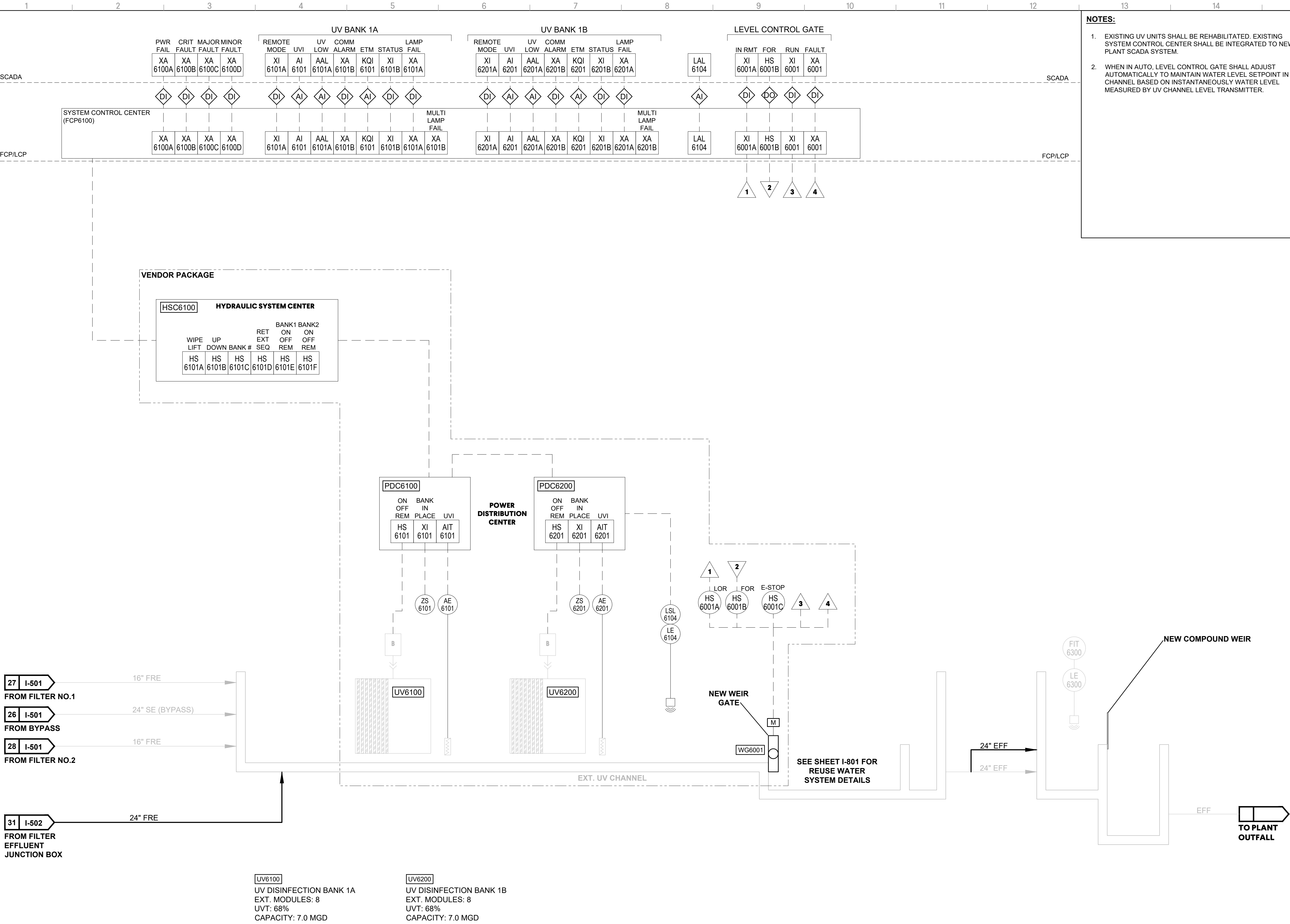
FTR5300
CLOTH MEDIA DISC FILTER NO.3
SPEC: 46 61 23
OF DISCS: 8
DRIVE: 0.75 HP

P5310
BACKWASH PUMP NO.5
SPEC: 46 61 23
CAPACITY: 130 GPM
TDH: 23.2 FT
DRIVE: 3.0 HP

P5320
BACKWASH PUMP NO.6
SPEC: 46 61 23
CAPACITY: 130 GPM
TDH: 23.2 FT
DRIVE: 3.0 HP

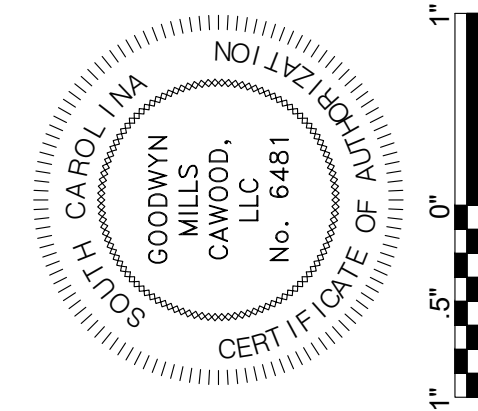
DRAWING FILE: T:\Projects\SC-Pendleton, Town of\CGCRE220027 - Pendleton-Clemson WWTP\0 DWG\VCAD\01 BID DRAWINGS\02 INSTRUMENTATION\I-601 P&ID.dwg
PLOTTED: Mar 11, 2024 - 5:18pm

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NOTES:

- EXISTING UV UNITS SHALL BE REHABILITATED. EXISTING SYSTEM CONTROL CENTER SHALL BE INTEGRATED TO NEW PLANT SCADA SYSTEM.
- WHEN IN AUTO, LEVEL CONTROL GATE SHALL ADJUST AUTOMATICALLY TO MAINTAIN WATER LEVEL SETPOINT IN UV CHANNEL BASED ON INSTANTANEOUSLY WATER LEVEL MEASURED BY UV CHANNEL LEVEL TRANSMITTER.



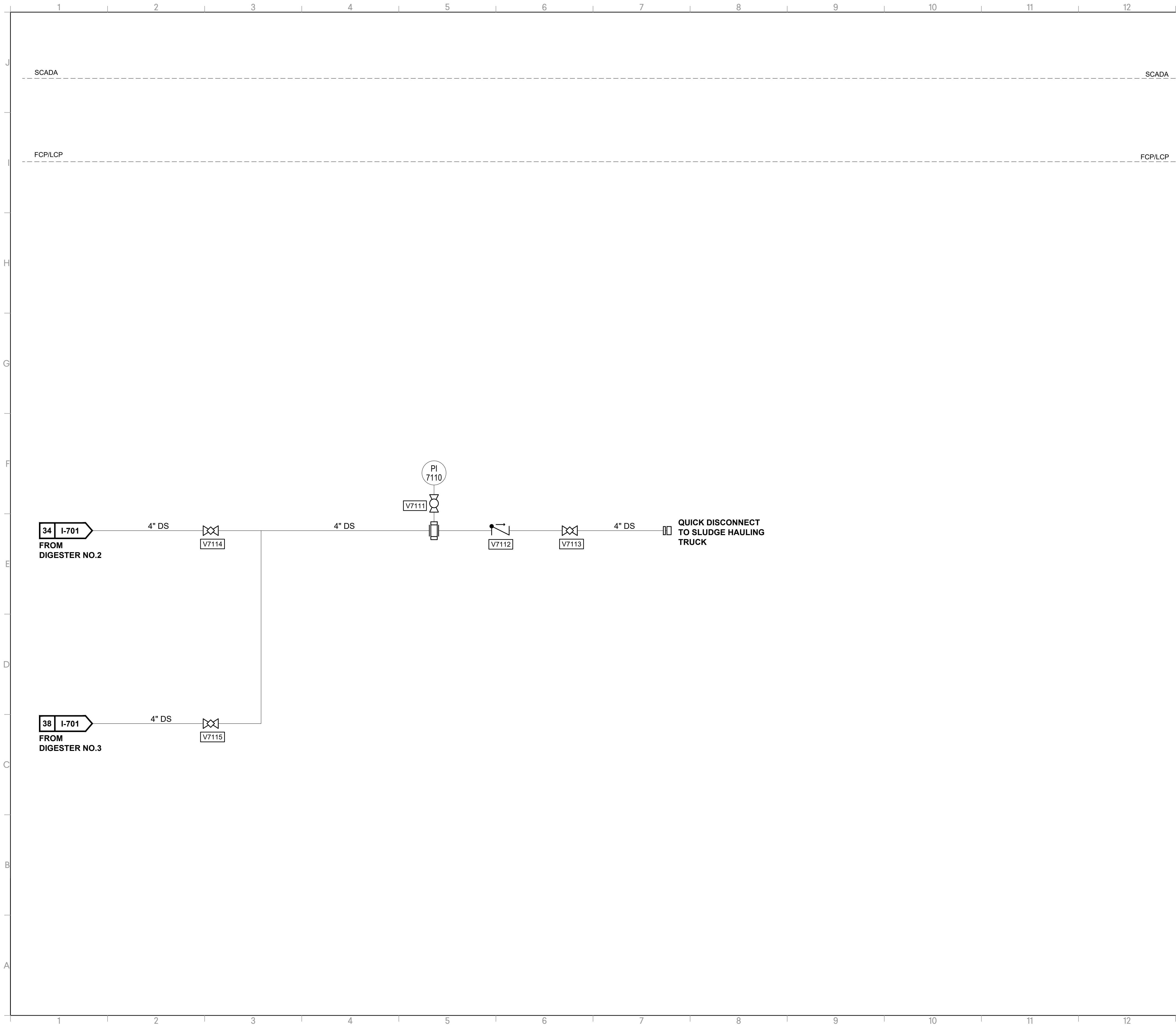
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Engineer:	TR
Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

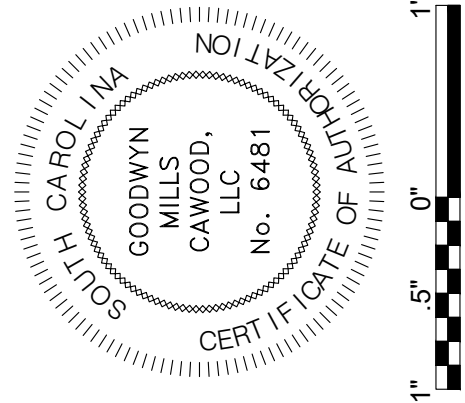
GMC PROJECT #CGCRE220027

P&ID
ULTRAVIOLET
DISINFECTION
I-601

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117 Welborn St.
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NOTES:



ISSUE	DATE
30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
100% Submittal	03/08/2024
Conformed Set	WN
Project Manager:	TR
Engineer:	JX
Designer:	
Drawn By:	HKD

**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**

PENDLETON, SOUTH CAROLINA

Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGR220027

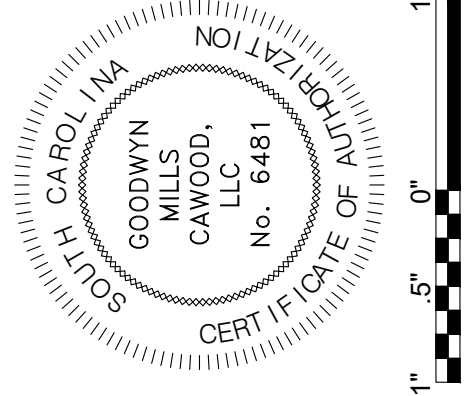
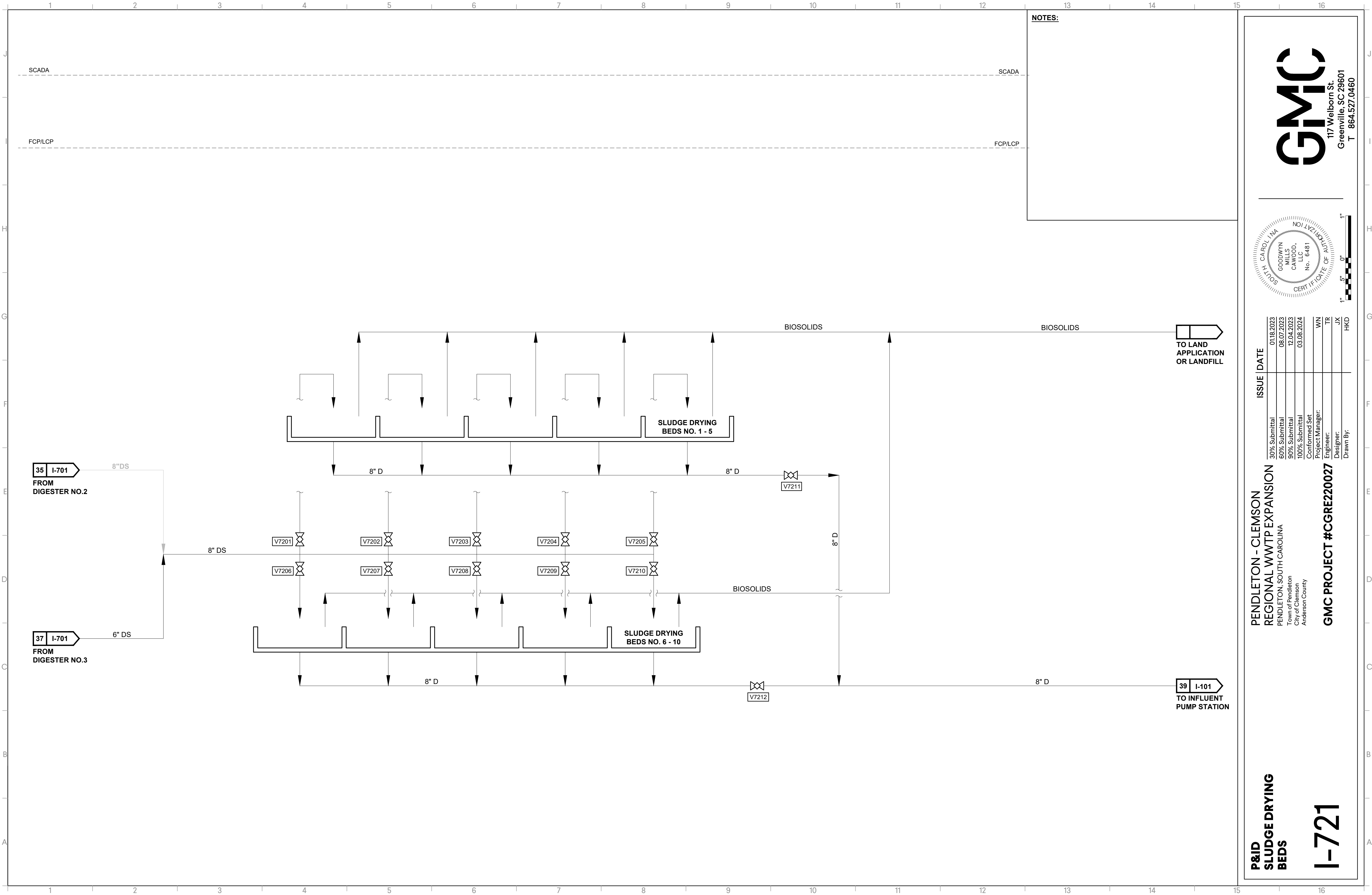
P&ID DIGESTED SLUDGE WITHDRAW PIPING

IN

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PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

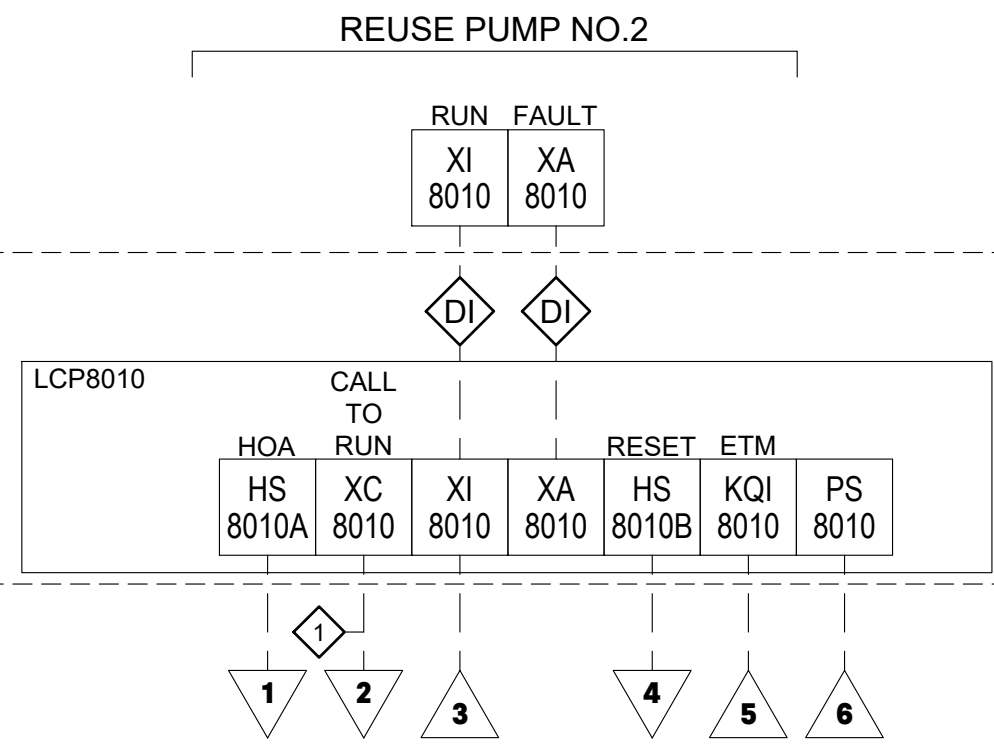
P&ID
SLUDGE DRYING
BEDS

I-721

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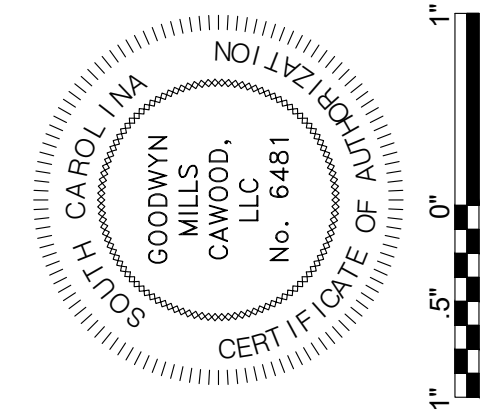
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NOTES:

- EXISTING REUSE PUMP NO.1 SHALL BE MANUALLY CONTROLLED FOR WATER CANNONS ONLY.
- PUMP NO.2 CALL TO RUN INITIATED BY TANK PRESSURE SENSOR. WHEN PRESSURE DROPS BELOW 65 PSI, PUMP SHALL START OPERATING. PUMP NO.2 SHALL STOP OPERATING WHEN TANK PRESSURE INCREASES TO 85 PSI.



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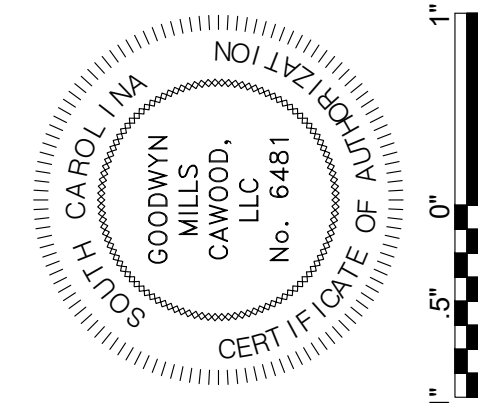
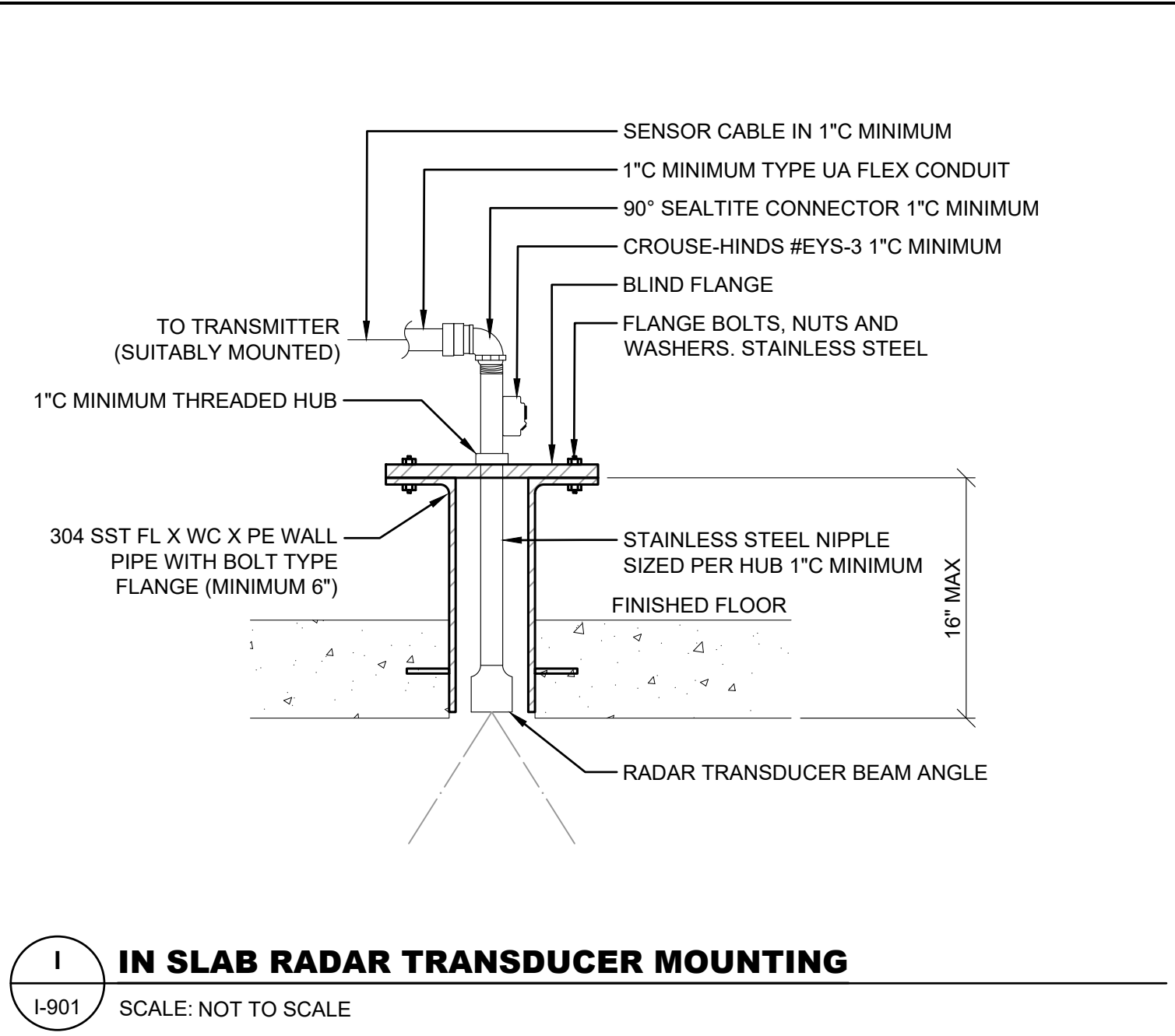
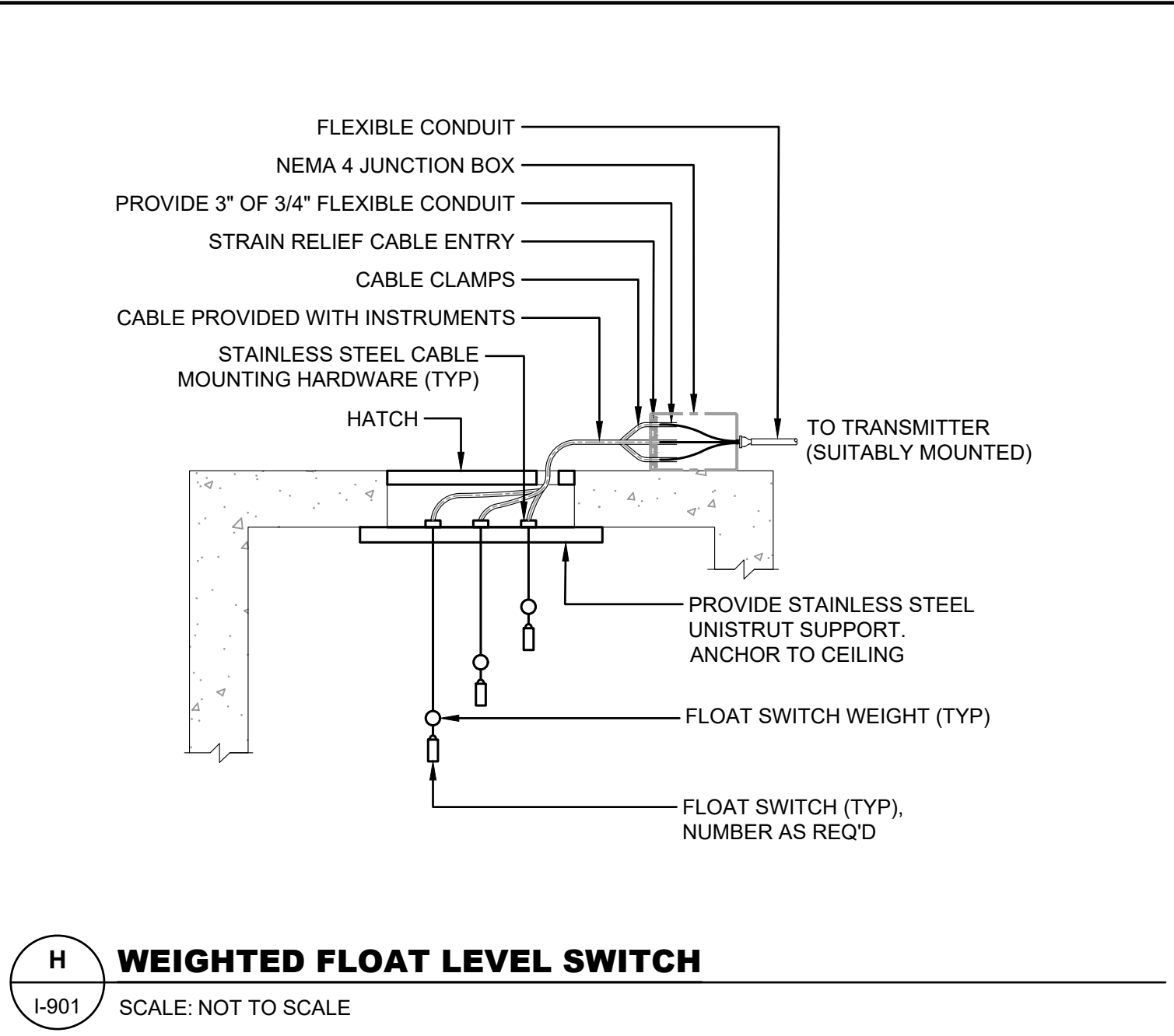
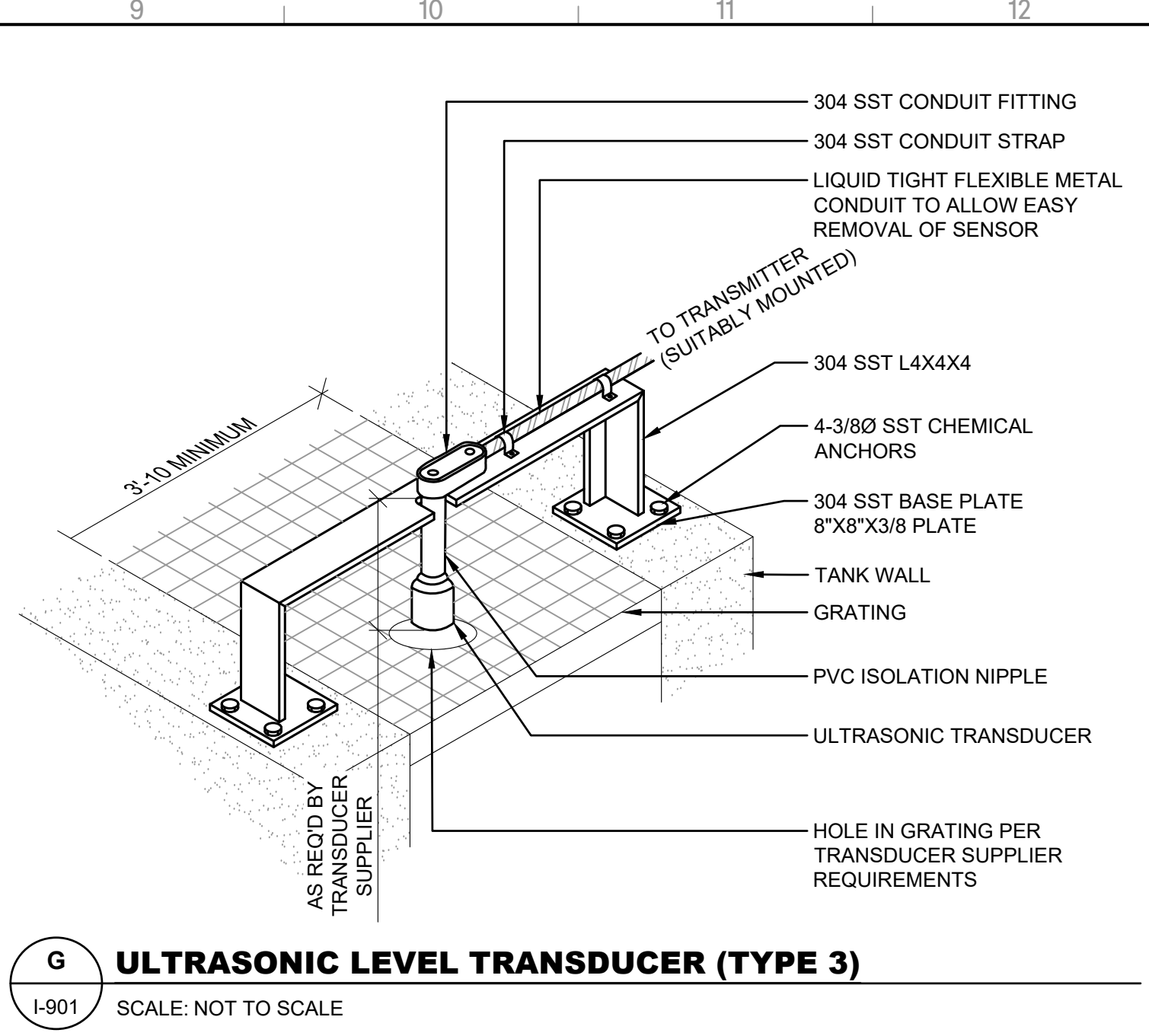
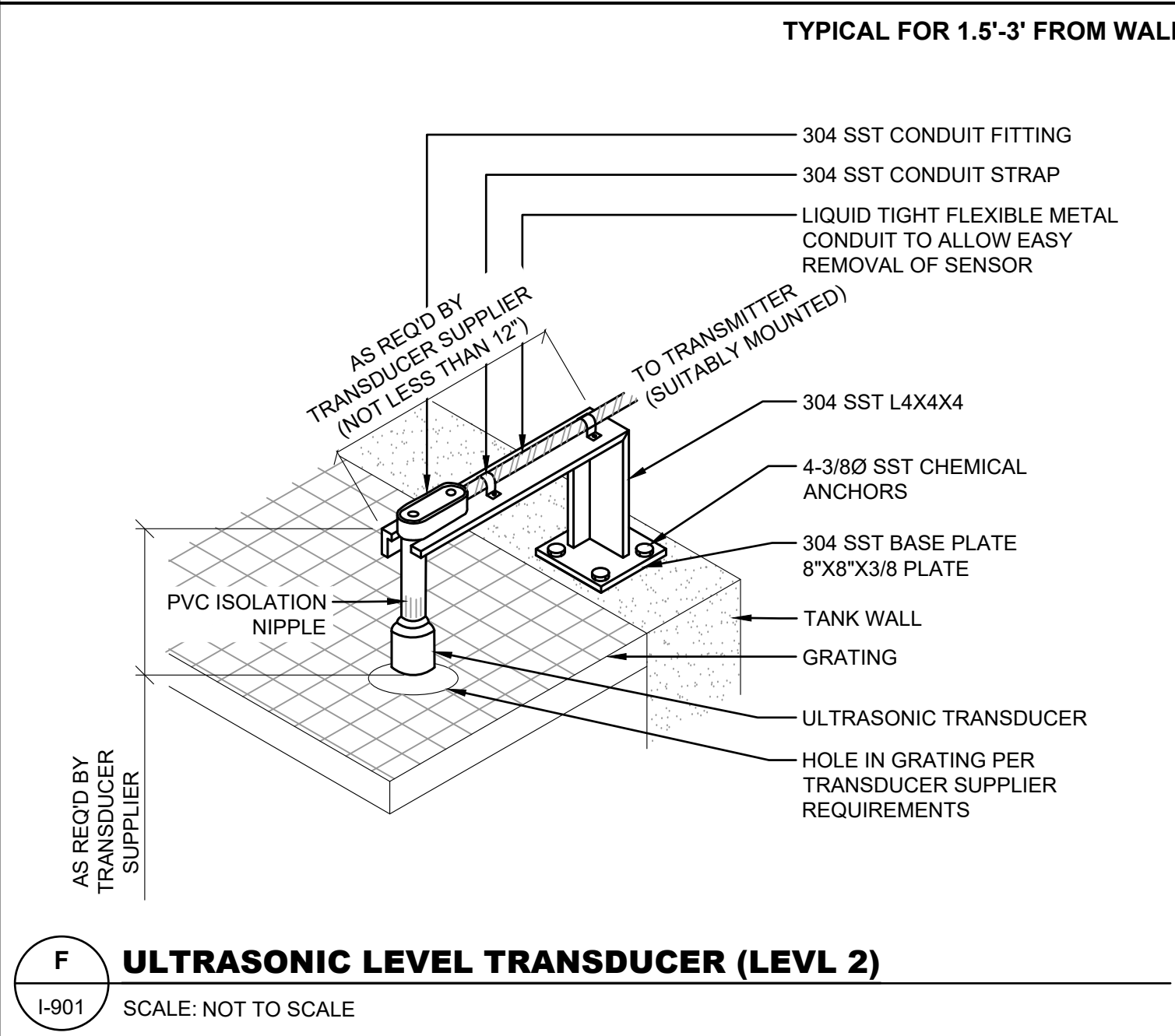
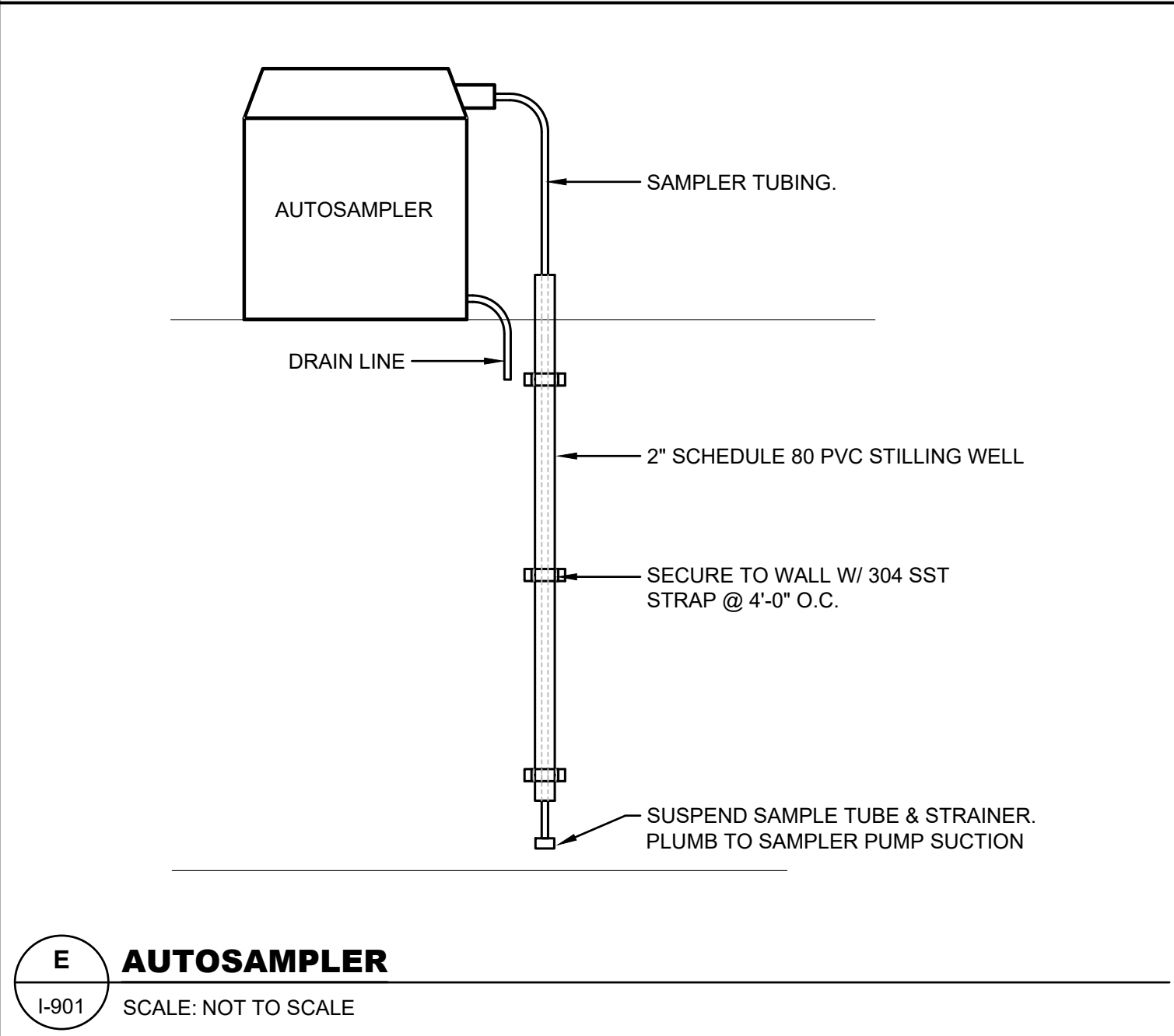
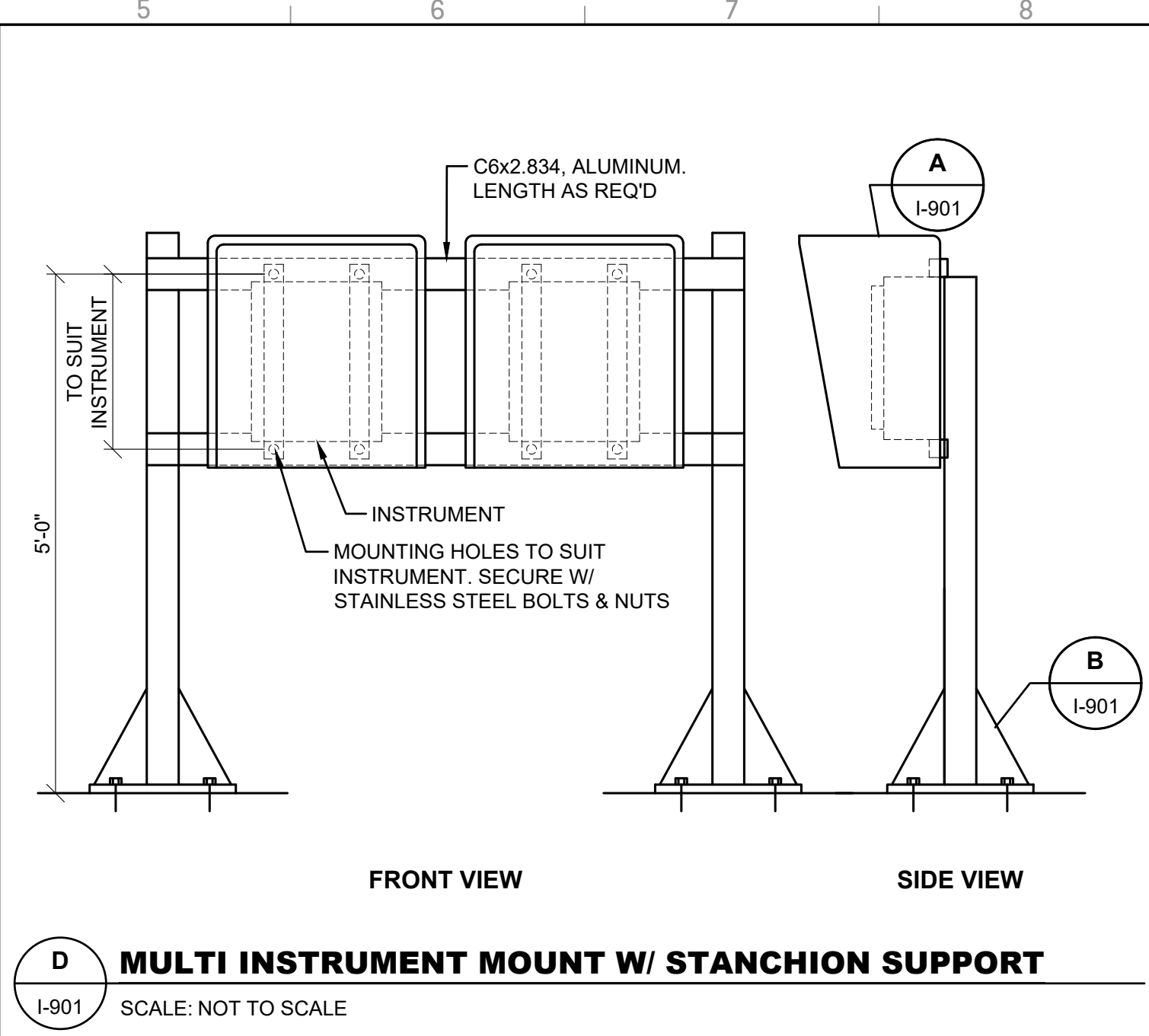
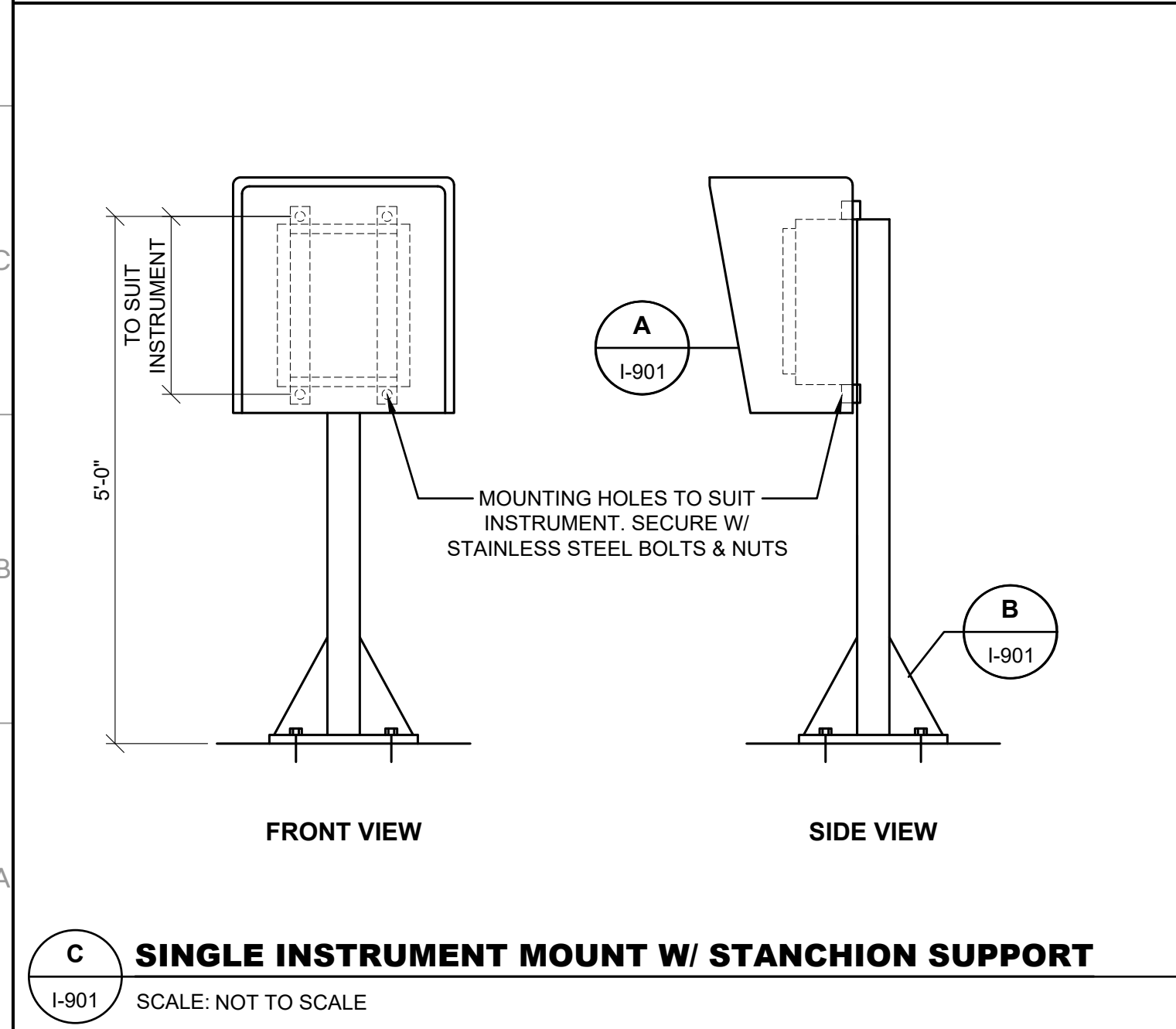
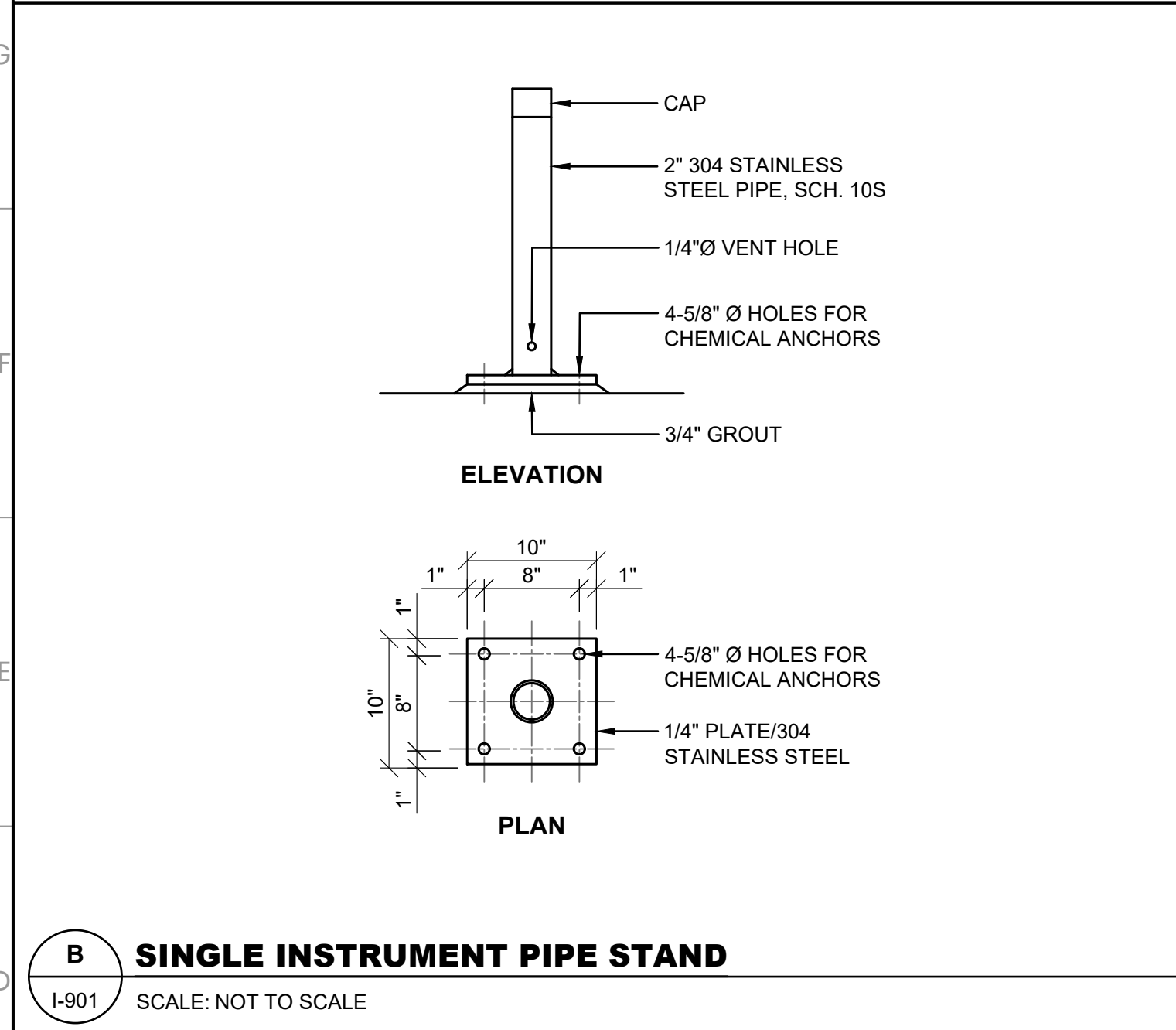
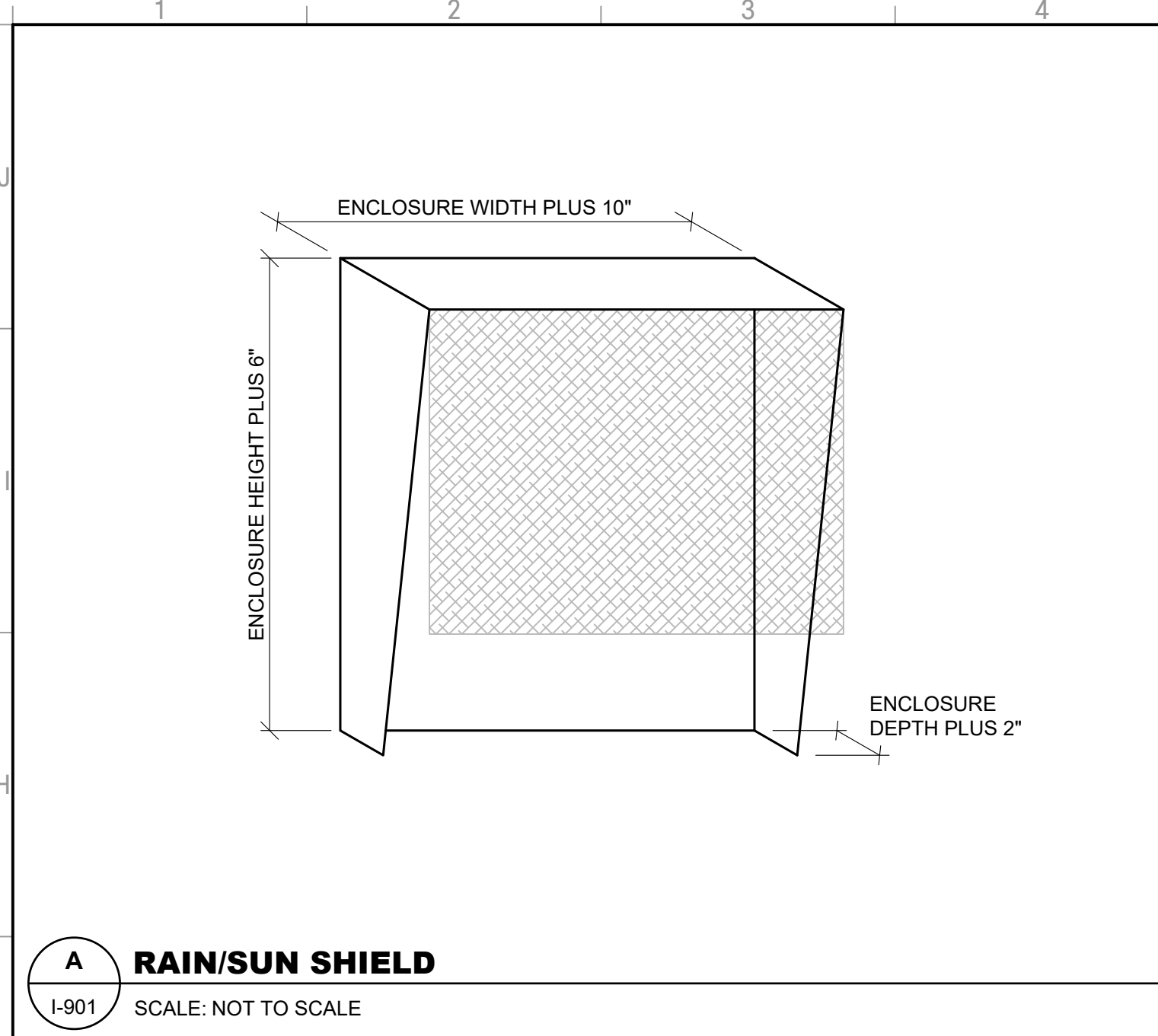
PENDLETON - CLEMSON
REGIONAL WWTp EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

P&ID
REUSE WATER SYSTEM

I-801

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PLOTTED: Mar 11, 2024 - 5:18pm



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PENDLETON, SOUTH CAROLINA
Town of Pendleton
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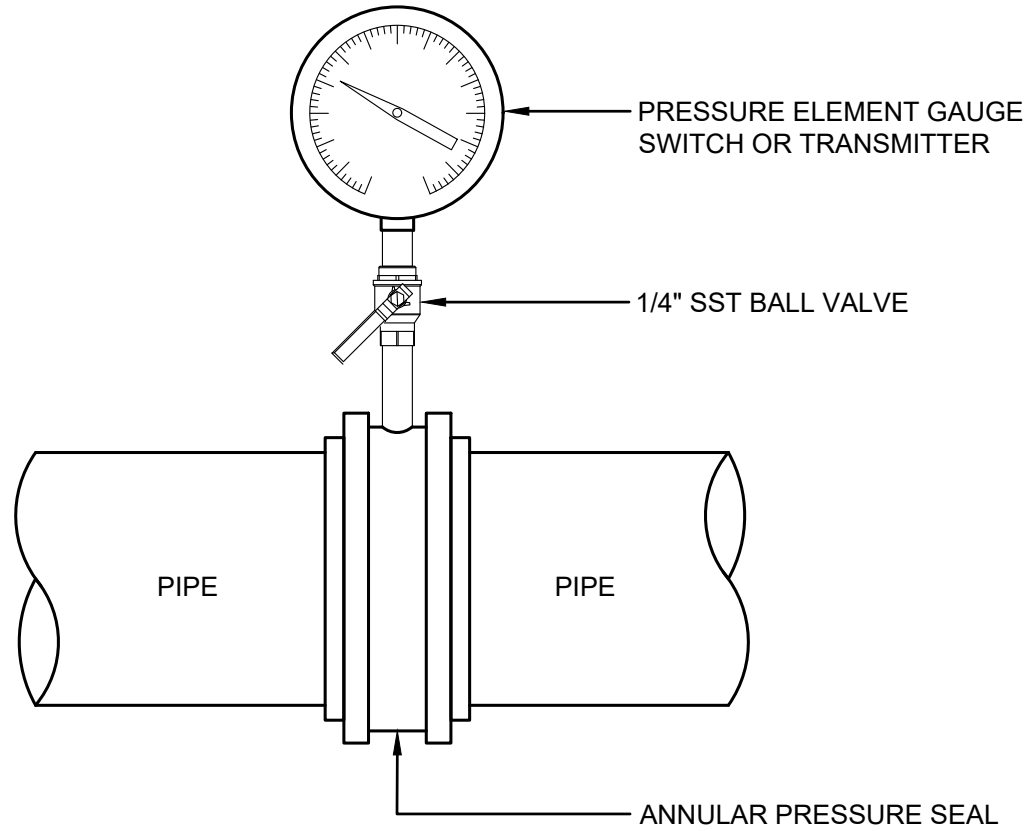
INSTRUMENTATION
DETAILS

I-901

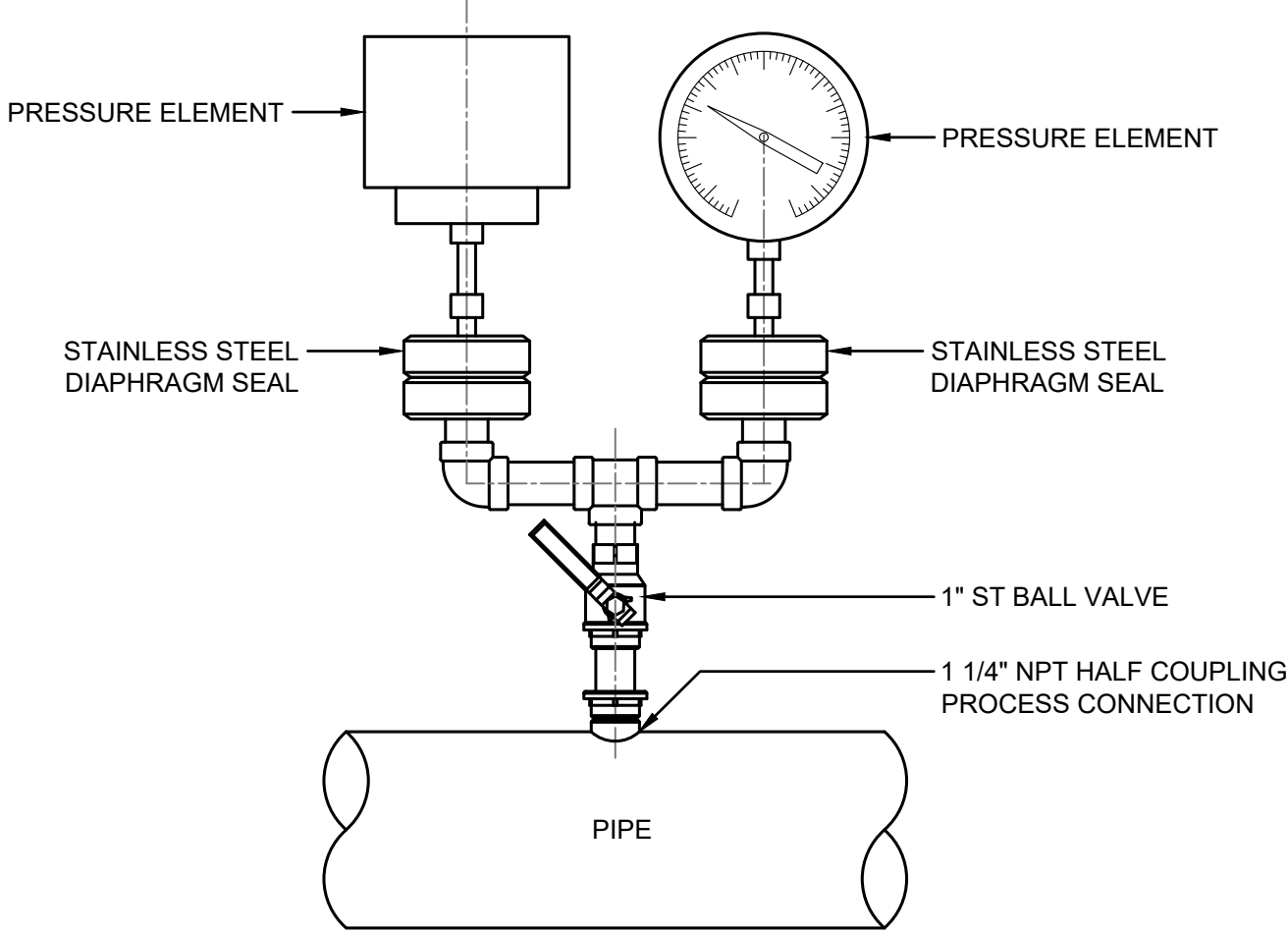
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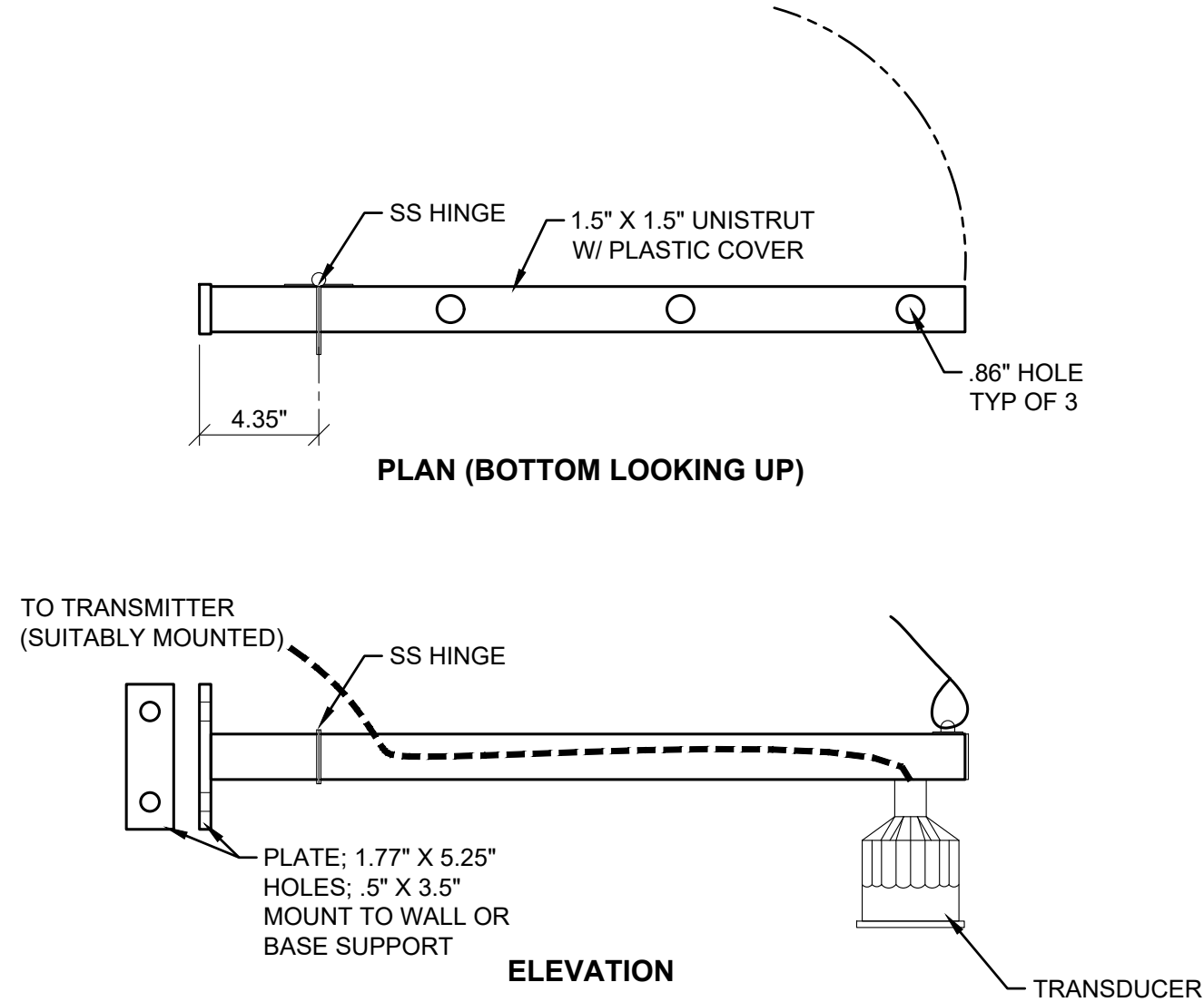
J PRESSURE ELEMENT W/ ANNULAR SEAL
I-902 SCALE: NOT TO SCALE



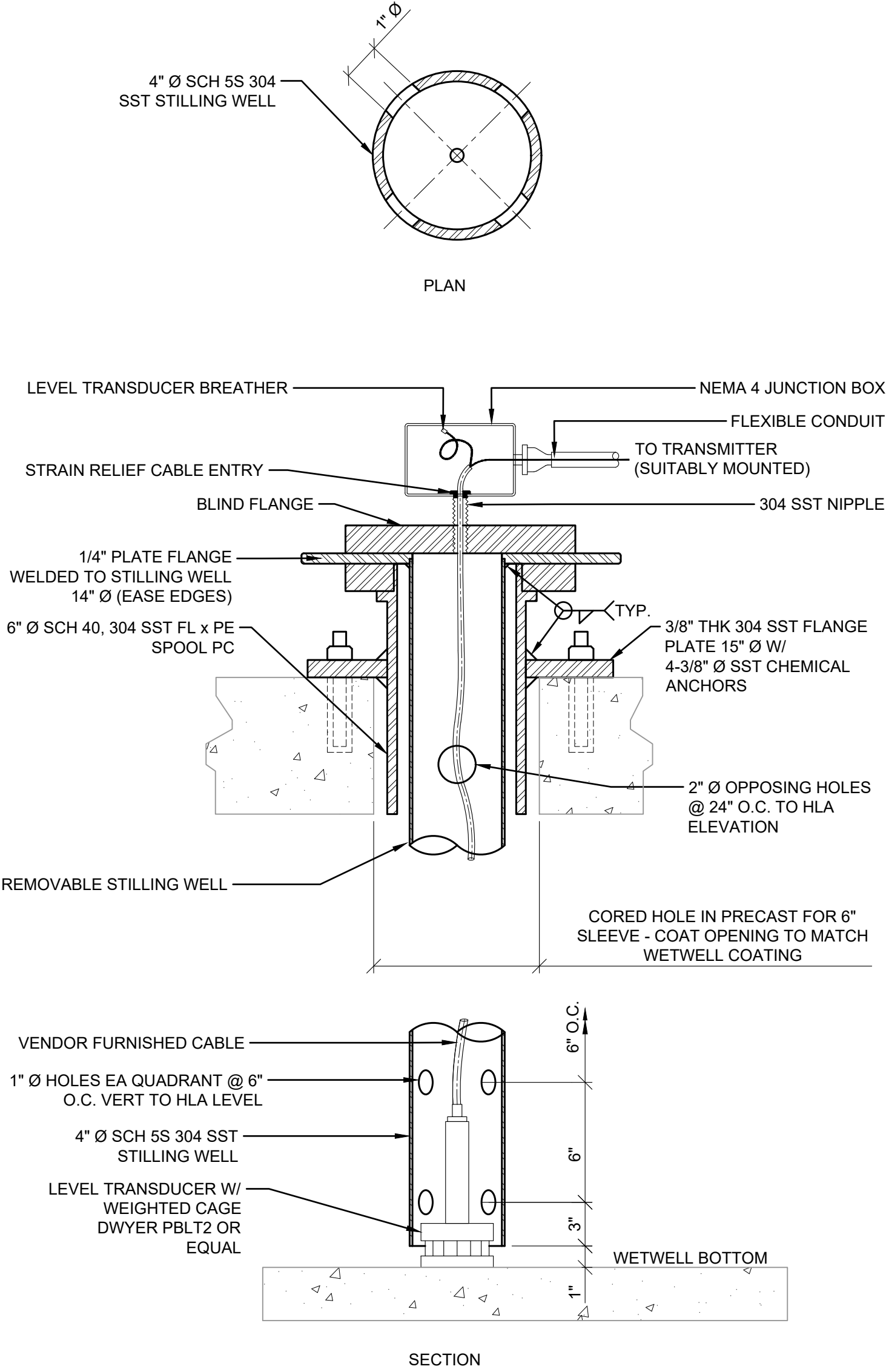
L PRESSURE ELEMENT AND SWITCH
I-902 SCALE: NOT TO SCALE



M ULTRASONIC TRANSDUCER W/ HINGE ARM
I-901 SCALE: NOT TO SCALE



K SUBMERSIBLE LEVEL TRANSDUCER (TYPE 1)
I-902 SCALE: NOT TO SCALE



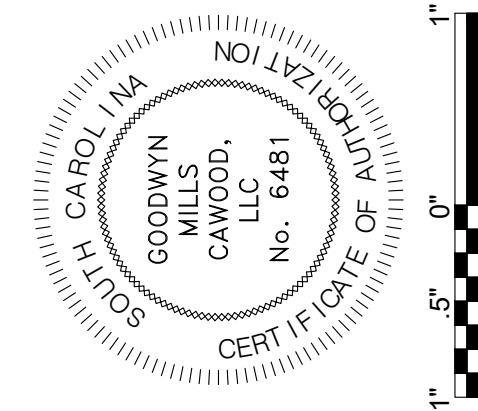
**INSTRUMENTATION
DETAILS**

I-902

**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
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PLOTTED: Mar 11, 2024 - 5:17pm

	Tag No.	Service Description	Device Type	Output Type	Range/Setpoint	Supplied By	P&ID	Power Type	Service	Spec	Comments
1000	LE/LIT1000	Course Mechanical Screen Upstream Level Transmitter	Ultrasonic Level Transmitter	Analog	0-8 ft	Equipment Vendor	I-101	120 VAC	RWW	40 72 13	
	LE/LIT1010	Influent Pump Station Wetwell Level Transmitter	Submersible Level Transmitter	Analog	0-10 ft	Equipment Vendor	I-101	120 VAC	RWW	40 72 44	
	LSL1010	Influent Pump Station Low Level Switch	Level Switch	Digital	-	Equipment Vendor	I-101	120 VAC	RWW	40 72 76	
	LSH1010	Influent Pump Station High Level Switch	Level Switch	Digital	-	Equipment Vendor	I-101	120 VAC	RWW	40 72 76	
	PI1010	Influent Pump No.1 Discharge Pressure	Pressure Gage	-	0-100 psig	Contractor	I-101	-	RWW	40 73 13	Annular Seal
	MS1010	Influent Pump No.1 Moisture Switch	Moisture Switch	-	-	Equipment Vendor	I-101	-	RWW	43 25 13	
	TSH1010	Influent Pump No.1 Temperature Switch	Temperature Switch	-	-	Equipment Vendor	I-101	-	RWW	43 25 13	
	PI1020	Influent Pump No.2 Discharge Pressure	Pressure Gage	-	0-100 psig	Contractor	I-101	-	RWW	40 73 13	Annular Seal
	MS1020	Influent Pump No.2 Moisture Switch	Moisture Switch	-	-	Equipment Vendor	I-101	-	RWW	43 25 13	
	TSH1020	Influent Pump No.2 Temperature Switch	Temperature Switch	-	-	Equipment Vendor	I-101	-	RWW	43 25 13	
	PI1030	Influent Pump No.3 Discharge Pressure	Pressure Gage	-	0-100 psig	Contractor	I-101	-	RWW	40 73 13	Annular Seal
	MS1030	Influent Pump No.3 Moisture Switch	Moisture Switch	-	-	Equipment Vendor	I-101	-	RWW	43 25 13	
	TSH1030	Influent Pump No.3 Temperature Switch	Temperature Switch	-	-	Equipment Vendor	I-101	-	RWW	43 25 13	
	PI1040	Influent Pump No.4 Discharge Pressure	Pressure Gage	-	0-100 psig	Contractor	I-101	-	RWW	40 73 13	Annular Seal
	MS1040	Influent Pump No.4 Moisture Switch	Moisture Switch	-	-	Equipment Vendor	I-101	-	RWW	43 25 13	
	TSH1040	Influent Pump No.4 Temperature Switch	Temperature Switch	-	-	Equipment Vendor	I-101	-	RWW	43 25 13	
	PI1050	Influent Pump No.5 Discharge Pressure	Pressure Gage	-	0-100 psig	Contractor	I-101	-	RWW	40 73 13	Annular Seal
	MS1050	Influent Pump No.5 Moisture Switch	Moisture Switch	-	-	Equipment Vendor	I-101	-	RWW	43 25 13	
	TSH1050	Influent Pump No.5 Temperature Switch	Temperature Switch	-	-	Equipment Vendor	I-101	-	RWW	43 25 13	
	PI1110	Rotary Drum Screen No.1 Spray Water Pressure	Pressure Gage	-	0-100 psig	Equipment Vendor	I-111	-	NPW	40 73 13	
	AE1110	Rotary Drum Screen No.1 Overflow Sensor	Conductivity Probe	Digital	-	Equipment Vendor	I-111	-	RWW	46 21 15	
	PI1111	Washing Compactor Washwater Pressure	Pressure Gage	-	0-60 psig	Equipment Vendor	I-111	-	NPW	40 73 13	
	PI1120	Rotary Drum Screen No.2 Spray Water Pressure	Pressure Gage	-	0-100 psig	Equipment Vendor	I-111	-	NPW	40 73 13	
	AE1120	Rotary Drum Screen No.2 Overflow Sensor	Conductivity Probe	Digital	-	Equipment Vendor	I-111	-	RWW	46 21 15	
	PI1130	Rotary Drum Screen No.3 Spray Water Pressure	Pressure Gage	-	0-100 psig	Equipment Vendor	I-111	-	NPW	40 73 13	
	AE1130	Rotary Drum Screen No.3 Overflow Sensor	Conductivity Probe	Digital	-	Equipment Vendor	I-111	-	RWW	46 21 15	
	PI1212	Grit Pump No.1 Discharge Pressure	Pressure Gage	-	0-30 psig	Equipment Vendor	I-112	-	GR	40 73 13	
	PI1222	Grit Pump No.2 Discharge Pressure	Pressure Gage	-	0-30 psig	Equipment Vendor	I-112	-	GR	40 73 13	
	LE/FIT1230	Influent Parshall Flume	Parshall Flume	Analog	0-15.7 MGD	Contractor	I-112	120 VAC	RWW	40 71 69	
	AE/AIT1310A	EQ Basin No.1 DO	DO Prober	Analog	-	Equipment Vendor	I-121		RWW	46 53 54	
	AE/AIT1310B	EQ Basin No.1 ORP	ORP Probe	Analog	-	Equipment Vendor	I-121		RWW	46 53 54	
	LE/LIT1310	EQ Basin No.1 Level	Radar Level Transmitter	Analog	0-20 ft	Equipment Vendor	I-121		RWW	46 53 54	
	LSH1310	EQ Basin No.1 High Level Switch	Level Switch	Digital	-	Equipment Vendor	I-121		RWW	46 53 54	
	AE/AIT1320A	EQ Basin No.2 DO	DO Prober	Analog	-	Equipment Vendor	I-121		RWW	46 53 54	
	AE/AIT1320B	EQ Basin No.2 ORP	ORP Probe	Analog	-	Equipment Vendor	I-121		RWW	46 53 54	
2000	PE/LIT2002	EQ Basin No.2 Pressure Level Transmitter	Level Transmitter	Analog	-	Owner	I-201		RWW	-	Existing
	FE/FIT2010	BNR Influent Flow Meter	Magnetic Flow Meter	Analog	0-17 MGD	Contractor	I-201		RWW	40 71 13	
3000	FE/FIT3110	BNR Basin No.1 Air Flow Meter	Thermal Mass Flow Meter	Analog		Equipment Vendor	I-301		A	46 53 54	
	AE3100A	BNR Basin No.1 TSS Sensor	Analytic Instrument	Analog		Equipment Vendor	I-301		ML	46 53 54	
	AE3100B	BNR Basin No.1 DO Probe	Analytic Instrument	Analog		Equipment Vendor	I-301		ML	46 53 54	
	AE3100C	BNR Basin No.1 ORP Sensor	Analytic Instrument	Analog		Equipment Vendor	I-301		ML	46 53 54	
	AE3100D	BNR Basin No.1 Tempature/pH Sensor	Analytic Instrument	Analog		Equipment Vendor	I-301		ML	46 53 54	
	AE/AIT3100E	BNR Basin No.1 Ammonia Sensor/Transmitter	Analytic Instrument	Analog		Equipment Vendor	I-301		ML	46 53 54	
	AE3100F	BNR Basin No.1 Nitrate Sensor	Analytic Instrument	Analog		Equipment Vendor	I-301		ML	46 53 54	
	AE3100G	BNR Basin No.1 Phosphorus Sensor	Analytic Instrument	Analog		Equipment Vendor	I-301		ML	46 53 54	
	AIT3100A	BNR Basin No.1 Multi-Parameter Transmitter	Sensor Transmitter	Analog		Equipment Vendor	I-301		ML	46 53 54	
	LE/LIT3100	BNR Basin No.1 Water Level	Submersible Level Transmitter	Analog		Equipment Vendor	I-301		ML	46 53 54	
	LSH3100	BNR Basin No.1 High Level Switch	Level Switch	Digital		Equipment Vendor	I-301		ML	46 53 54	
	PE/PIT3110	BNR Basin No.1 Air Pressure	Pressure Transmitter	Analog		Equipment Vendor	I-301		A	46 53 54	
	FE/FIT3210	BNR Basin No.2 Air Flow Meter	Thermal Mass Flow Meter	Analog		Equipment Vendor	I-302		A	46 53 54	
	AE3200A	BNR Basin No.2 TSS Sensor	Analytic Instrument	Analog		Equipment Vendor	I-302		ML	46 53 54	
	AE3200B	BNR Basin No.2 DO Probe	Analytic Instrument	Analog		Equipment Vendor	I-302		ML	46 53 54	
	AE3200C	BNR Basin No.2 ORP Sensor	Analytic Instrument	Analog		Equipment Vendor	I-302		ML	46 53 54	
	AE3200D	BNR Basin No.2 Tempature/pH Sensor	Analytic Instrument	Analog		Equipment Vendor	I-302		ML	46 53 54	
	AE/AIT3200E	BNR Basin No.2 Ammonia Sensor/Transmitter	Analytic Instrument	Analog		Equipment Vendor	I-302		ML	46 53 54	
	AE3200F	BNR Basin No.2 Nitrate Sensor	Analytic Instrument	Analog		Equipment Vendor	I-302		ML	46 53 54	
	AE3200G	BNR Basin No.2 Phosphorus Sensor	Analytic Instrument	Analog		Equipment Vendor	I-302		ML	46 53 54	
	AIT3200A	BNR Basin No.2 Multi-Parameter Transmitter	Sensor Transmitter	Analog		Equipment Vendor	I-302		ML	46 53 54	
	LE/LIT3200	BNR Basin No.2 Water Level	Submersible Level Transmitter	Analog		Equipment Vendor	I-302		ML	46 53 54	
	LSH3200	BNR Basin No.2 High Level Switch	Level Switch	Digital		Equipment Vendor	I-302		ML	46 53 54	
	PE/PIT3210	BNR Basin No.2 Air Pressure	Pressure Transmitter	Analog		Equipment Vendor	I-302		A	46 53 54	
	FE/FIT3310	BNR Basin No.3 Air Flow Meter	Thermal Mass Flow Meter	Analog		Equipment Vendor	I-303		A	46 53 54	
	AE3300A	BNR Basin No.3 TSS Sensor	Analytic Instrument	Analog		Equipment Vendor	I-303		ML	46 53 54	
	AE3300B	BNR Basin No.3 DO Probe	Analytic Instrument	Analog		Equipment Vendor	I-303		ML	46 53 54	
	AE3300C	BNR Basin No.3 ORP Sensor	Analytic Instrument	Analog		Equipment Vendor	I-303		ML	46 53 54	
	AE3300D	BNR Basin No.3 Tempature/pH Sensor	Analytic Instrument	Analog		Equipment Vendor	I-303		ML	46 53 54	
	AE/AIT3300E	BNR Basin No.3 Ammonia Sensor	Analytic Instrument	Analog		Equipment Vendor	I-303		ML	46 53 54	
	AE3300F	BNR Basin No.3 Nitrate Sensor	Analytic Instrument	Analog		Equipment Vendor	I-303		ML	46 53 54	

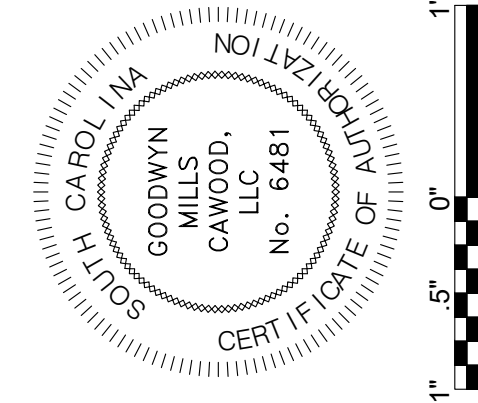
INSTRUMENTATION
SCHEDULE

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

I-911

GMC PROJECT #CGRE220027

ISSUE	DATE
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60% Submittal	08.07.2023
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DRAWING FILE: T:\Projects\SC\Pendleton_Town of CGRE220027 - Pendleton-Clemson WWTP\0 DWG\+CAD\01 BID DRAWINGS\02 INSTRUMENTATION\I-911 instrumentation schedule.dwg
PLOTTED: Mar 11, 2024 - 5:17pm

	Tag No.	Service Description	Device Type	Output Type	Range/Setpoint	Supplied By	P&ID	Power Type	Service	Spec	Comments
3000	AE3300G	BNR Basin No.3 Phosphorus Sensor	Analytic Instrument	Analog		Equipment Vendor	I-303		ML	46 53 54	
	AIT3300A	BNR Basin No.3 Multi-Parameter Transmitter	Sensor Transmitter	Analog		Equipment Vendor	I-303		ML	46 53 54	
	LE/LIT3300	BNR Basin No.3 Water Level	Submersible Level Transmitter	Analog		Equipment Vendor	I-303		ML	46 53 54	
	LSH3300	BNR Basin No.3 High Level Switch	Level Switch	Digital		Equipment Vendor	I-303		ML	46 53 54	
	PE/PIT3310	BNR Basin No.3 Air Pressure	Pressure Transmitter	Analog		Equipment Vendor	I-303		A	46 53 54	
	LE/LIT3400	Level Correction Tank Water Level	Submersible Level Transmitter	Analog		Contractor	I-311		SN	40 72 43	
	LSH3400	Level Correction Tank High Level	Level Switch	Digital	-	Contractor	I-311		SN	40 72 76	
	PI3410	Level Correction Pump No.1 Discharge Pressure	Pressure Gage	-	-	Contractor	I-311	-	SN	40 73 13	
	PI3420	Level Correction Pump No.2 Discharge Pressure	Pressure Gage	-	-	Contractor	I-311	-	SN	40 73 13	
	LE/LIT3500	Sludge Buffer Tank Water Level	Submersible Level Transmitter	Analog	-	Contractor	I-312		WAS	40 72 43	
	LSH3500	Sludge Buffer Tank High Level	Level Switch	Digital	-	Contractor	I-312		WAS	40 72 76	
	FE/FIT3510	WAS Pump No.1 Flow Meter	Magnetic Flow Meter	Analog		Owner	I-312	-	WAS	-	Existing
	FE/FIT3520	WAS Pump No.2 Flow Meter	Magnetic Flow Meter	Analog		Owner	I-312	-	WAS	-	Existing
	FE/FIT3530	WAS Pump No.3 Flow Meter	Magnetic Flow Meter	Analog		Owner	I-312	-	WAS	-	Existing
	TE3610	BNR Blower No.1 Oil Temperature Sensor	Temperature Sensor	Analog		Equipment Vendor	I-321		A	46 53 54	
	PI3610	BNR Blower No.1 Discharge Pressure	Pressure Gauge	-		Equipment Vendor	I-321		A	40 73 13	
	PE/PIT3611	BNR Blower No.1 Inlet Pressure Transmitter	Pressure Transmitter	Analog		Equipment Vendor	I-321		A	46 53 54	
	TI/TAH3612	BNR Blower No.1 Discharge Temperature Sensor	Temperature Sensor	Analog		Equipment Vendor	I-321		A	46 53 54	
	PE/PIT3614	BNR Blower No.1 Discharge Pressure Transmitter	Pressure Transmitter	Analog		Equipment Vendor	I-321		A	46 53 54	
	TE3620	BNR Blower No.2 Oil Temperature Sensor	Temperature Sensor	Analog		Equipment Vendor	I-321		A		
	PI3620	BNR Blower No.2 Discharge Pressure	Pressure Gauge	-		Equipment Vendor	I-321		A	40 73 13	
	PE/PIT3621	BNR Blower No.2 Inlet Pressure Transmitter	Pressure Transmitter	Analog		Equipment Vendor	I-321		A		
	TI/TAH3622	BNR Blower No.2 Discharge Temperature Sensor	Temperature Sensor	Analog		Equipment Vendor	I-321		A		
	PE/PIT3624	BNR Blower No.2 Discharge Pressure Transmitter	Pressure Transmitter	Analog		Equipment Vendor	I-321		A		
	TE3630	BNR Blower No.3 Oil Temperature Sensor	Temperature Sensor	Analog		Equipment Vendor	I-321		A		
	PI3630	BNR Blower No.3 Discharge Pressure	Pressure Gauge	-		Equipment Vendor	I-321		A	40 73 13	
	PE/PIT3631	BNR Blower No.3 Inlet Pressure Transmitter	Pressure Transmitter	Analog		Equipment Vendor	I-321		A		
	TI/TAH3632	BNR Blower No.3 Discharge Temperature Sensor	Temperature Sensor	Analog		Equipment Vendor	I-321		A		
	PE/PIT3634	BNR Blower No.3 Discharge Pressure Transmitter	Pressure Transmitter	Analog		Equipment Vendor	I-321		A		
4000	LE/LIT4010	Post EQ Basin Level	Submersible Level Transmitter	Analog	0-12 ft	Contractor	I-401		SE	40 72 43	
	LSH4010	Post EQ Basin High Level Switch	Level Switch	Digital	-	Contractor	I-401		SE	40 72 76	
	FE/FIT4010	Post EQ Effluent Flow Meter	Magnetic Flow Meter	Analog	0-17 MGD	Contractor	I-401		SE	40 71 13	
5000	LSHH5200	Filter No.2 High High Water Level	Level Switch	Digital		Equipment Vendor	I-501		SE	46 61 23	
	LE/LIT5200	Filter No.2 Water Level	Submersible Level Transmitter	-	0-5 psig	Equipment Vendor	I-501		SE	46 61 23	
	VI5210	Backwash Pump No.3 Inlet Vacuum	Vacuum Gauge	-	-30 - 0 in Hg	Equipment Vendor	I-501		BWW	46 61 23	
	PI5210	Backwash Pump No.3 Discharge Pressure	Pressure Gauge	-		Equipment Vendor	I-501		BWW	46 61 23	
	VI5220	Backwash Pump No.4 Inlet Vacuum	Vacuum Gauge	-		Equipment Vendor	I-501		BWW	46 61 23	
	PI5220	Backwash Pump No.4 Discharge Pressure	Pressure Gauge	-		Equipment Vendor	I-501		BWW	46 61 23	
	LSHH5300	Filter No.3 High High Water Level	Level Switch	Digital		Equipment Vendor	I-502		SE	46 61 23	
	LE/LIT5300	Filter No.3 Water Level	Submersible Level Transmitter	-	0-5 psig	Equipment Vendor	I-502		SE	46 61 23	
	VI5310	Backwash Pump No.5 Inlet Vacuum	Vacuum Gauge	-	-30 - 0 in Hg	Equipment Vendor	I-502		BWW	46 61 23	
	PI5310	Backwash Pump No.5 Discharge Pressure	Pressure Gage	-		Equipment Vendor	I-502		BWW	46 61 23	
	VI5320	Backwash Pump No.6 Inlet Vacuum	Vacuum Gauge	-		Equipment Vendor	I-502		BWW	46 61 23	
	PI5320	Backwash Pump No.6 Discharge Pressure	Pressure Gage	-		Equipment Vendor	I-502		BWW	46 61 23	
6000	ZS6101	UV Disinfection Bank 1A Position Switch	Position Switch	Digital	-	Owner	I-601		FRE	-	Existing
	AE6101	UV Disinfection Bank 1A UV Intensity	UV Intensity Sensor	Analog	-	Owner	I-601		FRE	-	Existing
	LE6104	Power Distribution Center Level Element	Ultrasonic Level Element	Analog	0-5 ft	Equipment Vendor	I-601	120 VAC	FRE	-	
	ZS6201	UV Disinfection Bank 1B Position Switch	Position Switch	Digital	-	Owner	I-601		FRE	-	Existing
	AE6201	UV Disinfection Bank 1B UV Intensity	UV Intensity Sensor	Analog	-	Owner	I-601		FRE	-	Existing
7000	DPI7030	Blower No.3 Inlet Pressure Differential	Pressure Gauge	-	0-100 psig	Equipment Vendor	I-701	-	A	43 11 33	
	PI7030	Blower No.3 Digester Pressure	Pressure Gauge	-	0-100 psig	Equipment Vendor	I-701	-	A	40 73 13	
	TI7030	Blower No.3 Discharge Temperature	Temperature Sensor	Analog		Equipment Vendor	I-701	120 VAC	A	43 11 33	
	PI7110	Digested Sludge Withdraw Line Pressure	Pressure Gauge	-	0-100 psig	Contractor	I-711	-	DS	40 73 13	Annular Seal Ring
8000	PI8010	Pneumatic Tank Discharge Pressure	Pressure Gauge	-	0-150 psig	Contractor	I-801	-	RUW	40 73 13	
	PS8010	Pneumatic Tank Discharge Pressure Switch	Pressure Switch	-	-	Contractor	I-801	120 VAC	RUW	43 42 21	
	PI8011	Pneumatic Tank Internal Pressure	Pressure Gauge	-	0-150 psig	Contractor	I-801	-	RUW	40 73 13	
	PI8012	Reuse Water System Pressure	Pressure Gauge	-	0-150 psig	Contractor	I-801	-	RUW	40 73 13	

INSTRUMENTATION
SCHEDULE

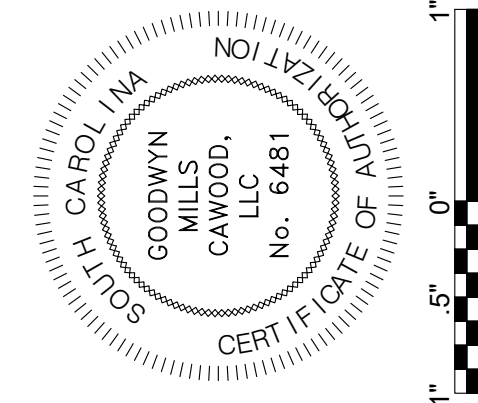
PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION

PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

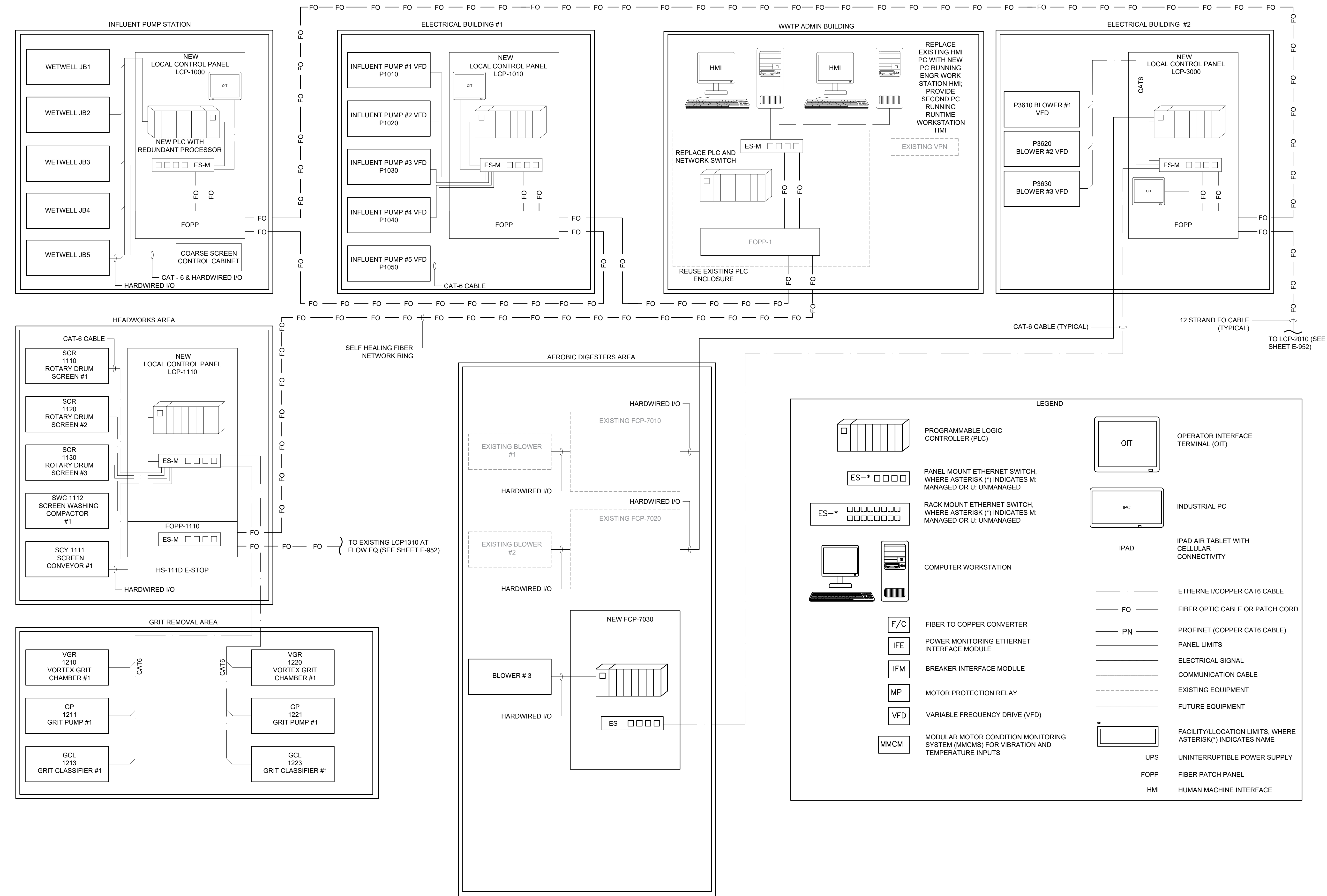
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GMC PROJECT #CGRE220027

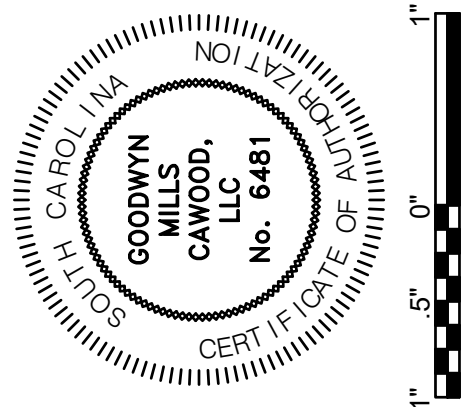
ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

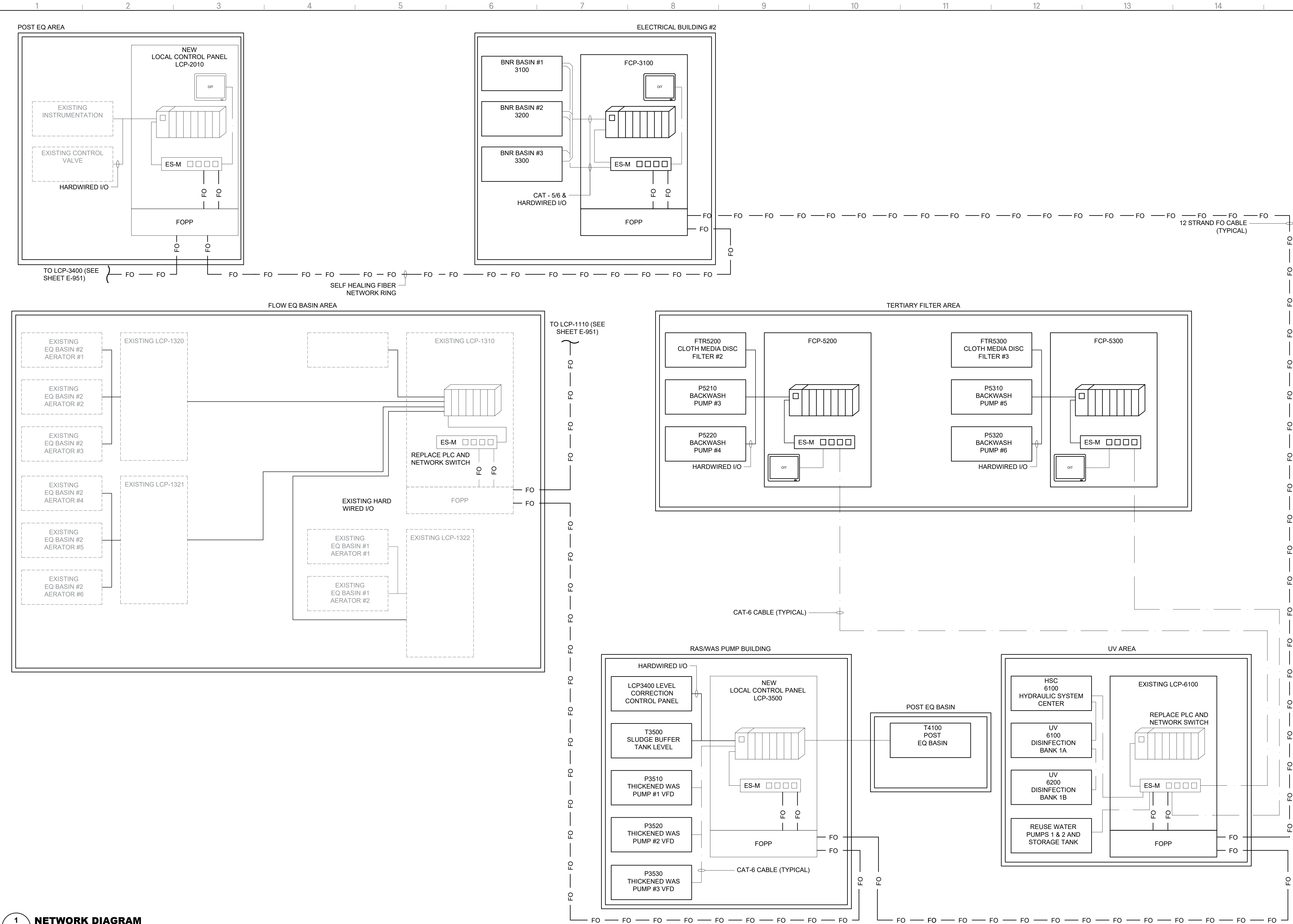


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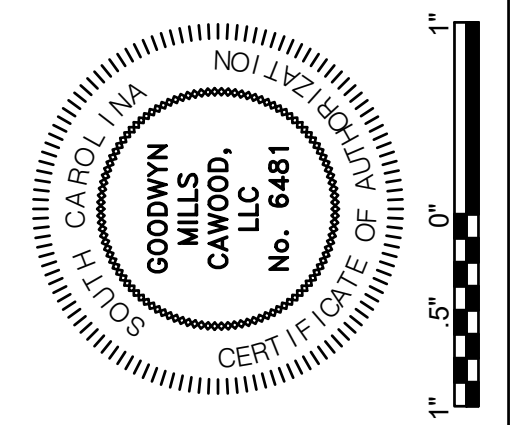


ISSUE	DATE
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Conformed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH





1 NETWORK DIAGRAM
E-952 NOT TO SCALE



ISSUE	DATE
30% Submittal	01.18.2023
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PENDLETON - CLEMSON
REGIONAL WWT EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

NETWORK DIAGRAM

I-932

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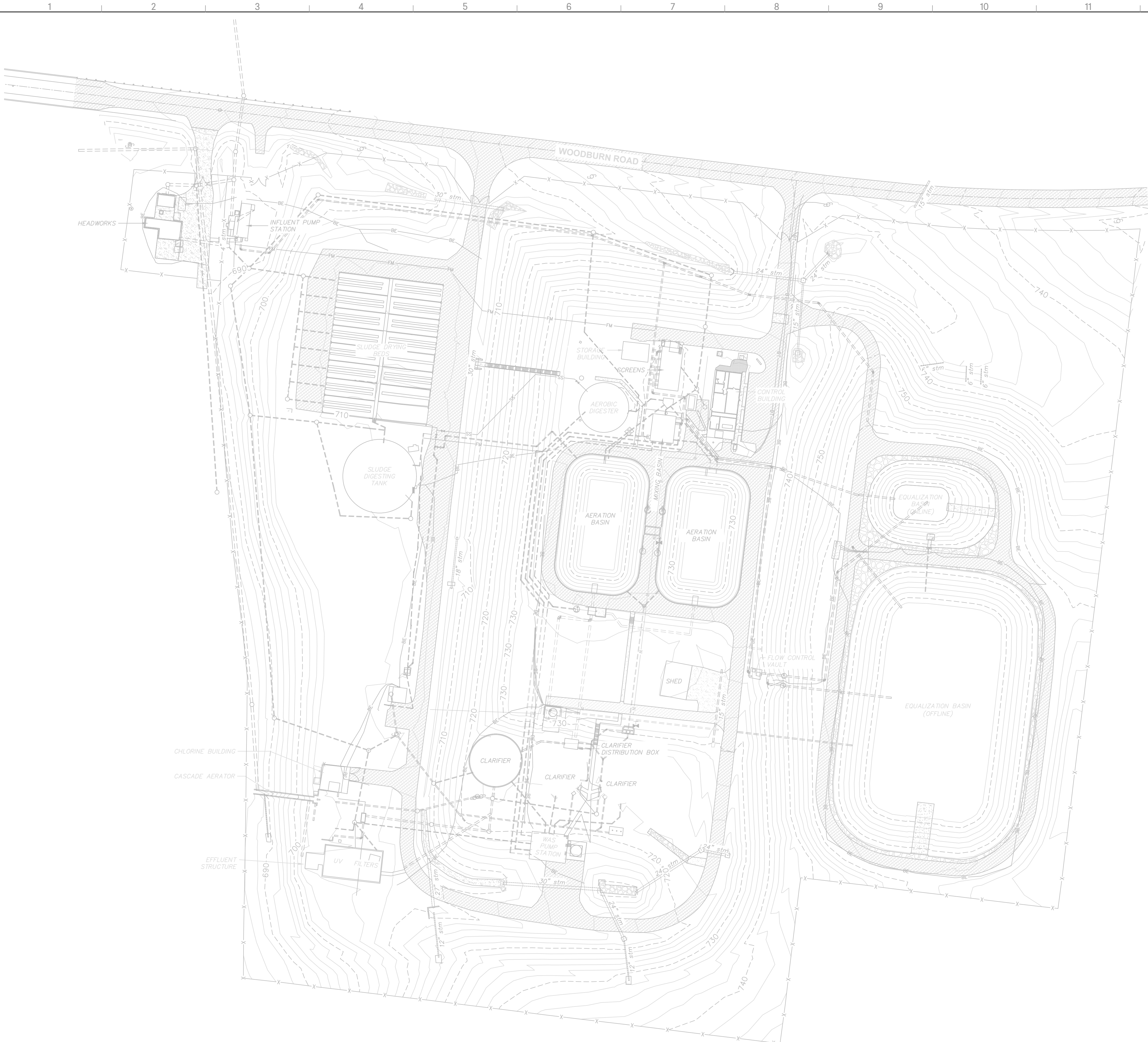


1

SITE PLAN

C-001

SCALE: 1" = 60'-0"



SITE NOTES:

1. THE CONTRACTOR SHALL ADHERE TO THE LOCATIONS AND GEOMETRIC SHAPES FOR CONCRETE PADS OTHER THAN THE BUILDING AS SHOWN ON THE SITE PLAN UNLESS SPECIFIC DETAILS ARE PROVIDED IN THE ARCHITECTURAL AND STRUCTURAL DRAWINGS.
2. ANY PROPERTY CORNERS OR PERMANENT SURVEY MARKERS DISTURBED DURING CONSTRUCTION SHALL BE REPLACED BY A LICENSED SURVEYOR AT CONTRACTORS EXPENSE.
3. ANY PAVEMENT OR CURBING DISTURBED BY CONSTRUCTION ACTIVITIES SHALL BE REPLACED AND RESTORED TO LIKE OR BETTER CONDITION.
4. SITE SECURITY AND EQUIPMENT STORAGE WILL BE THE RESPONSIBILITY OF THE CONTRACTOR.
5. PROPERTY OWNERSHIP INFORMATION IS SHOWN FOR GENERAL INFORMATION ONLY AND MAY NOT BE THE MOST RECENT OWNERSHIP ON RECORD.
6. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO REMOVE AND RESET FENCING TO ORIGINAL CONDITION WHERE REQUIRED AT NO ADDITIONAL COST.
7. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO CLEAR AND GRUB AS NECESSARY
8. CONTRACTOR SHALL MINIMIZE THE DISTURBANCE TO ANY EXISTING LANDSCAPING AND TREES, UNLESS APPROVED BY THE ENGINEER AND OWNER.
9. ANY LANDSCAPING (SHRUBS, FLOWERS, ORNAMENTAL GRASS, ETC.) DISTURBED DURING PROJECT CONSTRUCTION ACTIVITIES SHALL BE REPLACED AND OR TRANSPLANTED TO THE SATISFACTION OF THE OWNER TO PRE-CONSTRUCTION CONDITION. THIS MAY INCLUDE SOD REPLACEMENT AS DEEMED NECESSARY BY THE OWNER. ALL RELATED COSTS FOR SUCH WORK SHALL BE INCLUDED IN THE BID PRICE.
10. THE CONTRACTOR MUST ADJUST ALL VALVE BOXES, COVERS, METERS, FIRE HYDRANTS, AND OTHER WATER SERVICE APPURTENANCES, TO FINAL GRADE. THE COST OF THESE ADJUSTMENTS SHALL BE INCLUDED IN THE PRICE BID.

PENDLETON - CLEMSON

REGIONAL WWTP EXPANSION

PENDLETON, SOUTH CAROLINA

Town of Pendleton

City of Clemson

Anderson County

CIVIL SITE PLAN
EXISTING CONDITIONS

C-001

ISSUE

DATE

30% Submittal	01.18.2023
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Conformed Set	
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Drawn By:	HKD

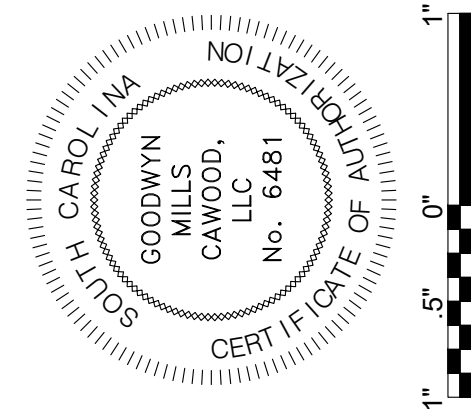
GMC PROJECT #CGRE220027

GMC

117 Welborn St.

Greenville, SC 29601

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GEOTECHNICAL			GEOTECHNICAL		
BORE #	NORTHING	EASTING	BORE #	NORTHING	EASTING
B-1-1	1024407.6756±	1457550.3933±	B-3-3	1023922.1538±	1457980.7648±
B-1-2	1024317.6184±	1457549.2295±	B-4-1	1023734.0507±	1457829.4486±
B-2-1	1024344.9272±	1458331.2312±	B-4-2	1023824.4556±	1458060.7750±
B-2-2	1024228.1844±	1458295.9007±	B-5-1	1024079.6583±	1457695.8929±
B-2-3	1024287.6396±	1458403.6632±	REFUSAL 1	1024502.9198±	1457596.7499±
B-2-4	1024207.2317±	1458401.5858±	REFUSAL 2	1024429.4741±	1457802.7515±
B-3-1	1023954.3821±	1457917.0583±	REFUSAL 3	1024212.8493±	1457948.3539±
B-3-2	1023986.0932±	1457983.8180±			

**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

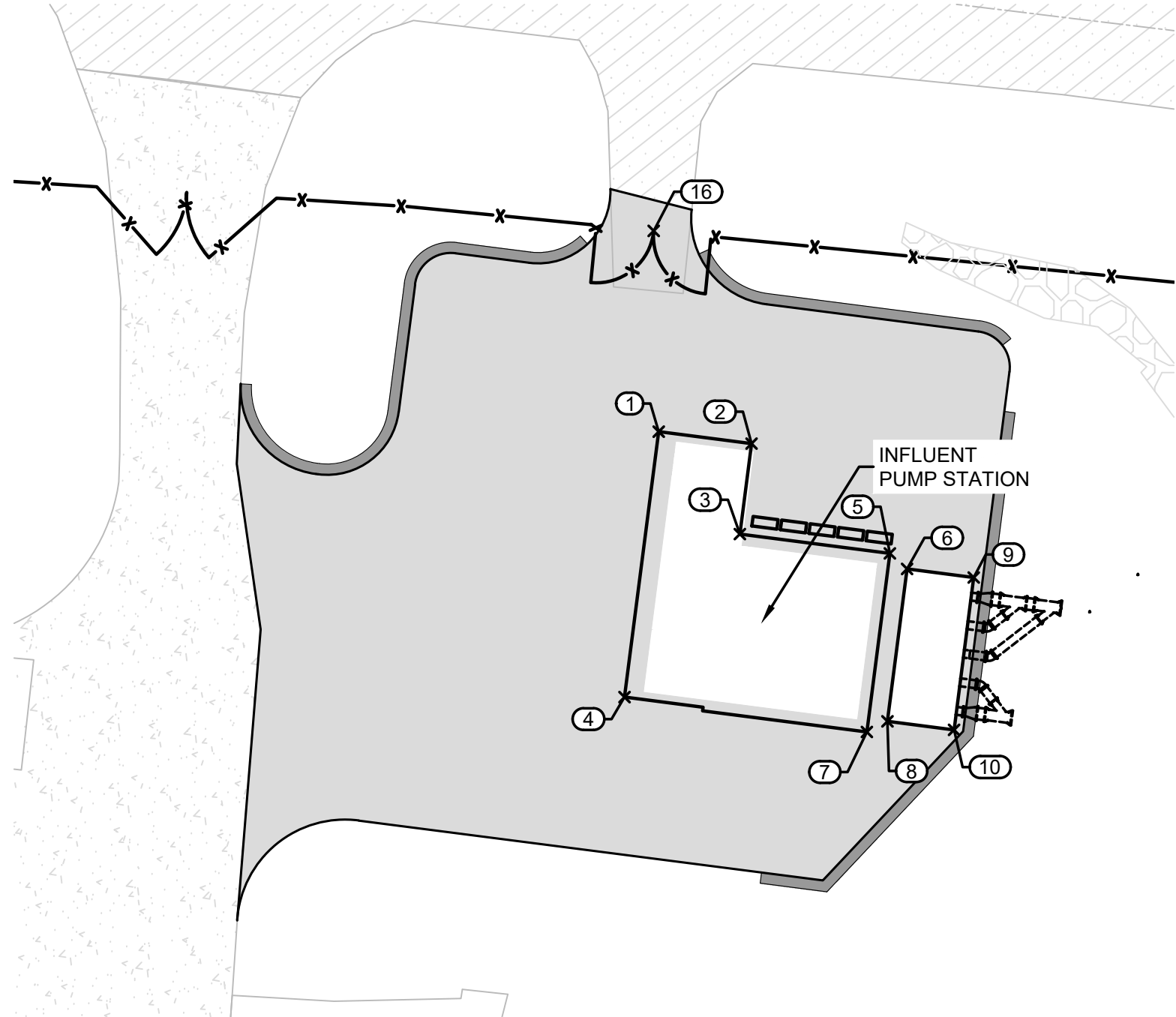
GMC PROJECT #CGRE22002

**CIVIL SITE PLAN
GEOMETRIC
CONTROLS**

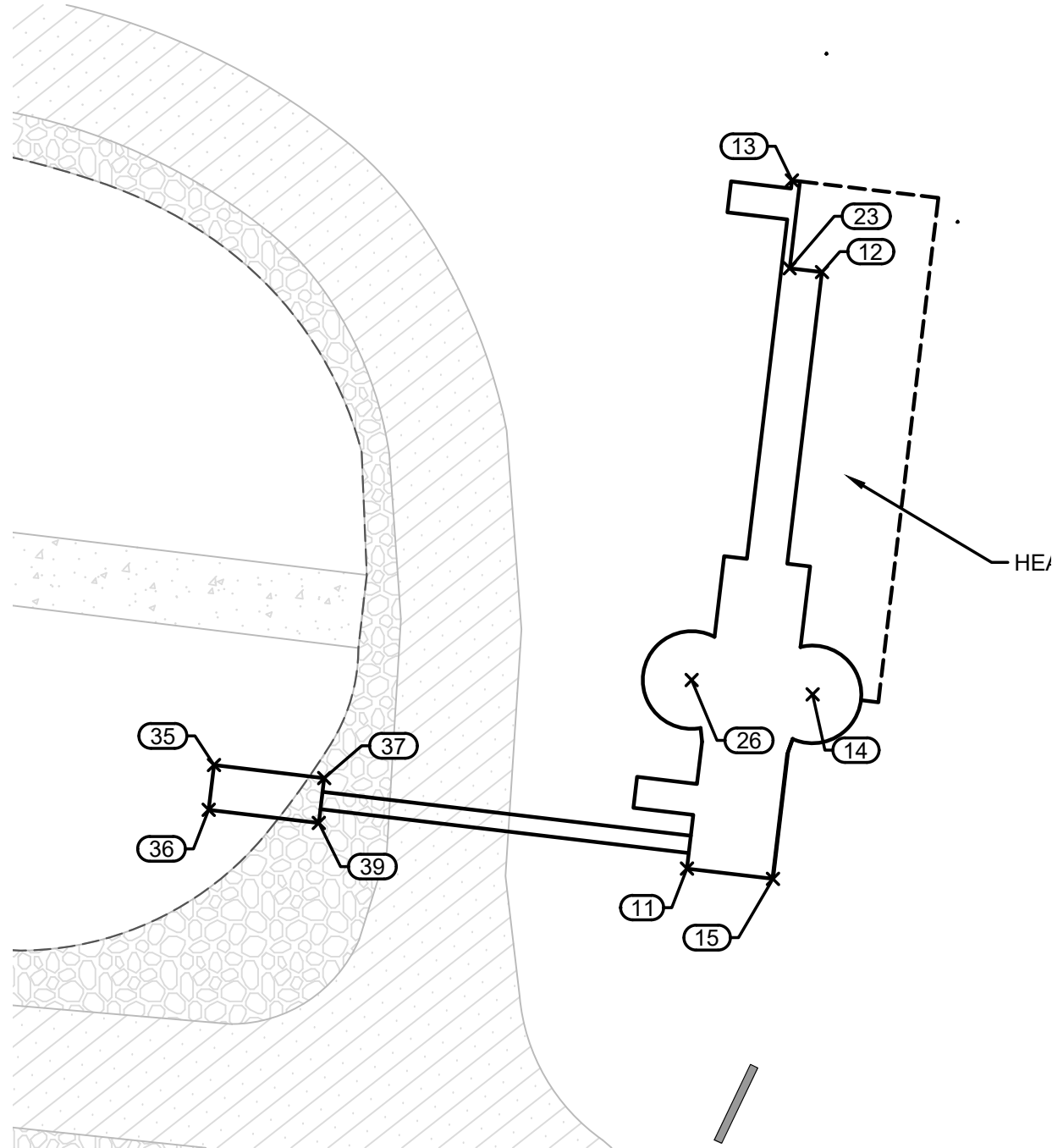
C-101

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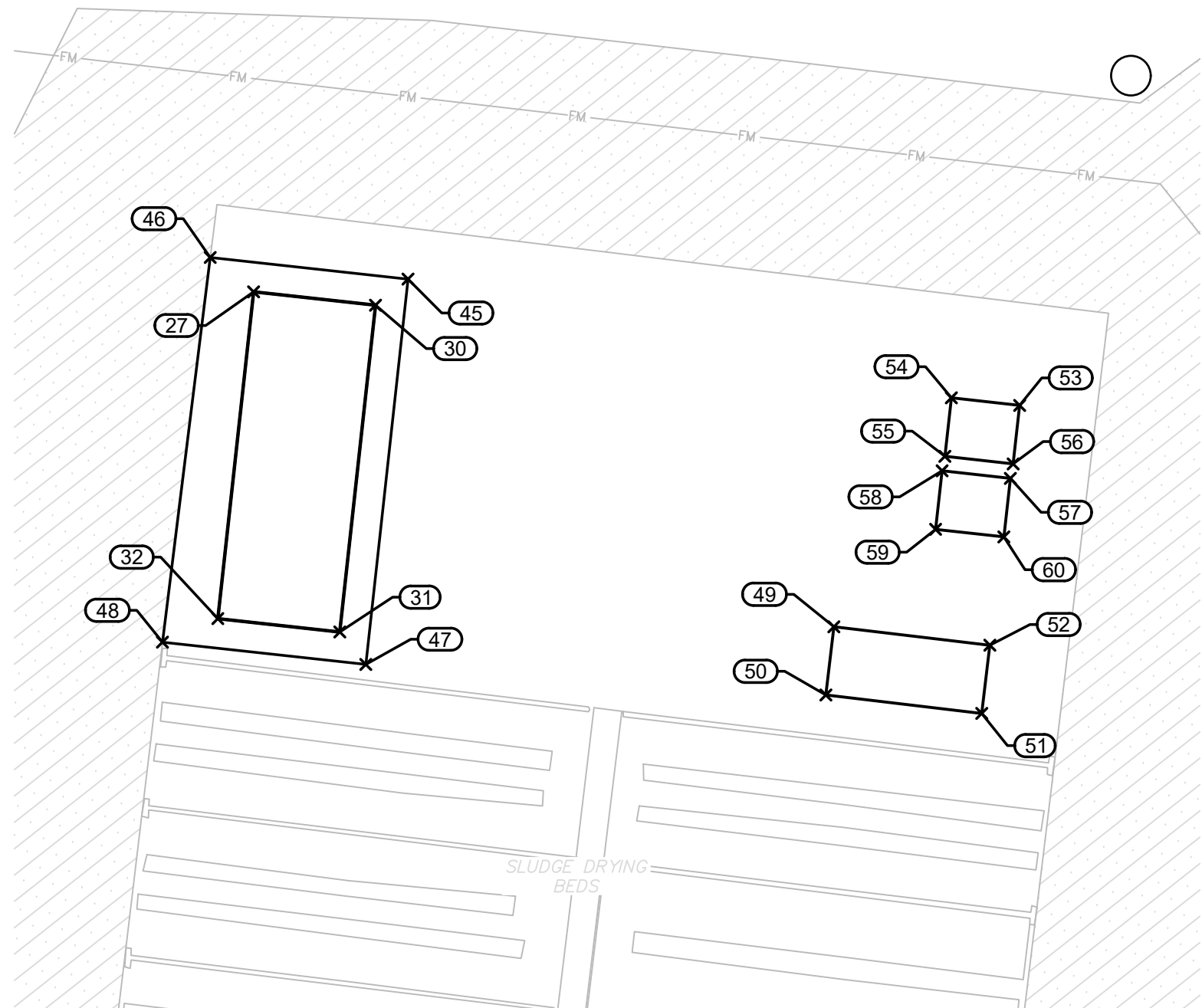
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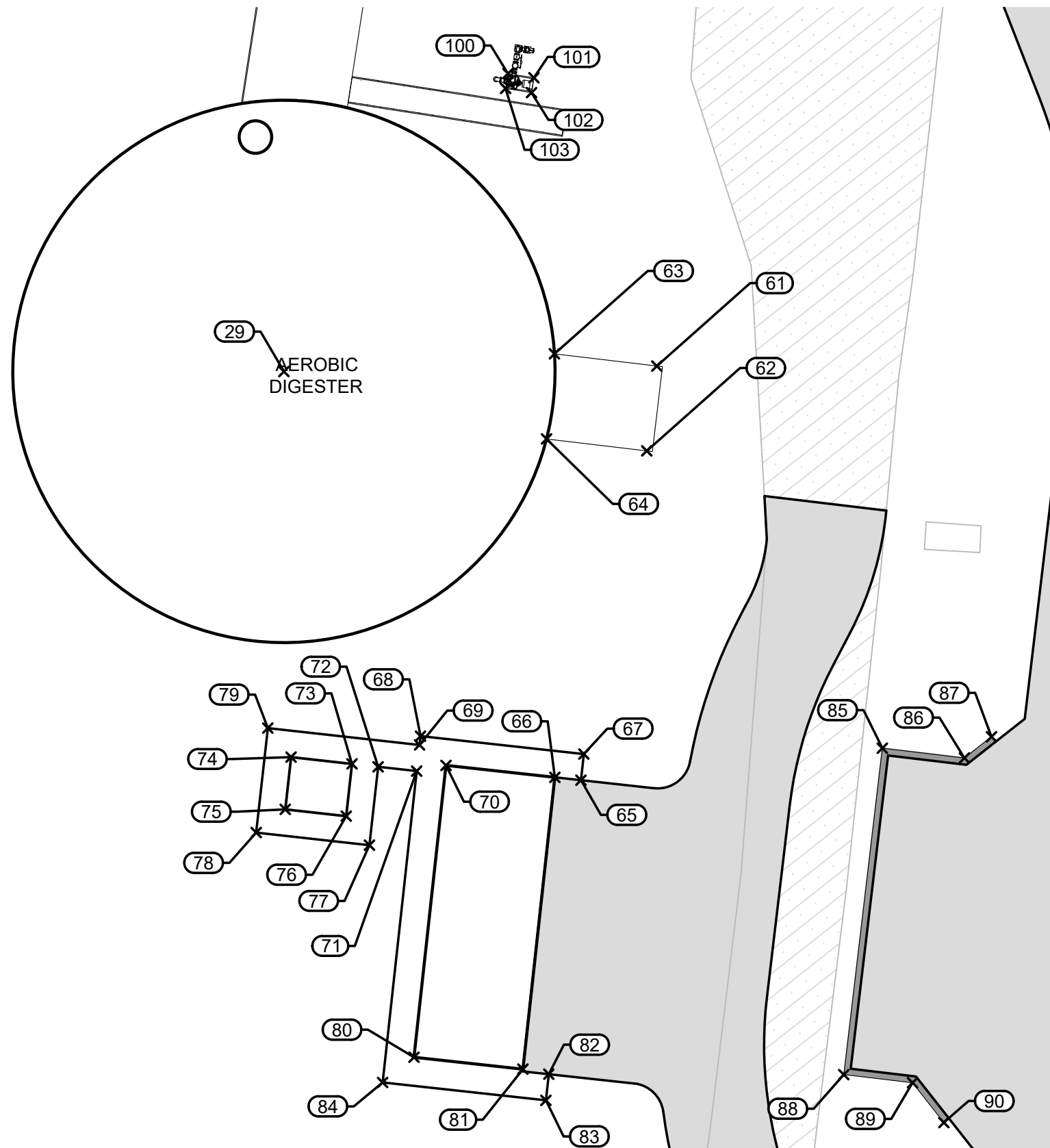
2 SITE PLAN
C-101 SCALE: 1" = 20'-0"



3 SITE PLAN
C-101 SCALE: 1" = 20'-0"



4 SITE PLAN
C-101 SCALE: 1" = 20'-0"



5 SITE PLAN
C-101 SCALE: 1" = 20'-0"

COORDINATES			COORDINATES		
#	NORTHING	EASTING	#	NORTHING	EASTING
1	1024529.8005	1457587.5582	56	1024376.7338	1457786.7414
2	1024528.1391	1457600.4516	57	1024374.7646	1457786.3641
3	1024515.5746	1457598.8326	58	1024375.7963	1457777.0879
4	1024492.9369	1457582.8082	59	1024367.8453	1457776.2036
5	1024512.8909	1457619.6604	60	1024366.8137	1457785.4798
6	1024510.7345	1457622.0498	61	1024075.3567	1457763.5589
7	1024488.0959	1457616.4655	62	1024062.4478	1457762.0229
8	1024489.5761	1457619.3234	63	1024077.2109	1457747.9762
9	1024509.5423	1457631.3024	64	1024064.2630	1457746.7682
10	1024488.3839	1457628.5761	65	1024012.3444	1457752.0106
11	1024100.3349	1458480.7864	66	1024012.7797	1457748.0343
12	1024173.7187	1458497.4063	67	1024016.3206	1457752.4459
13	1024184.9926	1458493.7130	68	1024019.0414	1457727.5944
14	1024121.7610	1458496.2550	69	1024017.7055	1457727.4481
15	1024099.0747	1458491.3772	70	1024014.5935	1457731.4673
16	1024557.6832	1457586.8622	71	1024013.7293	1457727.0128
17	1024567.9374	1457444.2796	72	1024014.3820	1457721.1441
18	1024550.1778	1457662.9206	73	1024014.8241	1457717.1686
19	1023969.6712	1458095.8214	74	1024015.8558	1457707.8925
20	1023994.6676	1457885.7544	75	1024007.9048	1457707.0082
21	1024009.5625	1457887.5268	76	1024006.8731	1457716.2843
22	1023991.7328	1458114.8913	77	1024002.4555	1457719.8177
23	1024174.1920	1458493.4348	78	1024004.3714	1457702.5906
24	1024008.2604	1457856.1532	79	1024020.2734	1457704.3591
25	1023961.5823	1457850.6618	80	1023970.1919	1457726.6062
26	1024123.5324	1458481.3684	81	1023968.3781	1457743.1732
27	1024400.1138	1457683.5383	82	1023967.6117	1457747.1132
28	1023907.9606	1457844.2812	83	1023963.6354	1457746.6779
29	1024074.5209	1457706.8140	84	1023966.3562	1457721.8264
30	1024398.2992	1457700.1053	85	1024017.2087	1457797.8721
31	1024353.8984	1457695.2442	86	1024015.7221	1457810.3624
32	1024355.7122	1457678.6772	87	1024018.9650	1457814.4817
33	1023663.2063	1457721.6000	88	1023967.5538	1457792.0076
34	1023879.3071	1458085.0824	89	1023966.3091	1457802.4685
35	1024113.0768	1458422.5843	90	1023960.2557	1457807.2344
36	1024107.5647	1458421.9284	91	1024137.7169	1457845.9265
37	1024111.4637	1458436.1407	92	1024097.0873	1457861.9023
38	1023667.6025	1457681.3393	93	1024052.2144	1457861.3833
39	1024105.9516	1458435.4848	94	1023890.7054	1457839.7117
40	1023700.9778	1457725.7611	95	1023858.9994	1457806.7283
41	1023705.3740	1457685.5004	96	1023794.5819	1457815.2698
42	1024010.9707	1457833.3763	97	1023793.6252	1457823.2101
43	1023964.2999	1457827.8229	98	1023780.9582	1457821.4936
44	1024530.9915	1457439.6602	99	1023781.9056	1457813.5522
45	1024401.8401	1457704.5168	100	1024119.8541	1457740.9008
46	1024404.7822	1457677.6438	101	1024119.2169	1457744.8498
47	1024349.4860	1457698.7850	102	1024116.9551	1457744.4848
48	1024352.5112	1457671.1531	103	1024117.5922	1457740.5359
49	1024354.5996	1457762.3868	104	1023818.8965	1458042.6556
50	1024345.3348	1457761.2925	105	1023808.9733	1458041.4187
51	1024342.8325	1457782.4786	106	1023993.4020	1458100.6555
52	1024352.0973	1457783.5729	107	1023981.4698	1458113.6879
53	1024384.6847	1457787.6256	108	1023983.1390	1458099.4521
54	1024385.7164	1457778.3495			
55	1024377.7654	1457777.4652			

**CIVIL SITE PLAN
ENLARGED
GEOMETRIC
CONTROLS**

C-102

**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**

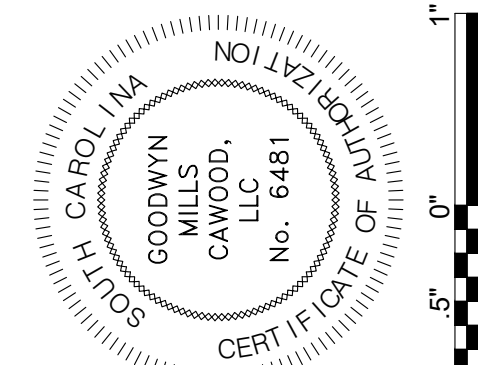
PENDLETON, SOUTH CAROLINA
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Anderson County

GMC PROJECT #CGRE220027

ISSUE

DATE

30% Submittal	01.18.2023
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90% Submittal	12.04.2023
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Conformed Set	
Project Manager:	WN
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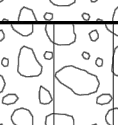
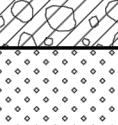
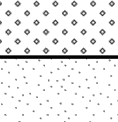
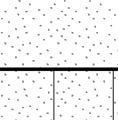
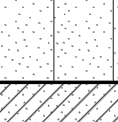
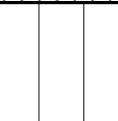
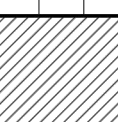
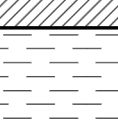
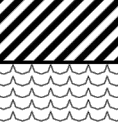
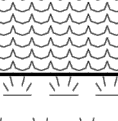


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SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS	
			GRAPH	LETTER		
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES	
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES	
	MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
			(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
	MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
					CH	INORGANIC CLAYS OF HIGH PLASTICITY
					OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
				HIGHLY ORGANIC SOILS		

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

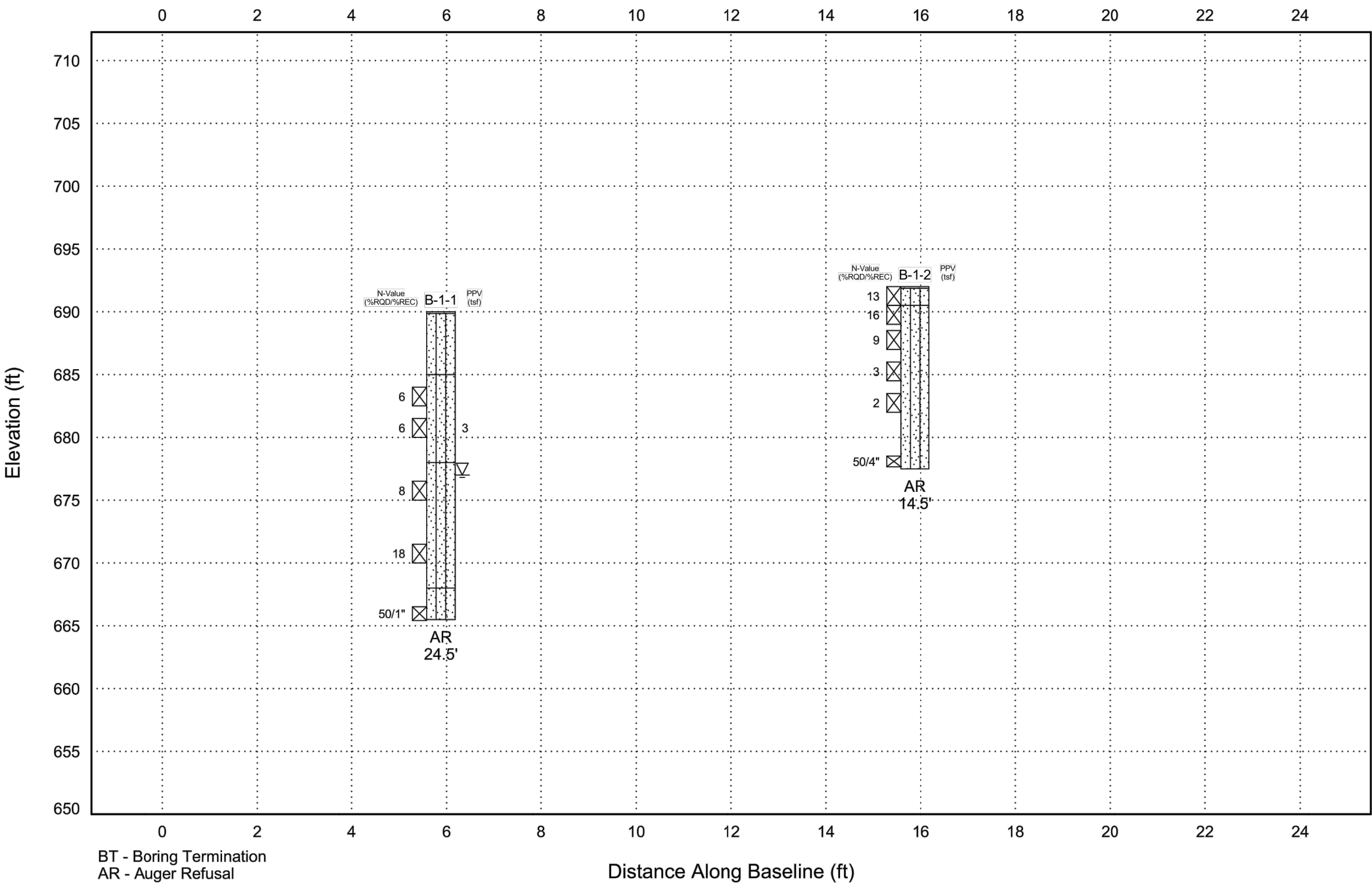


SUBSURFACE DIAGRAM
Influent Pump Station

CLIENT Town of Pendleton
PROJECT NUMBER GGRE220008

PROJECT NAME Pendleton Clemson WWTP Expansion
PROJECT LOCATION Pendleton, South Carolina

TOPSOIL SM



BT-AR DEPTH LOG GGRE220008 PENDLETON CLEMSON WWTP EXPANSION.GPJ GMC DATA TEMPLATE.GDT 9/21/22

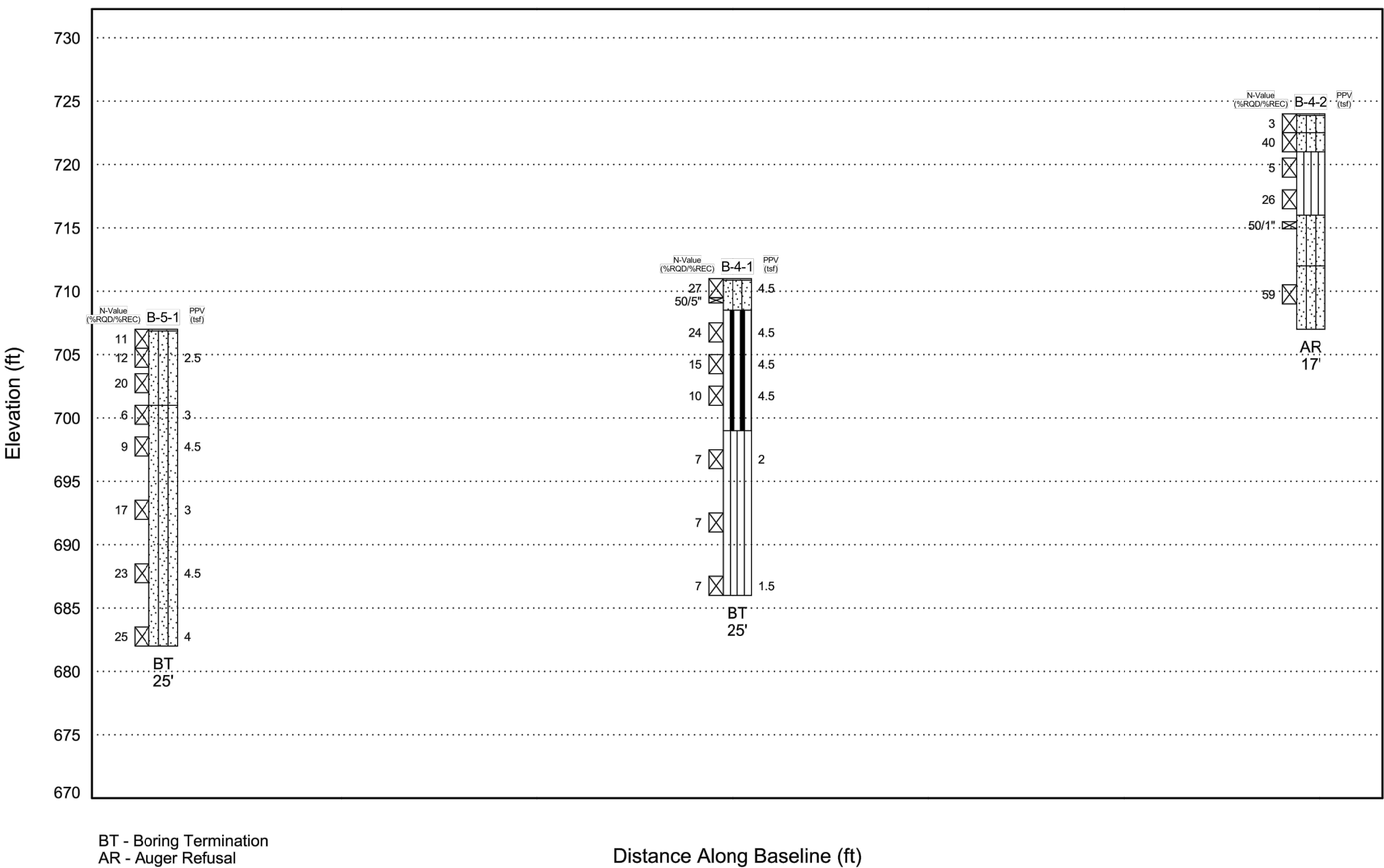


SUBSURFACE DIAGRAM
Aerobic Digester & Secondary Clarifiers

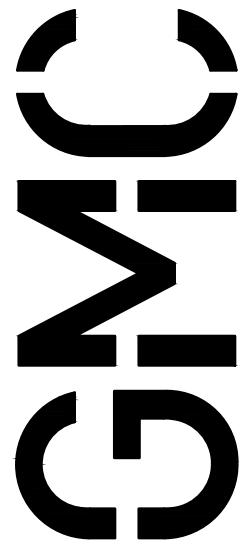
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PROJECT NUMBER GGRE220008

PROJECT NAME Pendleton Clemson WWTP Expansion
PROJECT LOCATION Pendleton, South Carolina

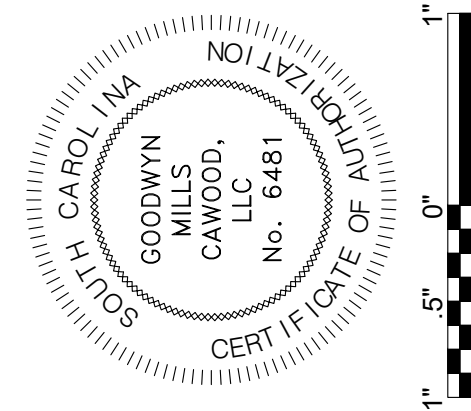
TOPSOIL SM MH ML



BT-AR DEPTH LOG GGRE220008 PENDLETON CLEMSON WWTP EXPANSION.GPJ GMC DATA TEMPLATE.GDT 9/21/22



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ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

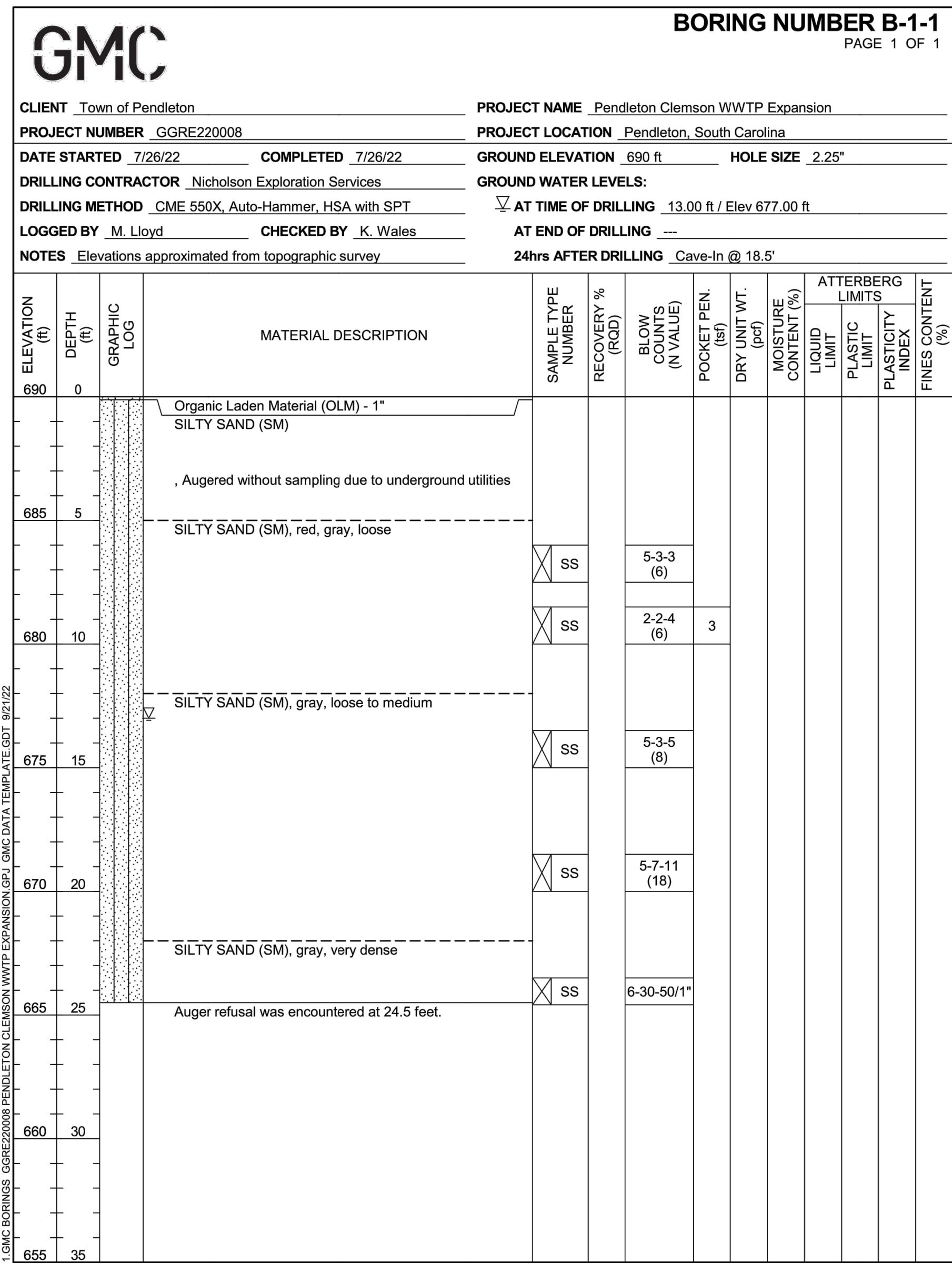
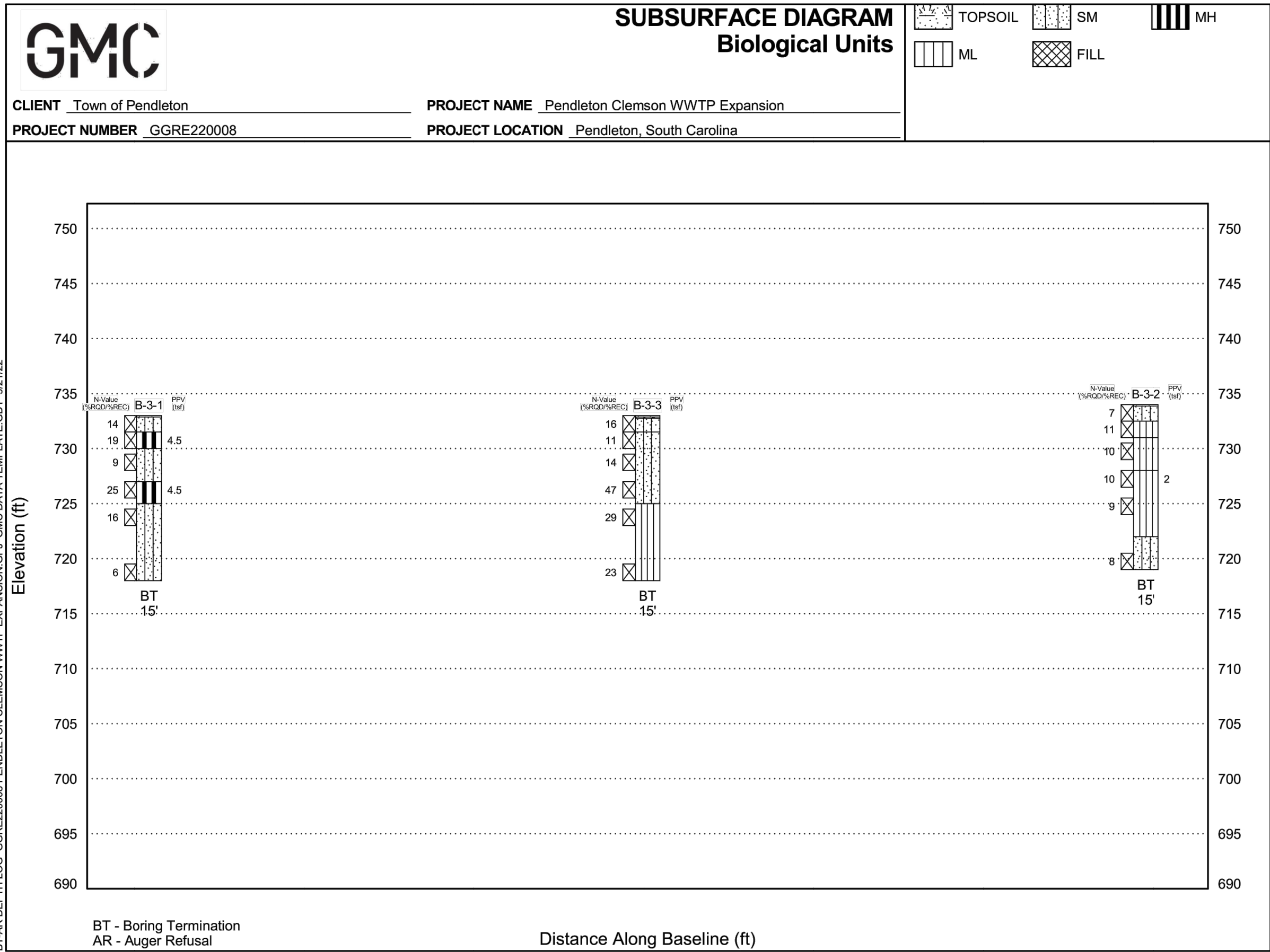
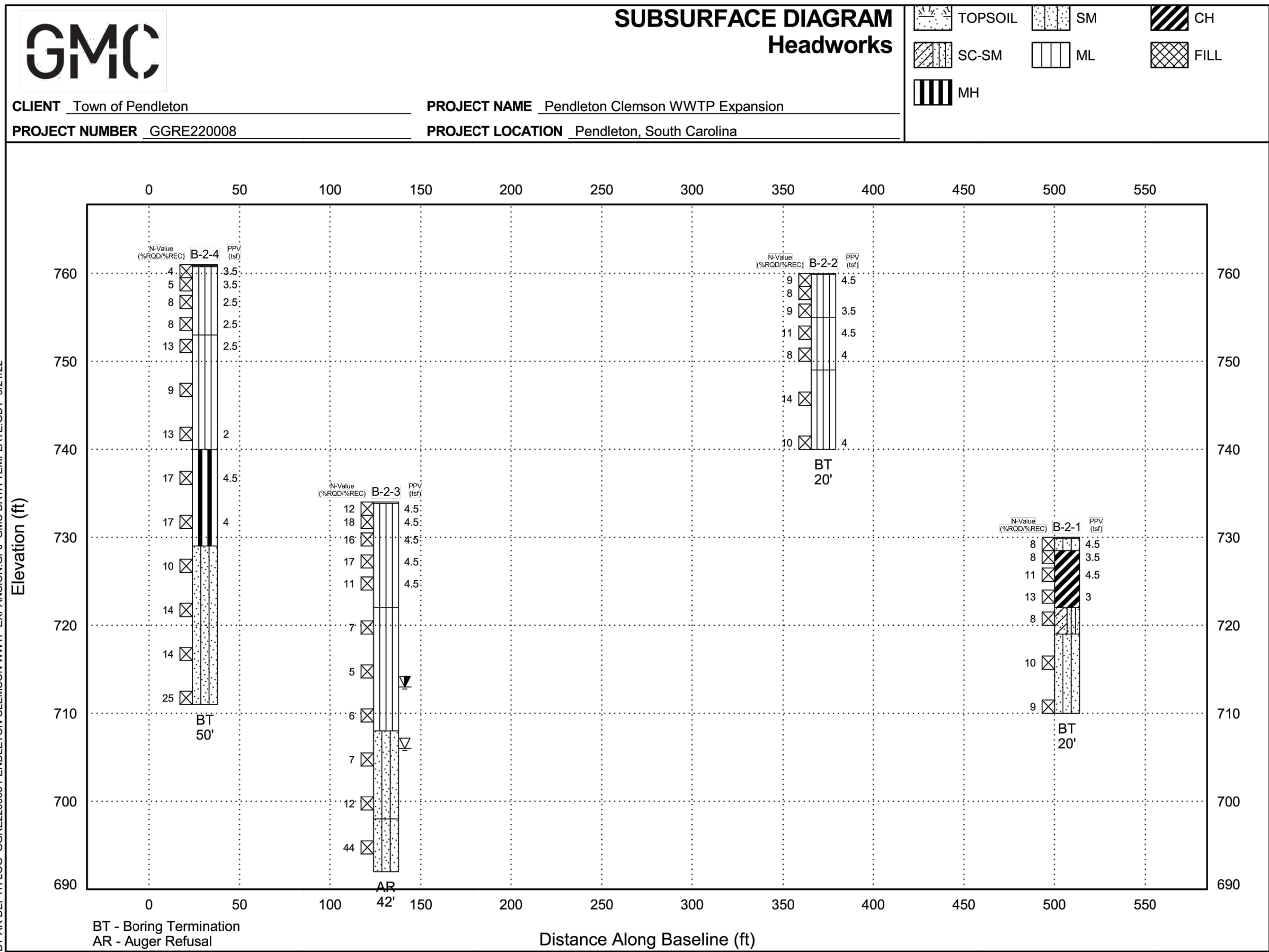
GMC PROJECT #CGRE220027

CIVIL SITE PLAN
GEOTECHNICAL
EXPLORATION
(1 OF 7)

C-111

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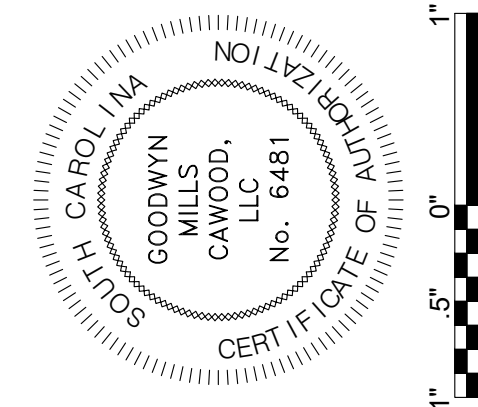


CIVIL SITE PLAN
GEOTECHNICAL
EXPLORATION
(2 OF 7)
C-112

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

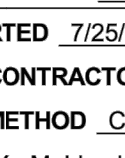
GMC PROJECT #CGRE220027

ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
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Project Manager:	WN
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Designer:	JX
Drawn By:	HKD



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BORING NUMBER B-2-1
 PAGE 1 OF 1

CLIENT Town of Pendleton

PROJECT NUMBER GGRE220008

DATE STARTED 7/25/22 **COMPLETED** 7/25/22

DRILLING CONTRACTOR Nicholson Exploration Services

DRILLING METHOD CME 550X, Auto-Hammer, HSA with SPT

LOGGED BY M. Lloyd **CHECKED BY** K. Wales

NOTES Elevations approximated from topographic survey

PROJECT NAME Pendleton Clemson WWTP Expansion

PROJECT LOCATION Pendleton, South Carolina

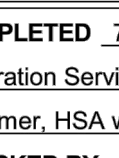
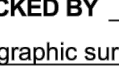
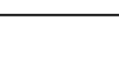
GROUND ELEVATION 730 ft **HOLE SIZE** 2.25"

GROUND WATER LEVELS:

AT TIME OF DRILLING None Encountered

AT END OF DRILLING ----

24hrs AFTER DRILLING Cave-In @ 13'

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS				FINES CONTENT (%)
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX		
730	0		Organic Laden Material (OLM) - 1"	X	SS	2-4-4 (8)	4.5		19					
	SILTY SAND (SM), red, loose		X	SS	3-4-4 (8)	3.5	26							
	SANDY FAT CLAY (CH), red, medium to stiff		X	SS	7-4-7 (11)	4.5	24		52	27	25	68		
725	5													
			SILTY CLAYEY SAND (SC-SM), red, loose	X	SS	6-6-7 (13)	3		26					
720	10													
			SILTY SAND (SM), gray, loose	X	SS	3-3-5 (8)								
715	15													
710	20		Boring was terminated at 20.0 feet.	X	SS	3-3-6 (9)								
705	25													
700	30													
695	35													

1. GMC BORINGS: GGRE220008 PENDLETON CLEMSON WWTP EXPANSION.GPJ / GMC DATA TEMPLATE.GDT 9/21/22

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**CIVIL SITE PLAN
GEOTECHNICAL
EXPLORATION
(3 OF 7)**

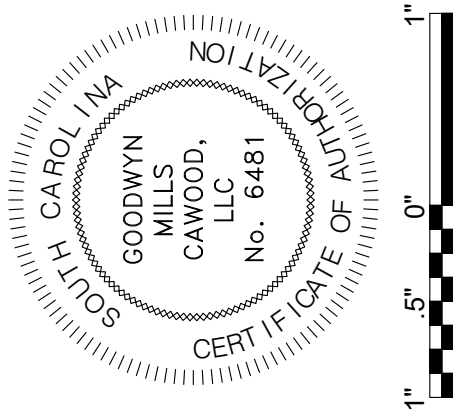
C-113

PENDLETON - CLEMSON

REGIONAL WWTP
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

ISSUE	DATE
30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
100% Submittal	03/08/2024
Conformed Set	WN
Project Manager:	TR
Engineer:	JX
Designer:	HKD
Drawn By:	



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BORING NUMBER B-2-3
PAGE 1 OF 2

CLIENT Town of Pendleton	PROJECT NAME Pendleton Clemson WWTP Expansion
PROJECT NUMBER GGRE220008	PROJECT LOCATION Pendleton, South Carolina
DATE STARTED 7/25/22 COMPLETED 7/25/22	
DILLING CONTRACTOR Nicholson Exploration Services	GROUND ELEVATION 734 ft HOLE SIZE 2.25"
DILLING METHOD CME 550X, Auto-Hammer, HSA with SPT	GROUND WATER LEVELS:
LOGGED BY M. Lloyd CHECKED BY K. Wales	AT TIME OF DILLING 28.00 ft / Elev 706.00 ft
NOTES Elevations approximated from topographic survey	24hrs AFTER DILLING 21.00 ft / Elev 713.00 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (ROD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS	LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0			Organic Laden Material (OLM) - 1" SANDY SILT (ML), red, very stiff to stiff	X SS		5-5-7 (12)	4.5							
				X SS		5-7-11 (18)	4.5							
				X SS		9-7-9 (16)	4.5		22					
				X SS		7-7-10 (17)	4.5		28					
730	5			X SS		4-4-7 (11)	4.5							
725	10													
720	15			X SS		2-3-2 (5)			44					
715	20			X SS		2-3-3 (6)			49					
710	25			X SS		3-3-4 (7)			44	NP	NP	NP		34
705	30			X SS		3-3-9 (12)			44					
700	35			X SS										

(Continued Next Page)

						BORING NUMBER B-2-3							
						PAGE 2 OF 2							
CLIENT Town of Pendleton						PROJECT NAME Pendleton Clemson WWTP Expansion							
PROJECT NUMBER GGRE220008						PROJECT LOCATION Pendleton, South Carolina							
ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (kg)	DRY UNIT WT.	MOISTURE CONTENT (%)	ATTERBERG LIMITS		FINES CONTENT (%)	
35			SILTY SAND (SM), gray, brown, loose to medium <i>(continued)</i> SILTY SAND (SM), gray, very dense										
695	40			X SS		6-17-27 (44)							
690	45		Auger refusal was encountered at 42.0 feet.										
685	50												
680	55												
675	60												
670	65												
665	70												
660	75												

1.GMC BORINGS - GGRE220008 PENDLETON CLEMSON WWTP EXPANSION.GPJ GMC DATA TEMPLATE.GDT 9/21/22

BORING NUMBER B-2-4
 PAGE 1 OF 2

CLIENT Town of Pendleton

PROJECT NUMBER GGRE220008

DATE STARTED 7/25/22 **COMPLETED** 7/25/22

DRILLING CONTRACTOR Nicholson Exploration Services

DRILLING METHOD CME 550X, Auto-Hammer, HSA with SPT

LOGGED BY M. Lloyd **CHECKED BY** K. Wales

NOTES Elevations approximated from topographic survey

PROJECT NAME Pendleton Clemson WWTP Expansion

PROJECT LOCATION Pendleton, South Carolina

GROUND ELEVATION 761 ft **HOLE SIZE** 2.25"

GROUND WATER LEVELS:

AT TIME OF DRILLING None Encountered

AT END OF DRILLING ---

24hrs AFTER DRILLING Cave-In @ 32.5'

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (gs)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS				FINES CONTENT (%)
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX		
0														
760			Organic Laden Material (OLM) - 1"	SS		3-2-2 (4)	3.5							
	Aggregate Base - 1"		SS		3-2-3 (5)	3.5								
	SANDY SILT (ML), red, brown, soft to medium - FILL		SS		4-3-5 (8)	2.5								
5			SS		4-3-5 (8)	2.5								
755			SS		5-6-7 (13)	2.5			29					
			SANDY SILT (ML), red, brown, stiff- FILL	SS										
10														
750														
				SS		5-4-5 (9)				31				
15														
745														
				SS		4-5-8 (13)	2			29	NP	NP	NP	69
20														
740			ELASTIC SILT with SAND (MH), red, very stiff											
				SS		7-5-12 (17)	4.5			26	67	33	34	74
25														
735														
				SS		6-7-10 (17)	4							
30														
730			SILTY SAND (SM), gray, loose to medium											
				SS		3-3-7 (10)								
35														

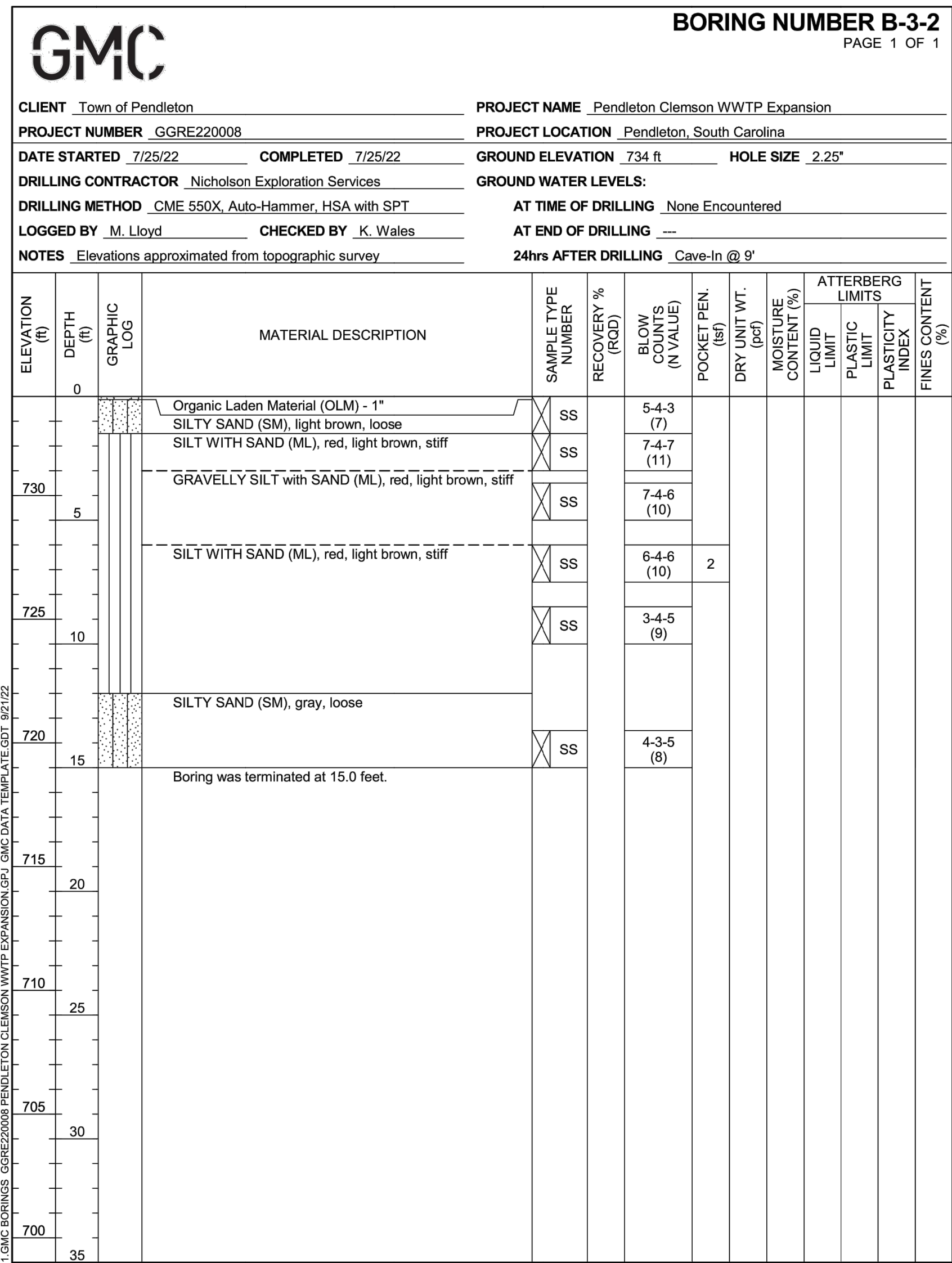
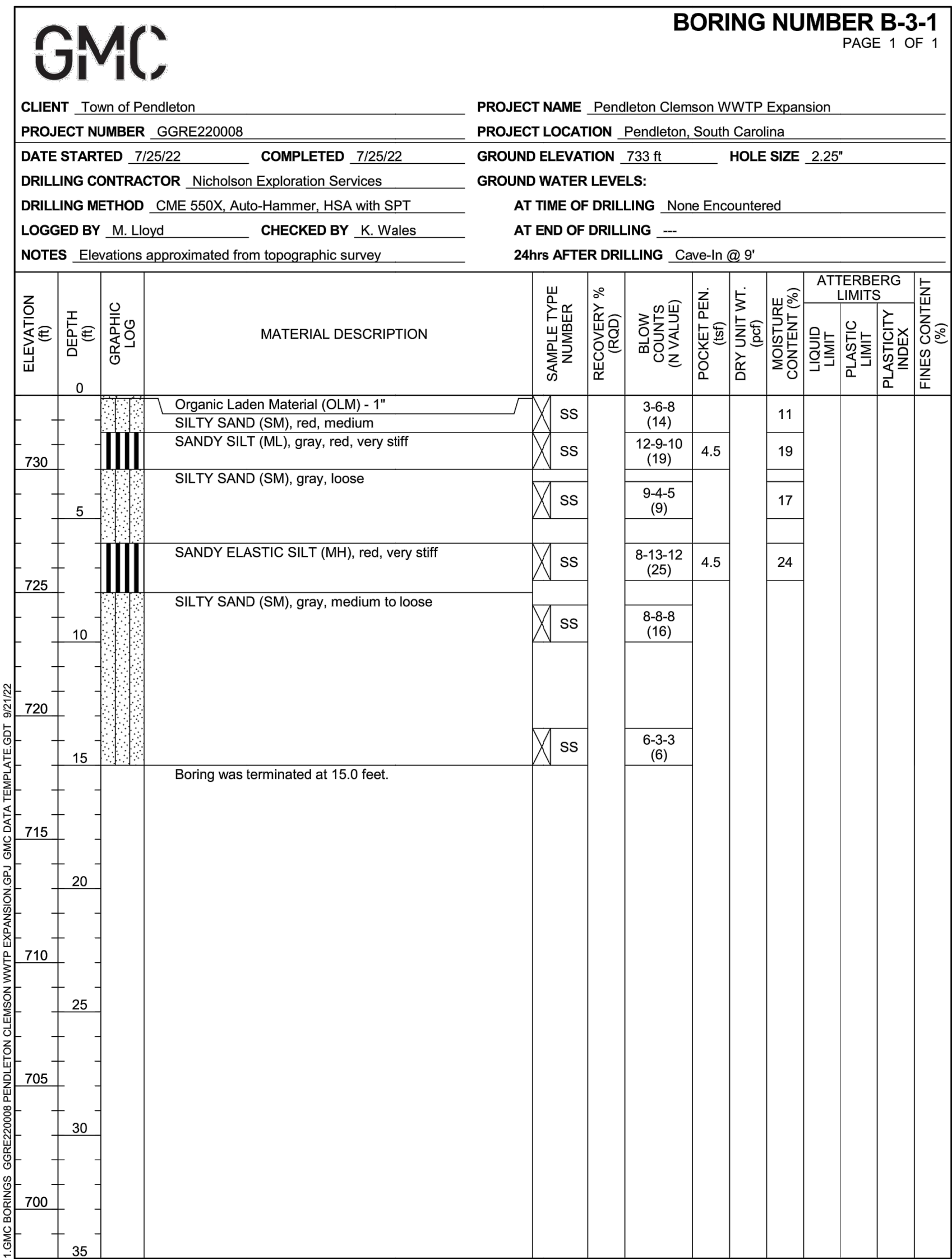
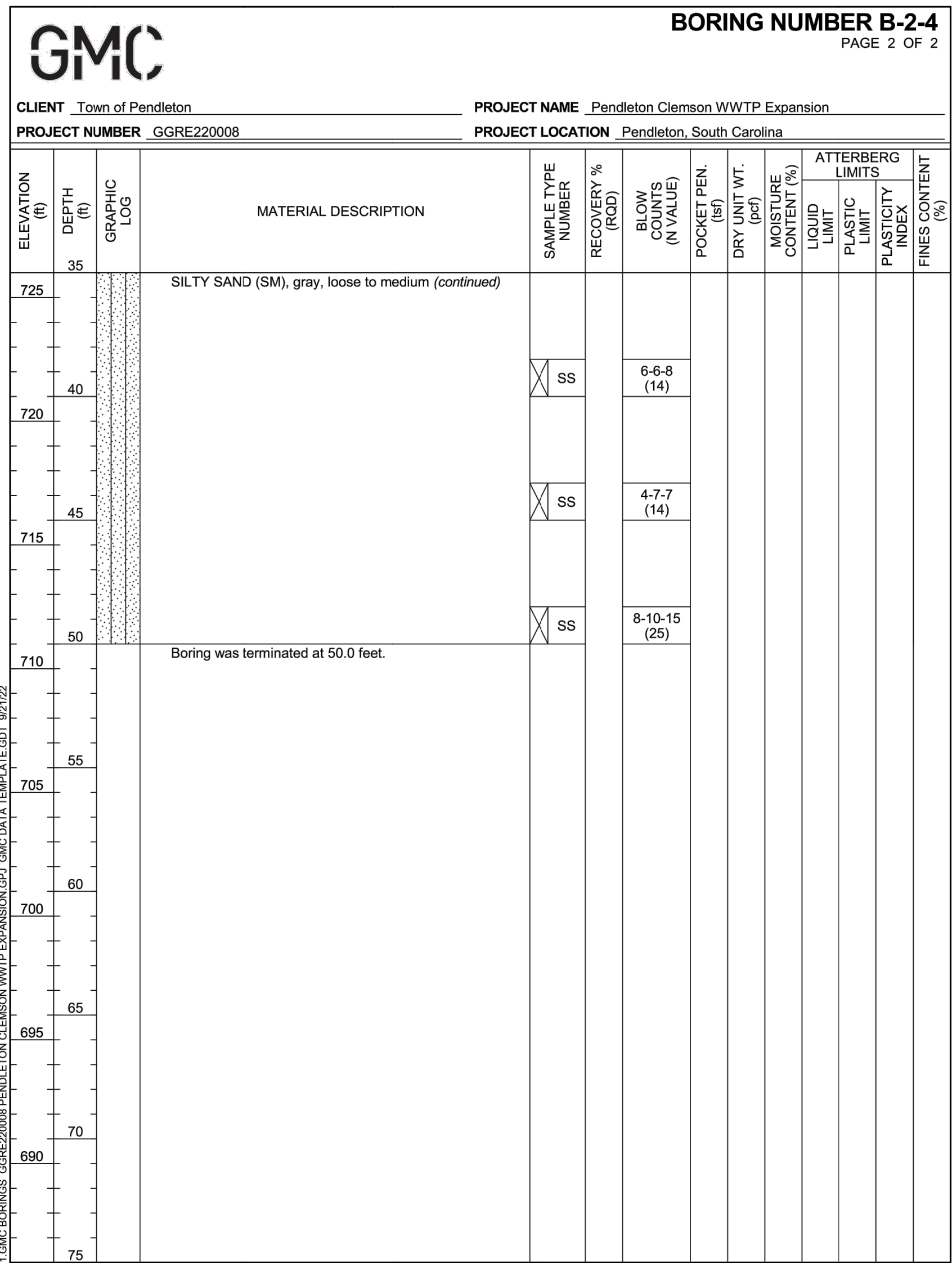
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**CIVIL SITE PLAN
GEOTECHNICAL
EXPLORATION
(4 OF 7)**

C-114

ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

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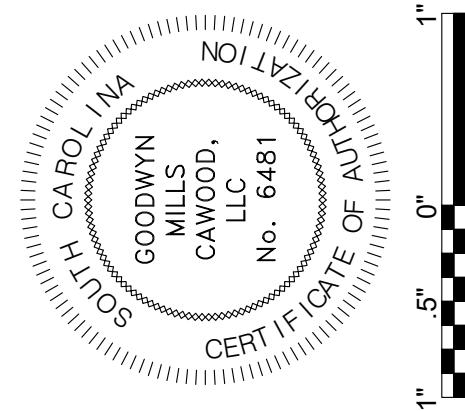
**CIVIL SITE PLAN
GEO TECHNICAL
EXPLORATION
(5 OF 7)**

0-115

**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

ISSUE	DATE
30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
100% Submittal	03/08/2024
Conformed Set	WN
Project Manager:	TR
Engineer:	JX
Designer:	HKD
Drawn By:	



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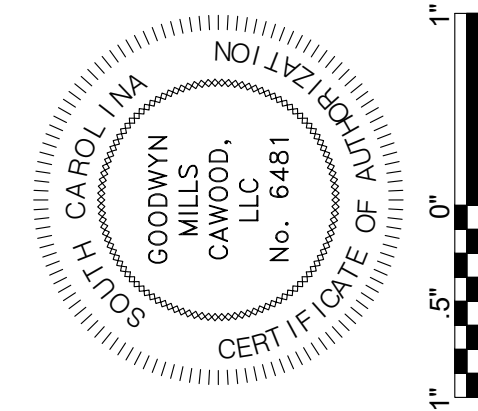
**CIVIL SITE PLAN
GEOTECHNICAL
EXPLORATION
(6 OF 7)**

C-116

**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

	ISSUE	DATE
Project Manager:	30% Submittal	01.18.2023
	60% Submittal	08.07.2023
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	100% Submittal	03.08.2024
	Conformed Set	
Engineer:	TR	
Designer:	JX	
Drawn By:	HKD	



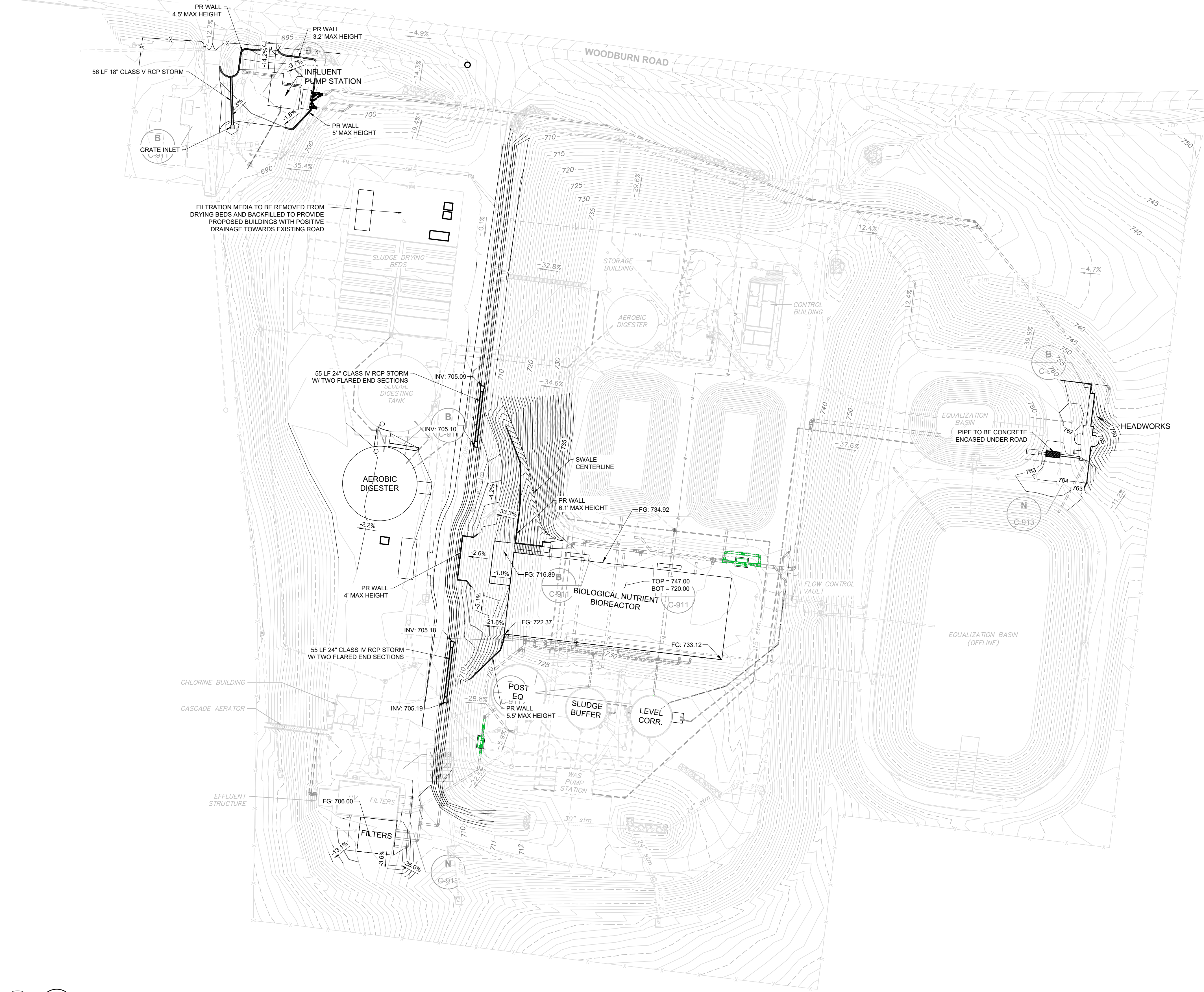
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SITE PLAN
SCALE: 1" = 60'-0"



SITE GRADING NOTES:

- CONTRACTOR IS RESPONSIBLE FOR DEMOLITION OF EXISTING STRUCTURES INCLUDING REMOVAL OF ANY EXISTING UTILITIES SERVING THE STRUCTURE. UTILITIES ARE TO BE REMOVED TO THE RIGHT-OF-WAY.
- THE CONTRACTOR IS SPECIFICALLY CAUTIONED THAT THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AS SHOWN ON THESE PLANS IS BASED ON RECORDS OF THE VARIOUS UTILITY COMPANIES, AND WHERE POSSIBLE, MEASUREMENTS TAKEN IN THE FIELD. THE INFORMATION IS NOT TO BE RELIED ON AS BEING EXACT OR COMPLETE. THE CONTRACTOR MUST CALL THE APPROPRIATE UTILITY COMPANIES AT LEAST 72 HOURS BEFORE ANY EXCAVATION TO REQUEST EXACT FIELD LOCATION OF UTILITIES. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO RELOCATE ALL EXISTING UTILITIES WHICH CONFLICT WITH THE PROPOSED IMPROVEMENTS SHOWN ON THE PLANS.
- ALL CUT OR FILL SLOPES SHALL BE 3:1 OR FLATTER UNLESS OTHERWISE NOTED.
- PRECAST STRUCTURES MAY BE USED AT CONTRACTORS OPTION.
- STORM PIPE SHALL BE AS FOLLOWS UNLESS OTHERWISE NOTED:
TYPE 1: RCP, CLASS III PER ASTM C-76, WITH FLEXIBLE PLASTIC BITUMEN GASKETS AT JOINTS, UNLESS OTHERWISE NOTED. HDPE MAY BE USED AS AN ALTERNATIVE *IF APPROVED BY THE ENGINEER*. CONTRACTOR TO PROVIDE TYPE I DETAILS ENSURING SPECIFICATIONS EQUAL TO OR GREATER THAN RCP.
- EXISTING DRAINAGE STRUCTURES TO BE INSPECTED AND REPAIRED AS NEEDED, AND EXISTING PIPES TO BE CLEANED OUT TO REMOVE ALL SILT AND DEBRIS.
- EXISTING GRADE CONTOUR INTERVALS SHOWN AT 1 FOOT INTERVALS.
- PROPOSED GRADE CONTOUR INTERVALS SHOWN AT 1 FOOT INTERVALS.
- IF ANY EXISTING STRUCTURES TO REMAIN ARE DAMAGED DURING CONSTRUCTION IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO REPAIR AND/OR REPLACE THE EXISTING STRUCTURE AS NECESSARY TO RETURN IT TO EXISTING CONDITIONS OR BETTER.
- ALL STORM PIPE ENTERING STRUCTURES SHALL BE GROUTED TO ASSURE CONNECTION AT STRUCTURE IS WATERTIGHT.
- ALL STORM SEWER MANHOLES IN PAVED AREAS SHALL BE FLUSH WITH PAVEMENT, AND SHALL HAVE TRAFFIC BEARING RING & COVERS. MANHOLES IN UNPAVED AREAS SHALL BE 6" ABOVE FINISH GRADE. LIDS SHALL BE LABELED "STORM SEWER".
- THE CONTRACTOR SHALL ADHERE TO ALL TERMS & CONDITIONS AS OUTLINED IN THE GENERAL N.P.D.E.S. PERMIT FOR STORMWATER DISCHARGE ASSOCIATED WITH CONSTRUCTION ACTIVITIES.
- CONTRACTOR SHALL ADJUST AND/OR CUT EXISTING PAVEMENT AS NECESSARY TO ASSURE A SMOOTH FIT AND CONTINUOUS GRADE.
- CONTRACTOR SHALL ASSURE POSITIVE DRAINAGE AWAY FROM BUILDINGS FOR ALL NATURAL AND PAVED AREAS.
- TOPOGRAPHIC INFORMATION TAKEN FROM A TOPOGRAPHIC SURVEY BY RIDGEWATER ENGINEERING & SURVEYING, IF CONTRACTOR DOES NOT ACCEPT EXISTING TOPOGRAPHY AS SHOWN ON THE PLANS, WITHOUT EXCEPTION, HE SHALL HAVE MADE, AT HIS EXPENSE, A TOPOGRAPHIC SURVEY BY A REGISTERED LAND SURVEYOR AND SUBMIT IT TO THE OWNER FOR REVIEW.
- ALL UNSURFACED AREAS DISTURBED BY GRADING OPERATION SHALL RECEIVE 4 INCHES OF TOPSOIL. CONTRACTOR SHALL APPLY STAKED SOD TO ALL SLOPES 3H:1V OR STEEPER. CONTRACTOR SHALL GRASS DISTURBED AREAS IN ACCORDANCE WITH STATE SPECIFICATIONS UNTIL A HEALTHY STAND OF GRASS IS OBTAINED. IF ADEQUATE TOPSOIL IS NOT AVAILABLE ON SITE THE CONTRACTOR SHALL PROVIDE TOPSOIL, APPROVED BY THE OWNER, AS NEEDED.
- CONSTRUCTION SHALL COMPLY WITH ALL APPLICABLE GOVERNING CODES AND BE CONSTRUCTED TO SAME.
- ALL STORM STRUCTURES SHALL HAVE A SMOOTH UNIFORM POURED MORTAR INVERT FROM INVERT IN TO INVERT OUT.
- CATCH BASINS, MANHOLES, FRAMES, GRATES, SHALL MEET THE REQUIREMENTS OF THE LATEST EDITION OF THE SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION STANDARD DETAILS FOR CONSTRUCTION AND TOWN OF PENDLETON REQUIREMENTS.
- THE CONTRACTOR SHALL REFER TO THE ARCHITECTURAL PLANS FOR THE EXACT NUMBER, SIZE AND LOCATION OF ANY ROOF DRAINS.
- INFORMATION CONCERNING UNDERGROUND UTILITIES WAS OBTAINED FROM AVAILABLE RECORDS AND FIELD LOCATIONS WHEN POSSIBLE, BUT THE CONTRACTOR MUST DETERMINE THE EXACT LOCATION AND ELEVATION OF ALL EXISTING UTILITIES BY DIGGING TEST PITS BY HAND AT ALL CROSSINGS WELL IN ADVANCE OF TRENCHING. IF CLEARANCES ARE LESS THAN SPECIFIED ON THE PLAN OR TWELVE INCHES (12"), WHICHEVER IS LESS, CONTACT THE DESIGN ENGINEER AND THE OWNER PRIOR TO PROCEEDING WITH CONSTRUCTION.
- THE CONTRACTOR IS RESPONSIBLE FOR THE DESIGN AND IMPLEMENTATION OF ALL SHEETING, SHORING, BRACING, AND SPECIAL EXCAVATION MEASURES REQUIRED TO MEET OSHA, FEDERAL, STATE, AND LOCAL REGULATIONS PURSUANT TO THE INSTALLATION OF ALL WORK INDICATED ON THESE DRAWINGS. THE OWNER AND THE DESIGN ENGINEER ACCEPT NO RESPONSIBILITY FOR THE DESIGNS TO INSTALL SAID ITEMS.
- PRECAST DRAINAGE STRUCTURES HAVE BEEN SPECIFIED ON THE PLANS. THE OWNER AND THE ENGINEER, HOWEVER, ASSUME NO RESPONSIBILITY FOR THESE STRUCTURES, AS FIELD CONDITIONS OFTEN DICTATE MINOR ELEVATION ADJUSTMENTS. THE CONTRACTOR ASSUMES ALL RESPONSIBILITY AND EXPENSE FOR MODIFYING THE PRECAST STRUCTURES TO ACCOMMODATE FIELD REVISIONS.
- ALL SLOPES 3:1 AND STEEPER ARE TO RECEIVE STAKED SOD.
- ALL GRADING OPERATIONS, EXCAVATIONS, FILL, COMPACTION TESTING AND BACKFILL SHALL BE OBSERVED AND TESTED BY A QUALIFIED GEOTECHNICAL ENGINEER. THE GEOTECHNICAL ENGINEER SHALL BE DESIGNATED BY AND PAID FOR BY THE OWNER.
- NO FILL SHALL BE PLACED PRIOR TO APPROVAL OF THE SUBGRADE BY THE GEOTECHNICAL ENGINEER.
- COMPACTION SHALL BE DONE IN ACCORDANCE WITH PENDLETON CLEMSON WWTP REQUIREMENTS AND THE ON-SITE GEOTECHNICAL ENGINEER'S RECOMMENDATIONS.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY ADDITIONAL COSTS INCURRED FOR INSPECTION AND TESTING OF SOILS DUE TO FAILURE TO COMPLY WITH THE MINIMUM REQUIREMENTS OF THE SOILS REPORT.
- ALL GRADING OPERATIONS SHALL BE STAKED BY A LICENSED LAND SURVEYOR PROVIDED BY THE CONTRACTOR AND APPROVED BY THE OWNER.
- UPON COMPLETION OF THE GRADING, THE GEOTECHNICAL ENGINEER SHALL PROVIDE OWNER WITH A LETTER INDICATING THAT THE SITE AND BUILDING PAD WERE PREPARED IN DIRECT CONFORMANCE WITH THE RECOMMENDATIONS AND CONCLUSIONS IN THE SOILS REPORT.
- CROSS-SLOPE THROUGH STRIPED AREA LEADING TO PUBLIC SIDEWALK SHALL NOT EXCEED 2.0%.
- NO EXPOSED FOOTINGS SHALL BE ALLOWED.

**CIVIL SITE PLAN
GRADING
OVERALL GRADING**

C-201

PENDLETON - CLEMSON

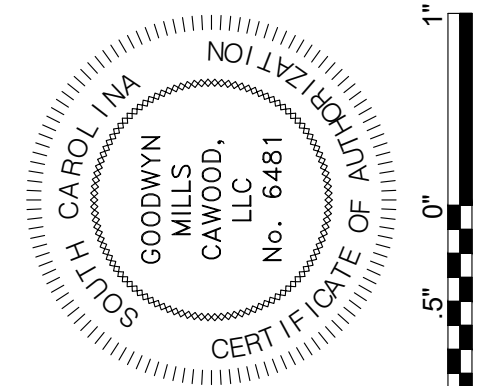
REGIONAL WWTP EXPANSION

PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

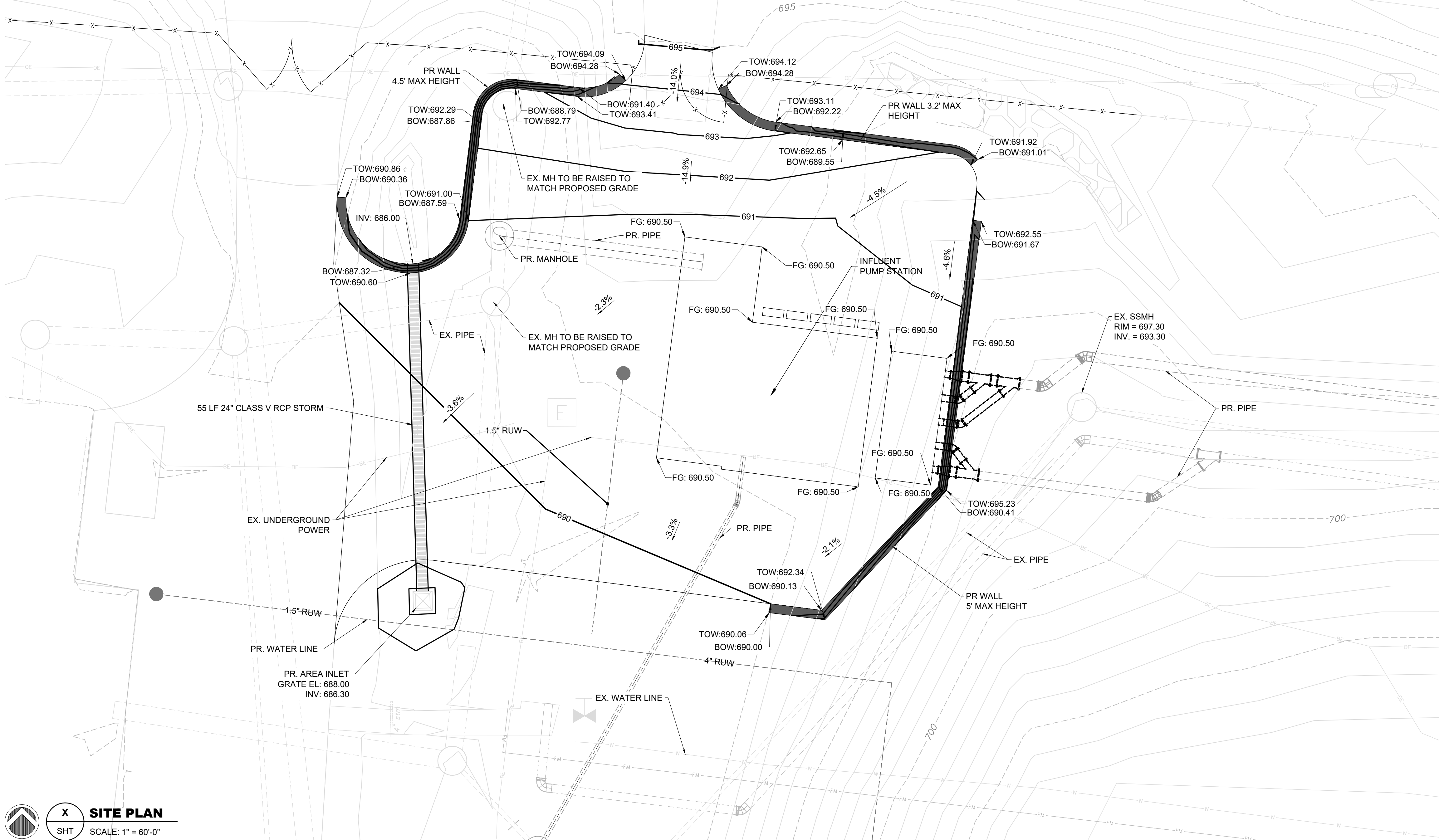
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T 864.527.0460

DRAWING FILE: T:\Projects\SC\Pendleton_Town of CGRE220027 - Pendleton-Clemson WWTP\0.DWG\CAD\01 BID DRAWINGS\03 CIVIL\C-202.dwg
PLOTTED: Mar 11, 2024 - 4:59pm



SITE GRADING NOTES:

- CONTRACTOR IS RESPONSIBLE FOR DEMOLITION OF EXISTING STRUCTURES INCLUDING REMOVAL OF ANY EXISTING UTILITIES SERVING THE STRUCTURE. UTILITIES ARE TO BE REMOVED TO THE RIGHT-OF-WAY.
- THE CONTRACTOR IS SPECIFICALLY CAUTIONED THAT THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AS SHOWN ON THESE PLANS IS BASED ON RECORDS OF THE VARIOUS UTILITY COMPANIES, AND WHERE POSSIBLE, MEASUREMENTS TAKEN IN THE FIELD. THE INFORMATION IS NOT TO BE RELIED ON AS BEING EXACT OR COMPLETE. THE CONTRACTOR MUST CALL THE APPROPRIATE UTILITY COMPANIES AT LEAST 72 HOURS BEFORE ANY EXCAVATION TO REQUEST EXACT FIELD LOCATION OF UTILITIES. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO RELOCATE ALL EXISTING UTILITIES WHICH CONFLICT WITH THE PROPOSED IMPROVEMENTS SHOWN ON THE PLANS.
- ALL CUT OR FILL SLOPES SHALL BE 3:1 OR FLATTER UNLESS OTHERWISE NOTED.
- PRECAST STRUCTURES MAY BE USED AT CONTRACTORS OPTION.
- STORM PIPE SHALL BE AS FOLLOWS UNLESS OTHERWISE NOTED:
TYPE 1: RCP, CLASS III PER ASTM C-76, WITH FLEXIBLE PLASTIC BITUMEN GASKETS AT JOINTS, UNLESS OTHERWISE NOTED. HDPE MAY BE USED AS AN ALTERNATIVE *IF APPROVED BY THE ENGINEER*. CONTRACTOR TO PROVIDE TYPE 1 DETAILS ENSURING SPECIFICATIONS EQUAL TO OR GREATER THAN RCP.
- EXISTING DRAINAGE STRUCTURES TO BE INSPECTED AND REPAIRED AS NEEDED, AND EXISTING PIPES TO BE CLEANED OUT TO REMOVE ALL SILT AND DEBRIS.
- EXISTING GRADE CONTOUR INTERVALS SHOWN AT 1 FOOT INTERVALS.
- PROPOSED GRADE CONTOUR INTERVALS SHOWN AT 1 FOOT INTERVALS.
- IF ANY EXISTING STRUCTURES TO REMAIN ARE DAMAGED DURING CONSTRUCTION IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO REPAIR AND/OR REPLACE THE EXISTING STRUCTURE AS NECESSARY TO RETURN IT TO EXISTING CONDITIONS OR BETTER.
- ALL STORM PIPE ENTERING STRUCTURES SHALL BE GROUTED TO ASSURE CONNECTION AT STRUCTURE IS WATERTIGHT.
- ALL STORM SEWER MANHOLES IN PAVED AREAS SHALL BE FLUSH WITH PAVEMENT, AND SHALL HAVE TRAFFIC BEARING RING & COVERS. MANHOLES IN UNPAVED AREAS SHALL BE 6" ABOVE FINISH GRADE. LIDS SHALL BE LABELED "STORM SEWER".
- THE CONTRACTOR SHALL ADHERE TO ALL TERMS & CONDITIONS AS OUTLINED IN THE GENERAL N.P.D.E.S. PERMIT FOR STORMWATER DISCHARGE ASSOCIATED WITH CONSTRUCTION ACTIVITIES.
- CONTRACTOR SHALL ADJUST AND/OR CUT EXISTING PAVEMENT AS NECESSARY TO ASSURE A SMOOTH FIT AND CONTINUOUS GRADE.
- CONTRACTOR SHALL ASSURE POSITIVE DRAINAGE AWAY FROM BUILDINGS FOR ALL NATURAL AND PAVED AREAS.
- TOPOGRAPHIC INFORMATION TAKEN FROM A TOPOGRAPHIC SURVEY BY RIDGEWATER ENGINEERING & SURVEYING, IF CONTRACTOR DOES NOT ACCEPT EXISTING TOPOGRAPHY AS SHOWN ON THE PLANS, WITHOUT EXCEPTION, HE SHALL HAVE MADE, AT HIS EXPENSE, A TOPOGRAPHIC SURVEY BY A REGISTERED LAND SURVEYOR AND SUBMIT IT TO THE OWNER FOR REVIEW.
- ALL UNSURFACED AREAS DISTURBED BY GRADING OPERATION SHALL RECEIVE 4 INCHES OF TOPSOIL. CONTRACTOR SHALL APPLY STAKED SOD TO ALL SLOPES 3H:1V OR STEEPER. CONTRACTOR SHALL GRASS DISTURBED AREAS IN ACCORDANCE WITH STATE SPECIFICATIONS UNTIL A HEALTHY STAND OF GRASS IS OBTAINED. IF ADEQUATE TOPSOIL IS NOT AVAILABLE ON SITE THE CONTRACTOR SHALL PROVIDE TOPSOIL, APPROVED BY THE OWNER, AS NEEDED.
- CONSTRUCTION SHALL COMPLY WITH ALL APPLICABLE GOVERNING CODES AND BE CONSTRUCTED TO SAME.
- ALL STORM STRUCTURES SHALL HAVE A SMOOTH UNIFORM POURED MORTAR INVERT FROM INVERT IN TO INVERT OUT.
- CATCH BASINS, MANHOLES, FRAMES, GRATES, SHALL MEET THE REQUIREMENTS OF THE LATEST EDITION OF THE SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION STANDARD DETAILS FOR CONSTRUCTION AND TOWN OF PENDLETON REQUIREMENTS.
- THE CONTRACTOR SHALL REFER TO THE ARCHITECTURAL PLANS FOR THE EXACT NUMBER, SIZE AND LOCATION OF ANY ROOF DRAINS.
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- ALL GRADING OPERATIONS, EXCAVATIONS, FILL, COMPACTION TESTING AND BACKFILL SHALL BE OBSERVED AND TESTED BY A QUALIFIED GEOTECHNICAL ENGINEER. THE GEOTECHNICAL ENGINEER SHALL BE DESIGNATED BY AND PAID FOR BY THE OWNER.
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- CROSS-SLOPE THROUGH STRIPED AREA LEADING TO PUBLIC SIDEWALK SHALL NOT EXCEED 2.0%.
- NO EXPOSED FOOTINGS SHALL BE ALLOWED.

CIVIL SITE PLAN
GRADING
INFLUENT PUMP
STATION

C-202

PENDLETON - CLEMSON

REGIONAL WWTP EXPANSION

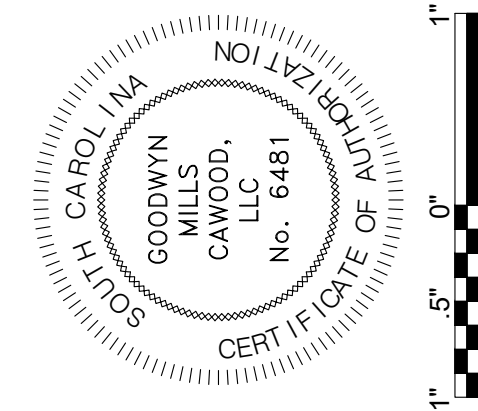
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

ISSUE

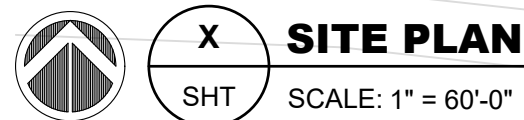
DATE	ISSUE
01/18/2023	30% Submittal
08/07/2023	60% Submittal
12/04/2023	90% Submittal
03/08/2024	100% Submittal
	Conformed Set
	Project Manager:
	Engineer:
	Designer:
	Drawn By:

GMC PROJECT #CGRE220027

GMC
117 Welborn St.
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T 864.527.0460



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CIVIL SITE PLAN
GRADING
HEADWORKS

C-203

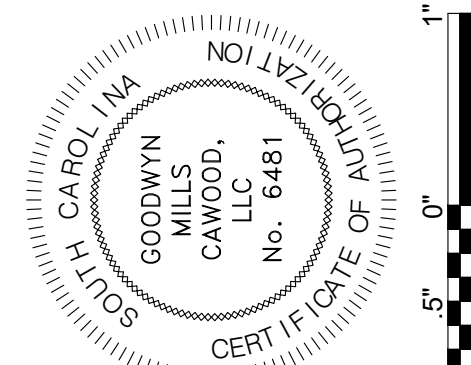
PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION

PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

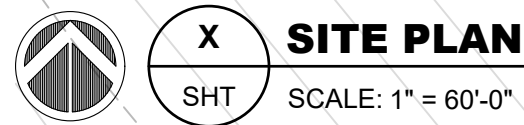
ISSUE DATE

30% Submittal	01/18/2023
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Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

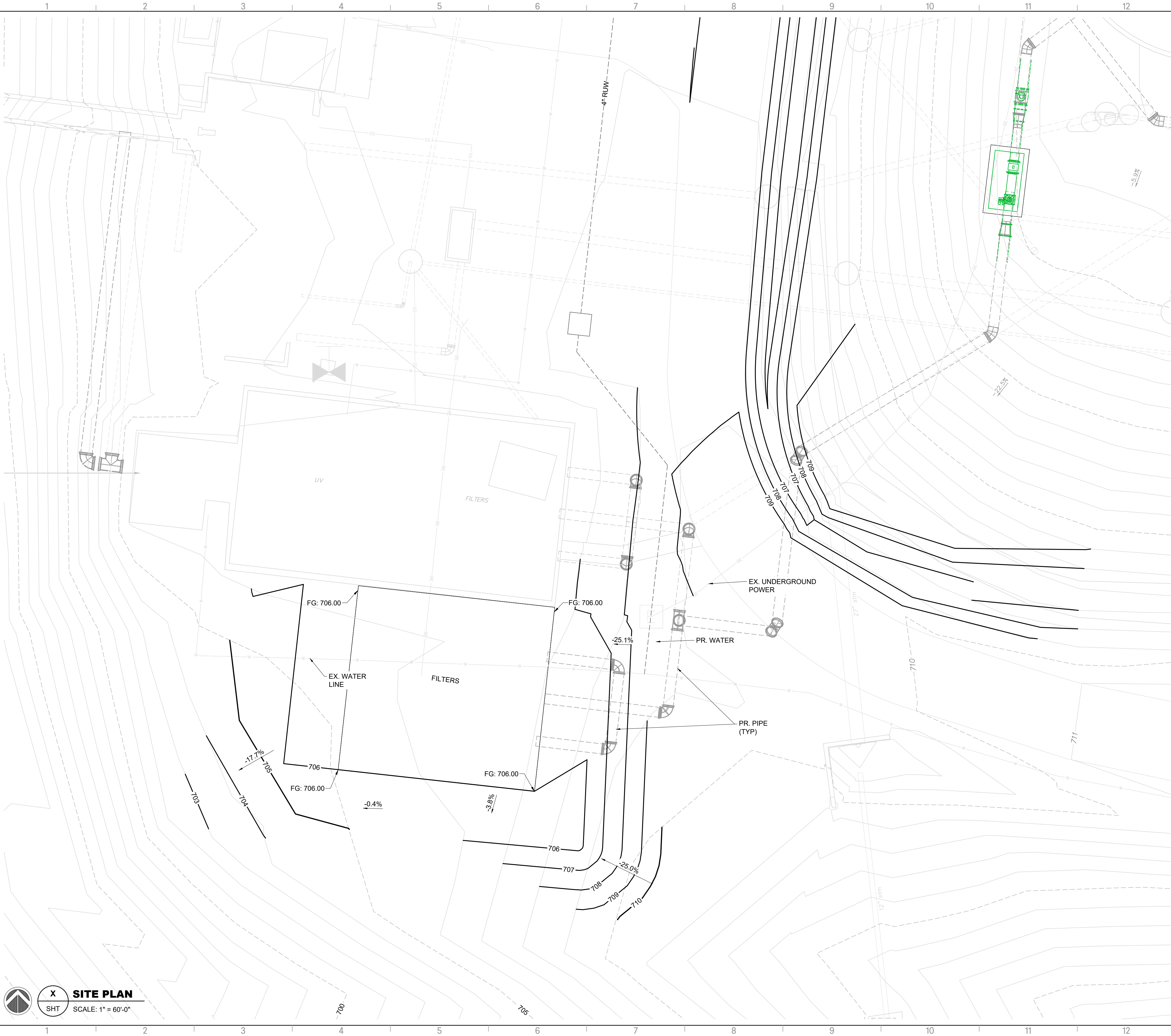


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PLOTTED: Mar 11, 2024 - 5:00pm



SITE PLAN
SCALE: 1" = 60'-0"



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**CIVIL SITE PLAN
GRADING
FILTERS**

C-204

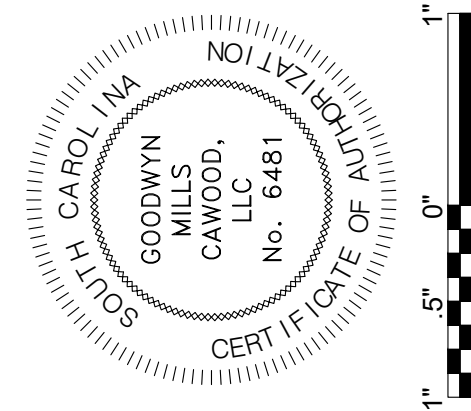
**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**

PENDLETON, SOUTH CAROLINA
Town of Pendleton
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Anderson County

GMC PROJECT #CGRE220027

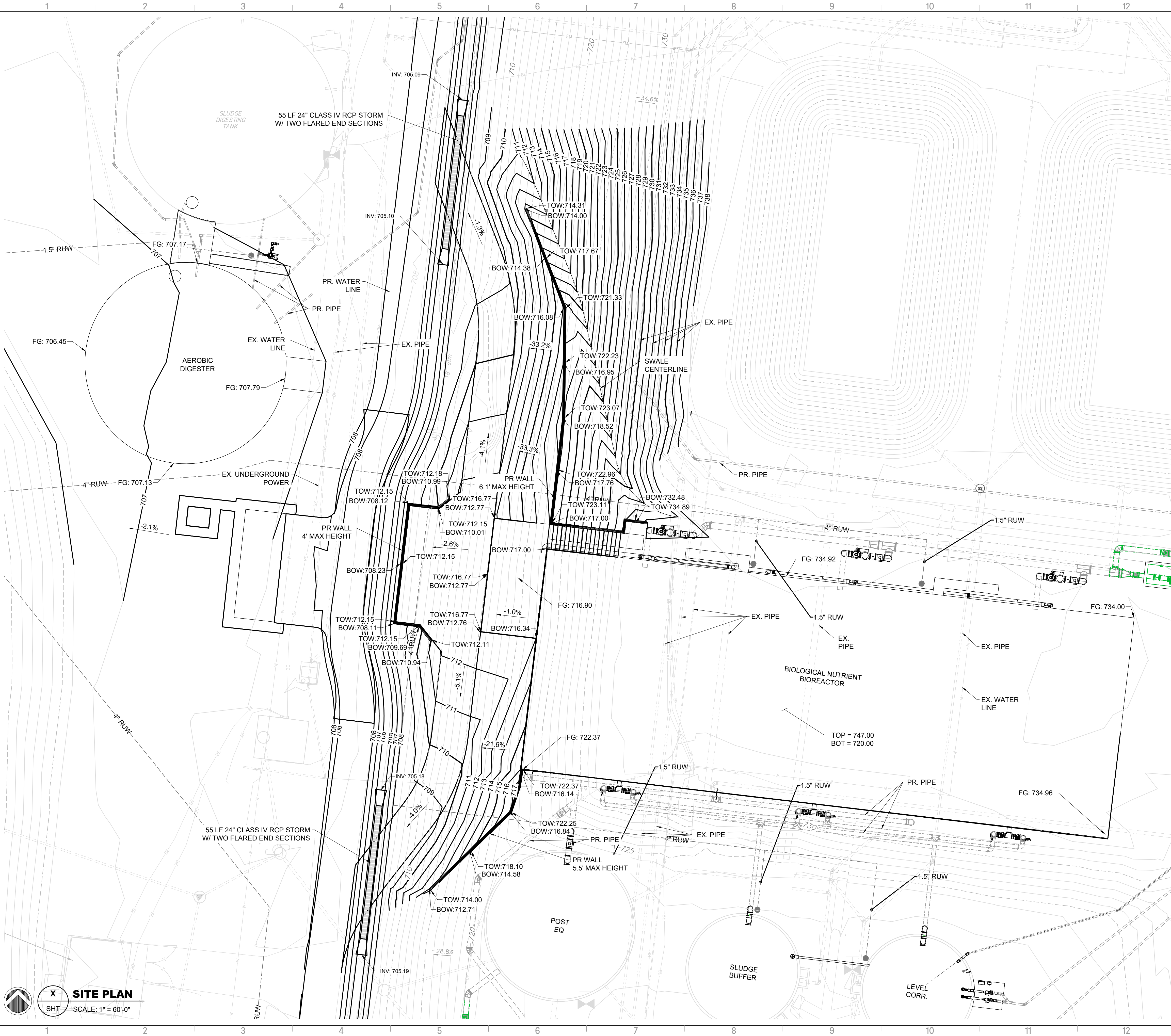
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- PRECAST STRUCTURES MAY BE USED AT CONTRACTORS OPTION.
- STORM PIPE SHALL BE AS FOLLOWS UNLESS OTHERWISE NOTED:
TYPE 1: RCP, CLASS III PER ASTM C-76, WITH FLEXIBLE PLASTIC BITUMEN GASKETS AT JOINTS, UNLESS OTHERWISE NOTED. HDPE MAY BE USED AS AN ALTERNATIVE *IF APPROVED BY THE ENGINEER*. CONTRACTOR TO PROVIDE TYPE 1 DETAILS ENSURING SPECIFICATIONS EQUAL TO OR GREATER THAN RCP.
- EXISTING DRAINAGE STRUCTURES TO BE INSPECTED AND REPAIRED AS NEEDED, AND EXISTING PIPES TO BE CLEANED OUT TO REMOVE ALL SILT AND DEBRIS.
- EXISTING GRADE CONTOUR INTERVALS SHOWN AT 1 FOOT INTERVALS.
- PROPOSED GRADE CONTOUR INTERVALS SHOWN AT 1 FOOT INTERVALS.
- IF ANY EXISTING STRUCTURES TO REMAIN ARE DAMAGED DURING CONSTRUCTION IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO REPAIR AND/OR REPLACE THE EXISTING STRUCTURE AS NECESSARY TO RETURN IT TO EXISTING CONDITIONS OR BETTER.
- ALL STORM PIPE ENTERING STRUCTURES SHALL BE GROUTED TO ASSURE CONNECTION AT STRUCTURE IS WATERTIGHT.
- ALL STORM SEWER MANHOLES IN PAVED AREAS SHALL BE FLUSH WITH PAVEMENT, AND SHALL HAVE TRAFFIC BEARING RING & COVERS. MANHOLES IN UNPAVED AREAS SHALL BE 6" ABOVE FINISH GRADE. LIDS SHALL BE LABELED "STORM SEWER".
- THE CONTRACTOR SHALL ADHERE TO ALL TERMS & CONDITIONS AS OUTLINED IN THE GENERAL N.P.D.E.S. PERMIT FOR STORMWATER DISCHARGE ASSOCIATED WITH CONSTRUCTION ACTIVITIES.
- CONTRACTOR SHALL ADJUST AND/OR CUT EXISTING PAVEMENT AS NECESSARY TO ASSURE A SMOOTH FIT AND CONTINUOUS GRADE.
- CONTRACTOR SHALL ASSURE POSITIVE DRAINAGE AWAY FROM BUILDINGS FOR ALL NATURAL AND PAVED AREAS.
- TOPOGRAPHIC INFORMATION TAKEN FROM A TOPOGRAPHIC SURVEY BY RIDGEWATER ENGINEERING & SURVEYING, IF CONTRACTOR DOES NOT ACCEPT EXISTING TOPOGRAPHY AS SHOWN ON THE PLANS, WITHOUT EXCEPTION, HE SHALL HAVE MADE, AT HIS EXPENSE, A TOPOGRAPHIC SURVEY BY A REGISTERED LAND SURVEYOR AND SUBMIT IT TO THE OWNER FOR REVIEW.
- ALL UNSURFACED AREAS DISTURBED BY GRADING OPERATION SHALL RECEIVE 4 INCHES OF TOPSOIL. CONTRACTOR SHALL APPLY STAKED SOD TO ALL SLOPES 3H:1V OR STEEPER. CONTRACTOR SHALL GRASS DISTURBED AREAS IN ACCORDANCE WITH STATE SPECIFICATIONS UNTIL A HEALTHY STAND OF GRASS IS OBTAINED. IF ADEQUATE TOPSOIL IS NOT AVAILABLE ON SITE THE CONTRACTOR SHALL PROVIDE TOPSOIL, APPROVED BY THE OWNER, AS NEEDED.
- CONSTRUCTION SHALL COMPLY WITH ALL APPLICABLE GOVERNING CODES AND BE CONSTRUCTED TO SAME.
- ALL STORM STRUCTURES SHALL HAVE A SMOOTH UNIFORM POURED MORTAR INVERT FROM INVERT IN TO INVERT OUT.
- CATCH BASINS, MANHOLES, FRAMES, GRATES, SHALL MEET THE REQUIREMENTS OF THE LATEST EDITION OF THE SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION STANDARD DETAILS FOR CONSTRUCTION AND TOWN OF PENDLETON REQUIREMENTS.
- THE CONTRACTOR SHALL REFER TO THE ARCHITECTURAL PLANS FOR THE EXACT NUMBER, SIZE AND LOCATION OF ANY ROOF DRAINS.
- INFORMATION CONCERNING UNDERGROUND UTILITIES WAS OBTAINED FROM AVAILABLE RECORDS AND FIELD LOCATIONS WHEN POSSIBLE, BUT THE CONTRACTOR MUST DETERMINE THE EXACT LOCATION AND ELEVATION OF ALL EXISTING UTILITIES BY DIGGING TEST PITS BY HAND AT ALL CROSSINGS WELL IN ADVANCE OF TRENCHING. IF CLEARANCES ARE LESS THAN SPECIFIED ON THE PLAN OR TWELVE INCHES (12"), WHICHEVER IS LESS, CONTACT THE DESIGN ENGINEER AND THE OWNER PRIOR TO PROCEEDING WITH CONSTRUCTION.
- THE CONTRACTOR IS RESPONSIBLE FOR THE DESIGN AND IMPLEMENTATION OF ALL SHEETING, SHORING, BRACING, AND SPECIAL EXCAVATION MEASURES REQUIRED TO MEET OSHA, FEDERAL, STATE, AND LOCAL REGULATIONS PURSUANT TO THE INSTALLATION OF ALL WORK INDICATED ON THESE DRAWINGS. THE OWNER AND THE DESIGN ENGINEER ACCEPT NO RESPONSIBILITY FOR THE DESIGNS TO INSTALL SAID ITEMS.
- PRECAST DRAINAGE STRUCTURES HAVE BEEN SPECIFIED ON THE PLANS. THE OWNER AND THE ENGINEER, HOWEVER, ASSUME NO RESPONSIBILITY FOR THESE STRUCTURES, AS FIELD CONDITIONS OFTEN DICTATE MINOR ELEVATION ADJUSTMENTS. THE CONTRACTOR ASSUMES ALL RESPONSIBILITY AND EXPENSE FOR MODIFYING THE PRECAST STRUCTURES TO ACCOMMODATE FIELD REVISIONS.
- ALL SLOPES 3:1 AND STEEPER ARE TO RECEIVE STAKED SOD.
- ALL GRADING OPERATIONS, EXCAVATIONS, FILL, COMPACTION TESTING AND BACKFILL SHALL BE OBSERVED AND TESTED BY A QUALIFIED GEOTECHNICAL ENGINEER. THE GEOTECHNICAL ENGINEER SHALL BE DESIGNATED BY AND PAID FOR BY THE OWNER.
- NO FILL SHALL BE PLACED PRIOR TO APPROVAL OF THE SUBGRADE BY THE GEOTECHNICAL ENGINEER.
- COMPACTION SHALL BE DONE IN ACCORDANCE WITH PENDLETON CLEMSON WWTP REQUIREMENTS AND THE ON-SITE GEOTECHNICAL ENGINEER'S RECOMMENDATIONS.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY ADDITIONAL COSTS INCURRED FOR INSPECTION AND TESTING OF SOILS DUE TO FAILURE TO COMPLY WITH THE MINIMUM REQUIREMENTS OF THE SOILS REPORT.
- ALL GRADING OPERATIONS SHALL BE STAKED BY A LICENSED LAND SURVEYOR PROVIDED BY THE CONTRACTOR AND APPROVED BY THE OWNER.
- UPON COMPLETION OF THE GRADING, THE GEOTECHNICAL ENGINEER SHALL PROVIDE OWNER WITH A LETTER INDICATING THAT THE SITE AND BUILDING PAD WERE PREPARED IN DIRECT CONFORMANCE WITH THE RECOMMENDATIONS AND CONCLUSIONS IN THE SOILS REPORT.
- CROSS-SLOPE THROUGH STRIPED AREA LEADING TO PUBLIC SIDEWALK SHALL NOT EXCEED 2.0%.
- NO EXPOSED FOOTINGS SHALL BE ALLOWED.

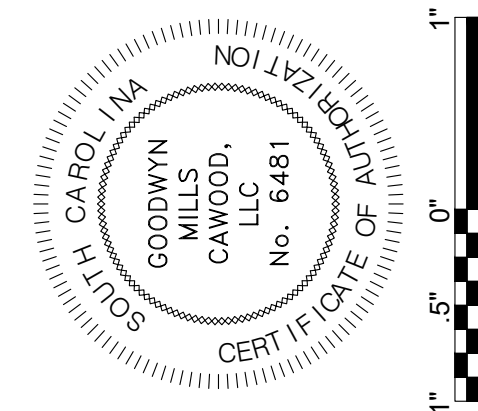
CIVIL SITE PLAN
GRADING
BIOLOGICAL NUTRIENT BIOREACTOR
AND AEROBIC DIGESTER

C-205

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

ISSUE	DATE
30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
100% Submittal	03/08/2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

GMC PROJECT #CGRE220027



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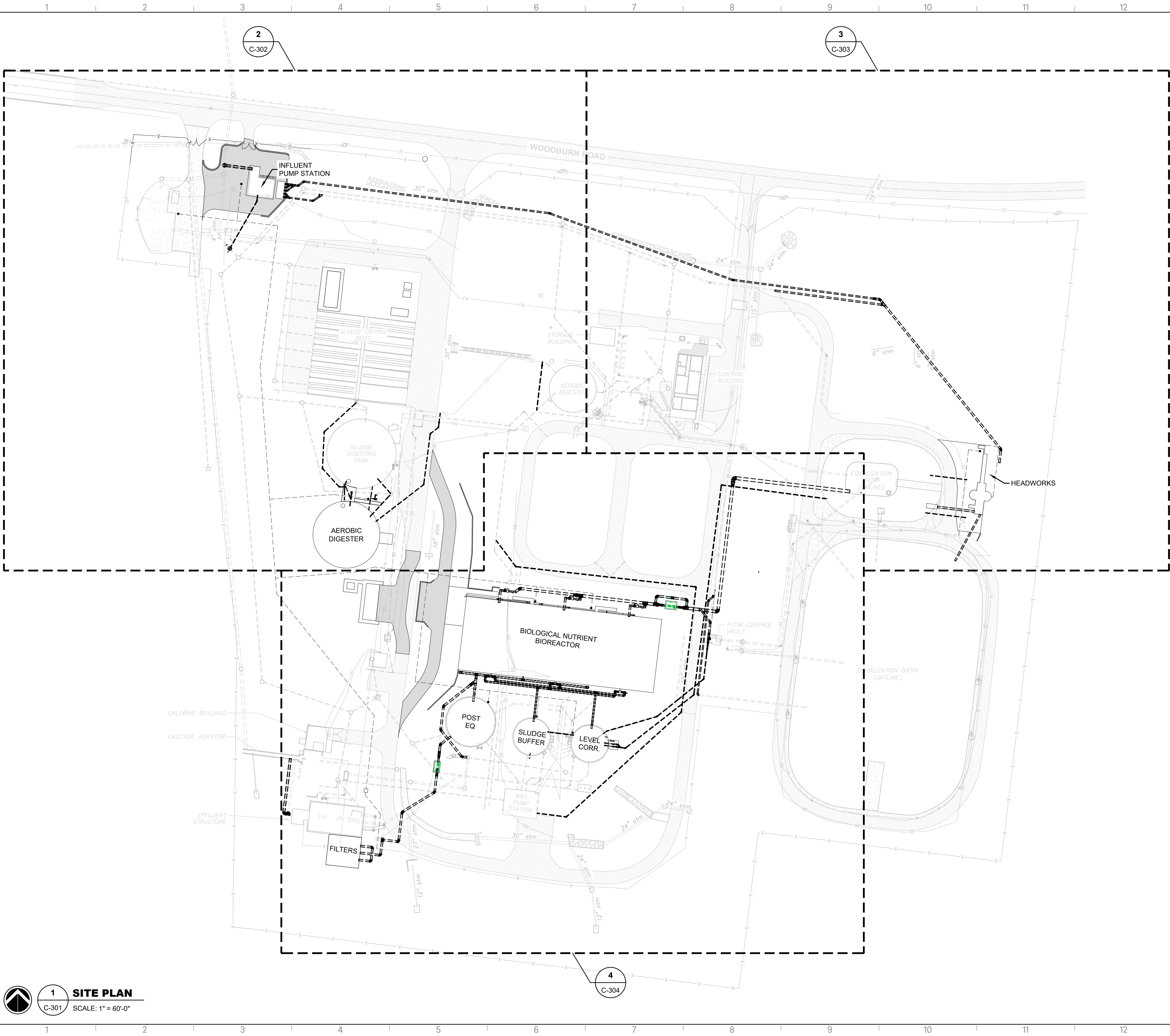


1

SITE PLAN

C-301

SCALE: 1" = 60'-0"



PIPING NOTES:

1. CONTRACTOR SHALL INCLUDE ANY REQUIRED BENDS TO AVOID ANY PIPING CONFLICTS DUE TO LIMITED AREA OF CONSTRUCTION AND UNFAVORABLE GRADE.
2. ALL BURIED PIPE MUST HAVE MINIMUM COVER DEPTH OF 30" OR AS OTHERWISE INDICATED IN THE SPECIFICATIONS OR DETAILS.
3. ALL NECESSARY APPURTENANCES REQUIRED TO MAKE THE PROCESS PIPING FULLY FUNCTIONAL SHALL BE PROVIDED BY THE CONTRACTOR. THIS INCLUDES BUT NOT LIMITED TO MIXING RINGS, INJECTORS, SPARGERS, TAPS, FLANGE ADAPTERS, COUPLINGS, PIPE SUPPORTS, ETC.
4. CONTRACTOR SHALL VERIFY VALVE LOCATIONS AND INTENDED USE AS REQUIRED BY THE PROCESS MANUFACTURER. IF VALVE RELOCATION IS DESIRED, IT SHALL BE AT THE ENGINEER'S DISCRETION.
5. ELECTRICAL CONDUIT AND YARD PIPING CONFLICTS SHALL BE RESOLVED IN THE FIELD BY THE INSPECTOR/ENGINEER.
6. CONTRACTOR SHALL PROVIDE HEAT TRACING, INSULATION AND ELECTRICAL APPURTENANCES FOR ALL EXTERIOR ABOVE GROUND PIPING AND POLYETHYLENE TANKS PER SPECIFICATION GOVERNING WATER AND SEWER PIPING. AIR PIPING IS EXCLUDED FROM THIS REQUIREMENT.
7. CONTRACTOR SHALL REFER TO EROSION CONTROL AND GRADING PLANS FOR SEQUENCING REQUIRED BY DISTURBANCE.
8. VALVES, PIPES, MOTORS, ELECTRICAL PANELS, ETC. SHALL BE POSITIONED SO THAT THEY DO NOT INTERFERE WITH PEDESTRIAN TRAFFIC.
9. PIPE PENETRATIONS THROUGH ALUMINUM GRATING SHALL BE CLEAN PENETRATIONS AND MAINTAIN A MAXIMUM OF A 1" BETWEEN THE EDGE OF THE GRATING AND O.D. OF THE PIPE. GRATING SUPPORTS SHALL BE DESIGNED SUCH THAT PENETRATIONS DO NOT COMPROMISE THE INTEGRITY OF THE GRATING. BANDING & SUPPORT FOR SPECIFIED LOADS IS REQUIRED TO PROVIDE CLEAN PENETRATIONS.

**CIVIL SITE PLAN
YARD PIPING**

C-301

PENDLETON - CLEMSON

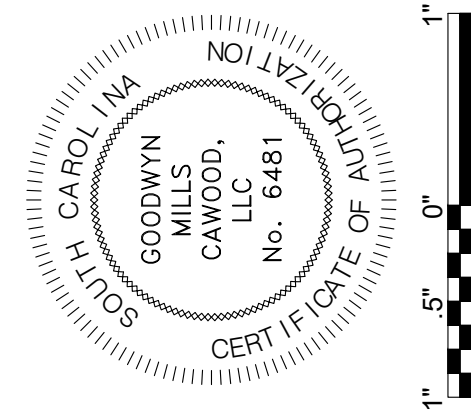
REGIONAL WWTPO EXPANSION

PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

ISSUE DATE

30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
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Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD



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1. 8" 22.5° MJ BEND
2. 18" 45° MJ BEND
3. 6" 22.5° MJ BEND
4. 16" MJ WYE
5. 8" MJ TEE
6. 6" MJ WYE
7. 8"X6" MJ TEE
8. 6" 45° MJ BEND
9. 8" MJ WYE



ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

C-302

CIVIL SITE PLAN ENLARGED YARD PIPING

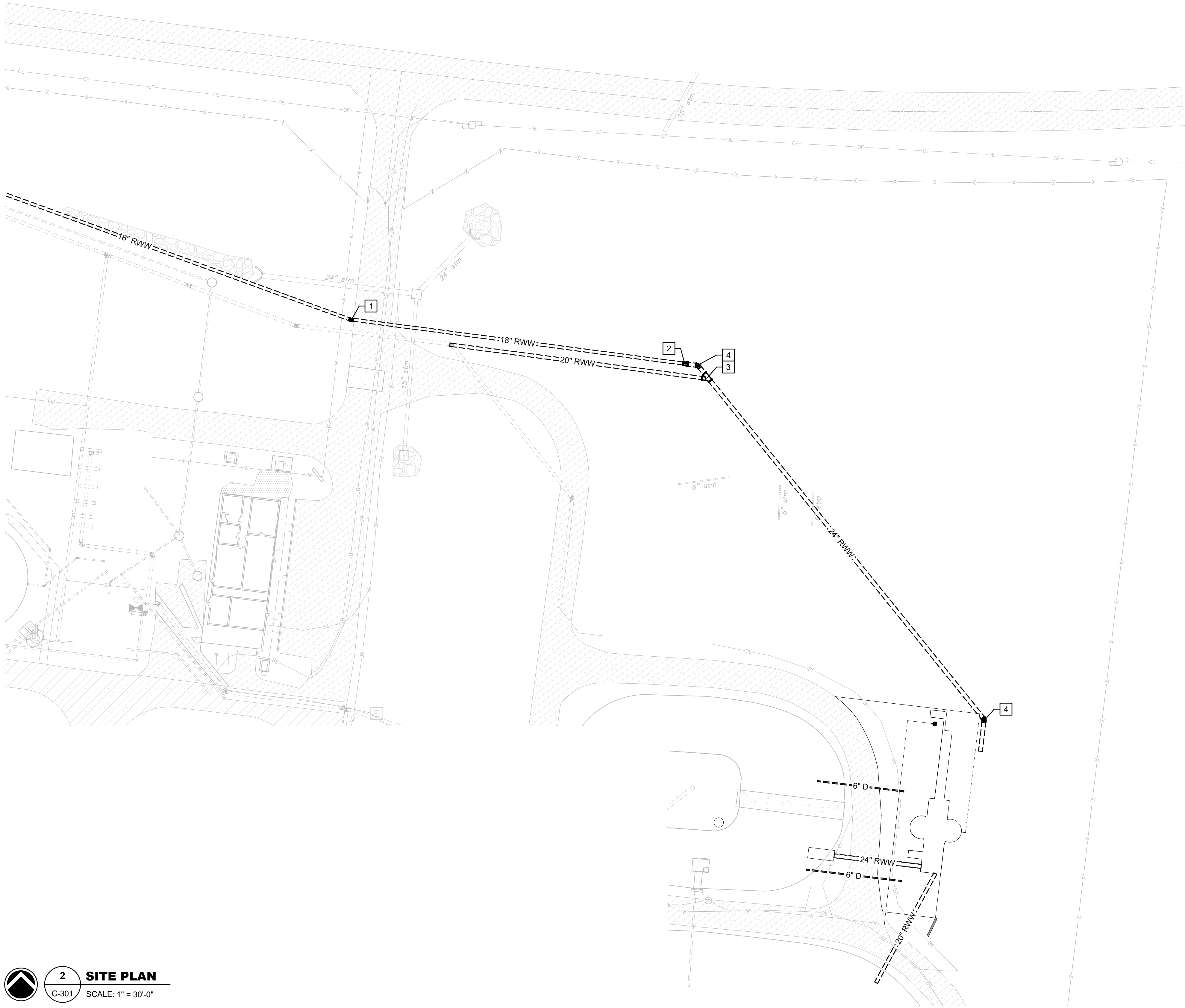
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2
C-301

SITE PLAN
SCALE: 1" = 30'-0"



KEY NOTE:

#

- 18" 22.5° MJ BEND
- 24"X18" MJ REDUCER
- 24"X20" MJ WYE
- 24" 45° MJ BEND

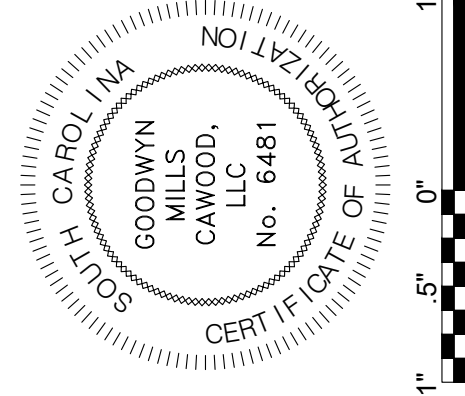
**CIVIL SITE PLAN
ENLARGED
YARD PIPING**

C-303

**PENDLETON - CLEMSON
REGIONAL WWTB EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

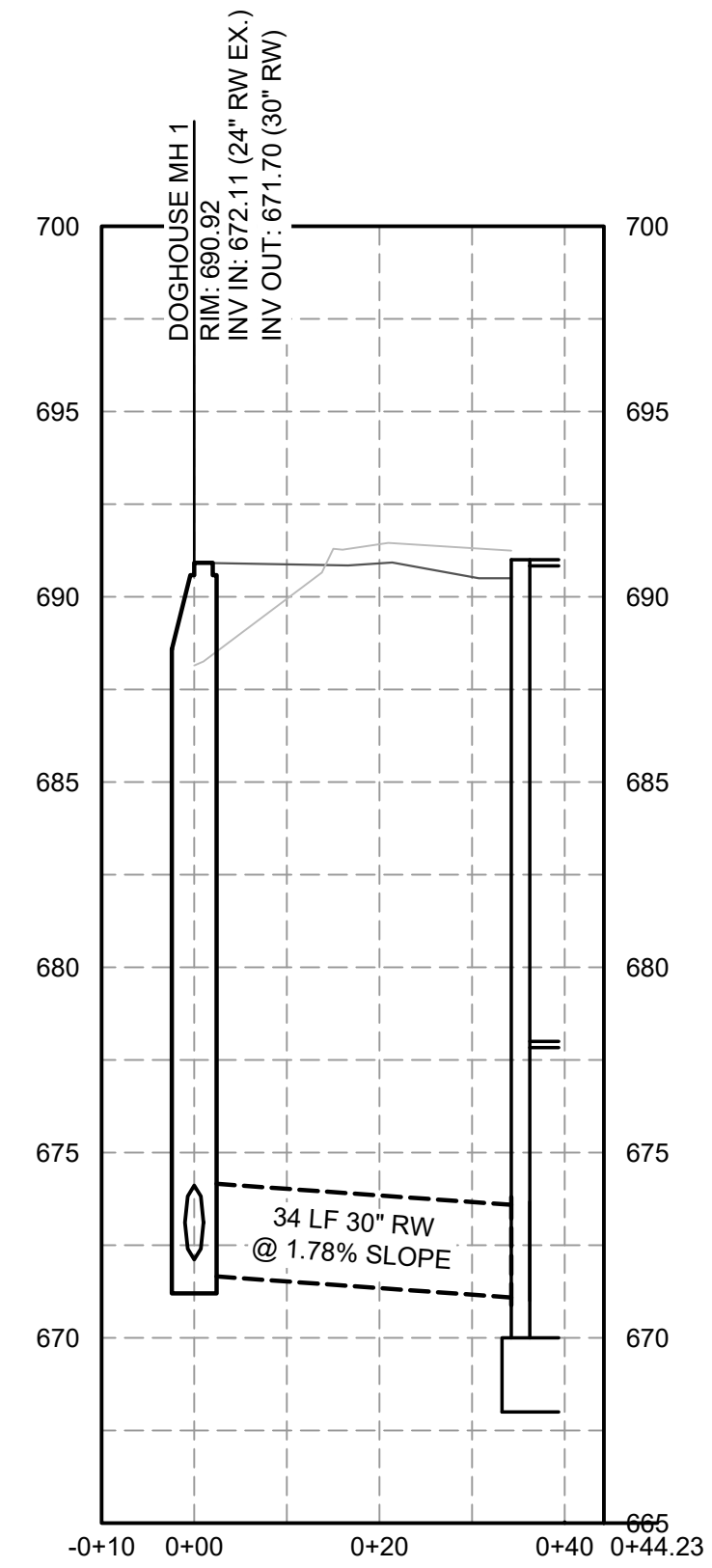
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ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

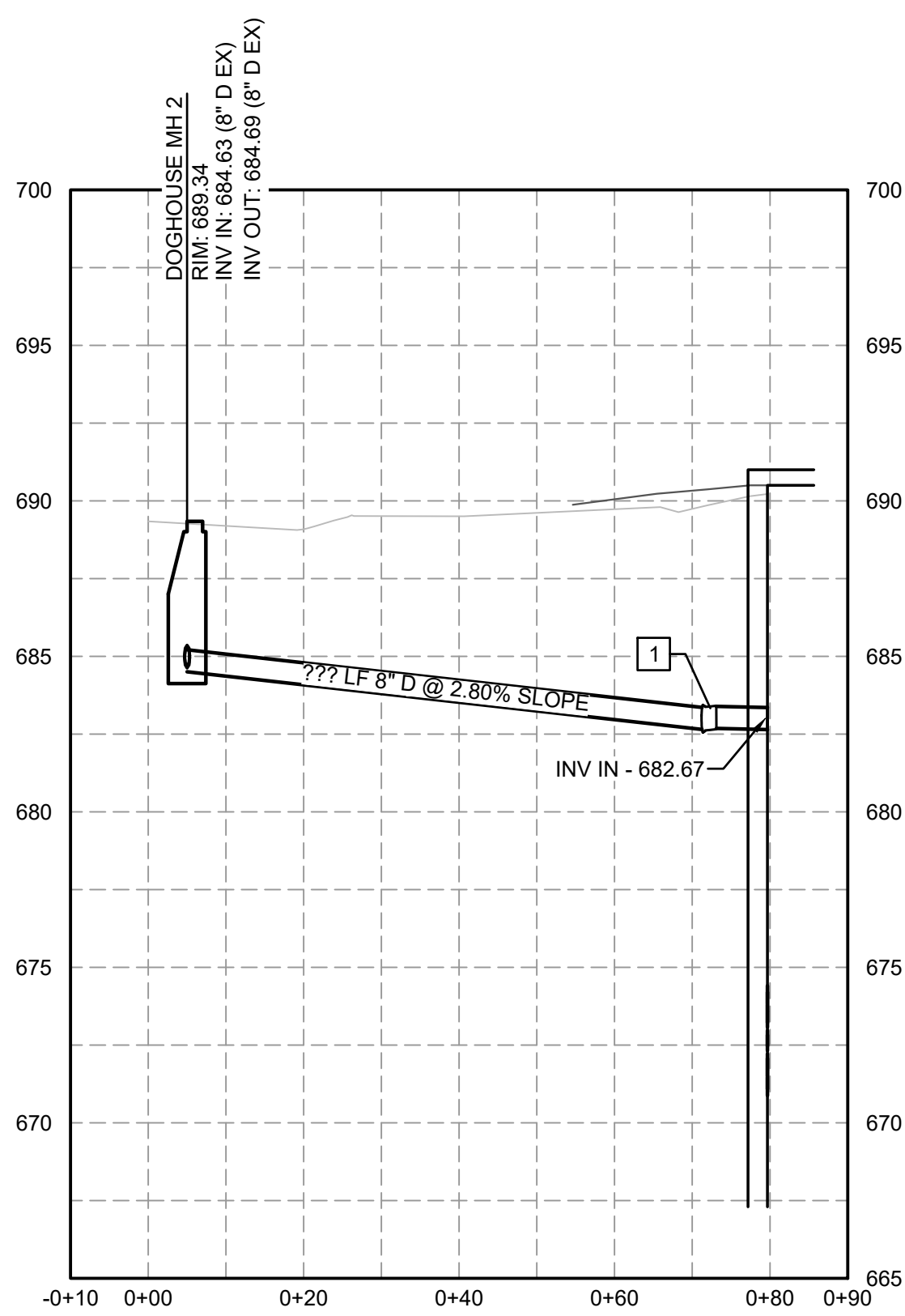


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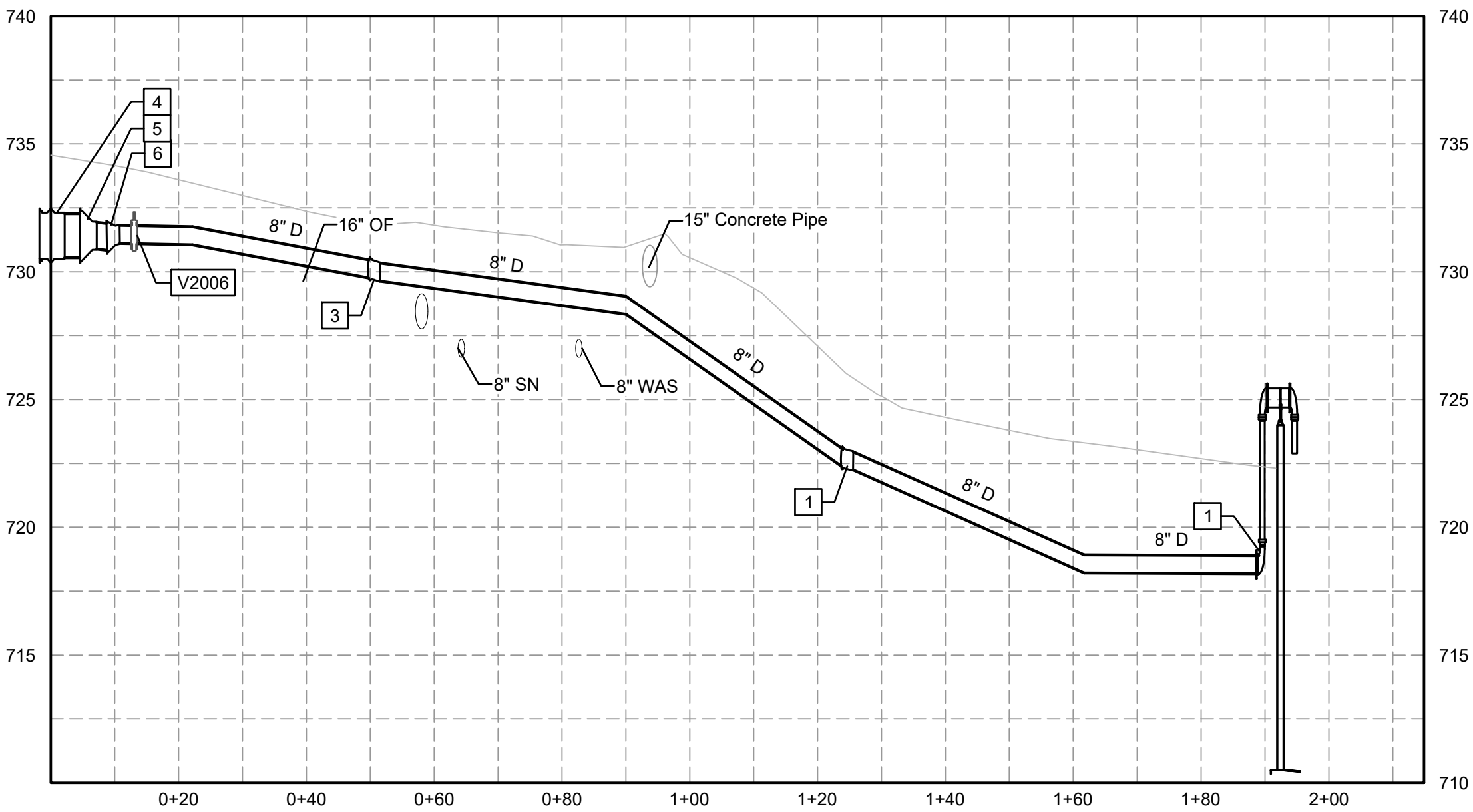
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A PROFILE
C-302 SCALE: VERT 1" = 5'-0" / HORIZ. 1" = 20'-0"



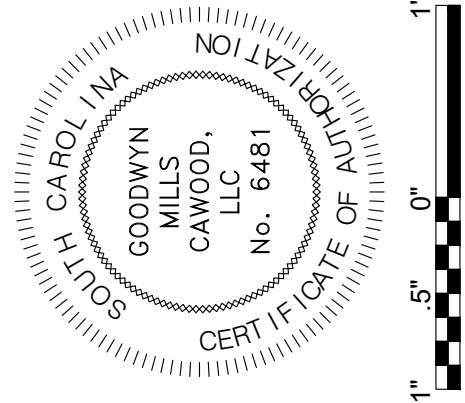
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C-302 SCALE: VERT 1" = 5'-0" / HORIZ. 1" = 20'-0"



C PROFILE
C-304 SCALE: VERT 1" = 5'-0" / HORIZ. 1" = 20'-0"

KEY NOTE: #

- 8" 22.5° MJ BEND
- 8" 90° MJ BEND
- 8" 45° MJ BEND
- 20" MJ TEE
- 20"x12" MJ REDUCER
- 12"x8" MJ REDUCER



ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
Project Manager:	WN
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Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

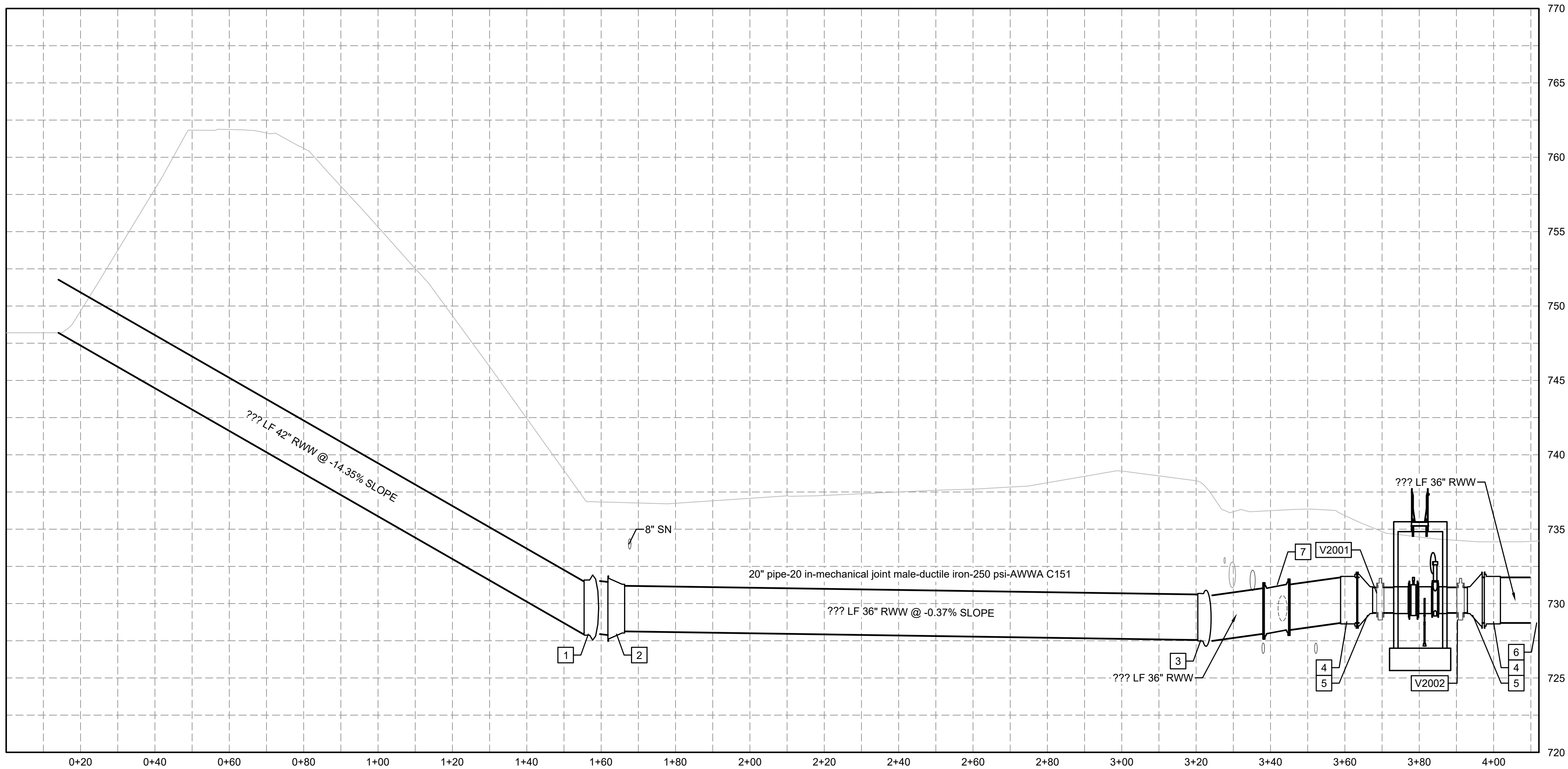
GMC PROJECT #CGRE220027

CIVIL SITE PLAN
YARD PIPING
PROFILES

C-305

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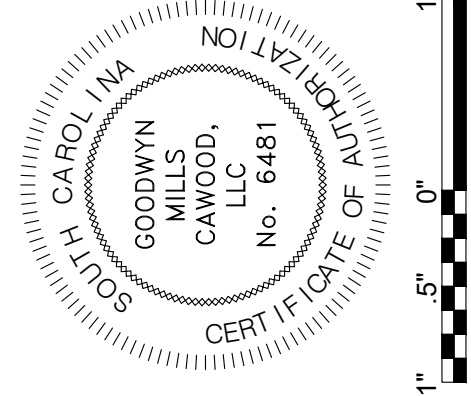
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D PROFILE
SCALE: VERT 1" = 5'-0" / HORIZ. 1" = 20'-0"

KEY NOTE: #

- 42" 90° MJ BEND
- 42"X36" MJ REDUCER
- 36" 90° MJ BEND
- 36"X24" MJ TEE
- 36"X24" MJ REDUCER
- 36"X30" MJ TEE
- 36"X20" MJ TEE



ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
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Drawn By:	HKD

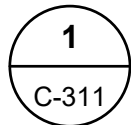
PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
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GMC PROJECT #CGRE220027

CIVIL SITE PLAN
YARD PIPING
PROFILES

C-306

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SCALE: 1" = 60'-0"

SCALE: 1" = 60'-0"



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CIVIL SITE PLAN YARD PIPING REUSE WATER LINE

C-311

PENDLETON - CLEMSON

REGIONAL WWTP EXPANSION

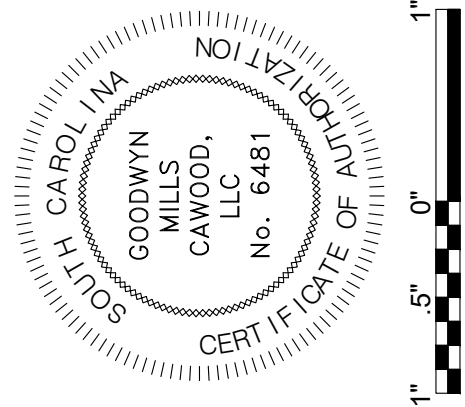
PENDLETON, SOUTH CAROLINA

Town of Pendleton
City of Clemson

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Anderson County

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	EXISTING MAJOR CONTOUR
	EXISTING MINOR CONTOUR
	PROPOSED CONTOUR
	PROPOSED CONTOUR
	LIMITS OF DISTURBANCE
	SILT FENCE
	INLET PROTECTION
	EROSION CONTROL BLANKET

- IF NECESSARY, SLOPES, WHICH EXCEED EIGHT (8) VERTICAL FEET SHOULD BE STABILIZED WITH SYNTHETIC OR VEGETATIVE MATS, IN ADDITION TO HYDROSEEDING. IT MAY BE NECESSARY TO INSTALL TEMPORARY SLOPE DRAINS DURING CONSTRUCTION. TEMPORARY BERMS MAY BE NEEDED UNTIL THE SLOPE IS BROUGHT TO GRADE.
2. STABILIZATION MEASURES SHALL BE INITIATED AS SOON AS PRACTICABLE IN PORTIONS OF THE SITE WHERE CONSTRUCTION ACTIVITIES HAVE TEMPORARILY OR PERMANENTLY CEASED, BUT IN NO CASE MORE THAN FOURTEEN (14) DAYS AFTER WORK HAS CEASED, EXCEPT AS NOTED BELOW:
 - WHERE STABILIZATION BY THE 14TH DAY IS PRECLUDED BY SNOW COVER OR FROZEN GROUND CONDITIONS STABILIZATION MEASURES MUST BE INITIATED AS SOON AS PRACTICABLE.
 - WHERE CONSTRUCTION ACTIVITY ON A PORTION OF THE SITE IS TEMPORARILY CEASED, AND EARTH-DISTURBING ACTIVITIES WILL BE RESUMED WITHIN 14 DAYS, TEMPORARY STABILIZATION MEASURES DO NOT HAVE TO BE INITIATED ON THAT PORTION OF THE SITE.
3. ALL SEDIMENT AND EROSION CONTROL DEVICES SHALL BE INSPECTED EVERY CALENDAR WEEK. IF PERIODIC INSPECTION OR OTHER INFORMATION INDICATES THAT A BM HAS BEEN INAPPROPRIATELY OR INCORRECTLY INSTALLED, THE PERMITTEE MUST ADDRESS THE NECESSARY REPLACEMENT OR MODIFICATION REQUIRED TO CORRECT THE BM WITHIN 48 HOURS OF DISCOVERY.
4. PROVIDE SILT FENCE AND/OR OTHER CONTROL DEVICES, AS MAY BE REQUIRED, TO CONTROL SOIL EROSION DURING UTILITY CONSTRUCTION. ALL DISTURBED AREAS SHALL BE CLEANED, GRADED, AND STABILIZED WITH GRASSING IMMEDIATELY AFTER THE UTILITY INSTALLATION, FILL, COVER, AND TEMPORARY SEEDING AT THE END OF EACH DAY ARE RECOMMENDED. IF WATER IS ENCOUNTERED WHILE TRENCHING, THE WATER SHOULD BE FILTERED TO REMOVE ANY SEDIMENTS BEFORE BEING PUMPED BACK INTO ANY WATERS OF THE STATE.
5. ALL EROSION CONTROL DEVICES SHALL BE PROPERLY MAINTAINED DURING ALL PHASES OF CONSTRUCTION UNTIL THE COMPLETION OF ALL CONSTRUCTION ACTIVITIES AND ALL DISTURBED AREAS HAVE BEEN STABILIZED.
 - REMOVE DEPOSITED SEDIMENT FROM SEDIMENT TRAPS OR SEDIMENTATION WHEN THE DESIGN CAPACITY HAS BEEN REDUCED BY 50% OR THE SEDIMENT HAS REACHED THE CLEAN OUT POINT ON THE CLEANOUT STAKE (WHICHEVER OCCURS FIRST).
 - REMOVE DEPOSITED SEDIMENT COLLECTED BY SEDIMENT CONTROL MEASURE (SILT FENCE, CHECK DAMS, SEDIMENT TUBES, ETC.) WHEN THE DEPOSITED SEDIMENT REACHES $\frac{1}{2}$ THE HEIGHT OF THE ABOVE-GROUND PORTION OF THESE BMPS, OR BEFORE IT REACHES A LOWER HEIGHT
 - ADDITIONAL CONTROL DEVICES MAY BE REQUIRED DURING CONSTRUCTION IN ORDER TO CONTROL EROSION AND/OR OFFSITE SEDIMENTATION. ALL TEMPORARY CONTROL DEVICES SHALL BE REMOVED ONCE CONSTRUCTION IS COMPLETE AND THE SITE IS STABILIZED.
6. THE CONTRACTOR MUST TAKE NECESSARY ACTION TO MINIMIZE THE TRACKING OF MUD ONTO PAVED ROADWAY(S) FROM CONSTRUCTION AREAS AND THE GENERATION OF DUST. THE CONTRACTOR SHALL DAILY REMOVE MUD/SOIL FROM PAVEMENT, AS MAY BE REQUIRED.
7. TEMPORARY DIVERSION BERMS AND/OR DITCHES WILL BE PROVIDED AS NEEDED DURING CONSTRUCTION TO PROTECT WORK AREAS FROM UPSLOPE RUNOFF AND/OR TO DIVERT SEDIMENT-LADEN WATER TO APPROPRIATE TRAPS OR STABLE OUTLETS.
8. ALL WATERS OF THE STATE (WOS), INCLUDING WETLANDS, ARE TO BE FLAGGED OR OTHERWISE CLEARLY MARKED IN THE FIELD. A DOUBLE ROW OF SILT FENCE IS TO BE INSTALLED IN ALL AREAS WHERE A 50-FOOT BUFFER CANNOT BE MAINTAINED BETWEEN THE DISTURBED AREA AND ALL WOS. A 10-FOOT BUFFER SHOULD BE MAINTAINED BETWEEN THE LAST ROW OF SILT FENCE AND ALL WOS.
9. LITTER, CONSTRUCTION DEBRIS, OILS, FUELS, AND BUILDING PRODUCTS WITH SIGNIFICANT POTENTIAL FOR IMPACT (SUCH AS STOCKPILES OF FRESHLY TREATED LUMBER AND CONSTRUCTION CHEMICALS THAT COULD BE EXPOSED TO STORM WATER MUST BE PREVENTED FROM BECOMING A POLLUTANT SOURCE IN STORM WATER DISCHARGES.
10. A COPY OF THE SWPPP, INSPECTIONS RECORDS, AND RAINFALL DATA MUST BE RETAINED AT THE CONSTRUCTION SITE OR A NEARBY LOCATION EASILY ACCESSIBLE DURING NORMAL BUSINESS HOURS, FROM THE DATE OF COMMENCEMENT OF CONSTRUCTION ACTIVITIES TO THE DATE THAT FINAL STABILIZATION IS REACHED.
11. INITIATE STABILIZATION MEASURES ON ANY EXPOSED STEEP SLOPE (3H:1V OR GREATER) WHERE LAND-DISTURBING ACTIVITIES HAVE PERMANENTLY OR TEMPORARILY CEASED, AND WILL NOT RESUME FOR A PERIOD OF 7 CALENDAR DAYS.
12. MINIMIZE SOIL COMPACTION AND, UNLESS INFEASIBLE, PRESERVE TOPSOIL.
13. MINIMIZE THE DISCHARGE OF POLLUTANTS FROM EQUIPMENT AND VEHICLE WASHING, WHEEL WASH WATER, AND OTHER WASH WATERS. WASH WATERS MUST BE TREATED IN A SEPARATE BASIN WITH AN ALTERNATIVE CONTROL THAT PROVIDES EQUIVALENT OR BETTER TREATMENT PRIOR TO DISCHARGE.
14. MINIMIZE THE DISCHARGE OF POLLUTANTS FROM DEWATERING OF TRENCHES AND EXCAVATED AREAS. THESE DISCHARGES ARE TO BE ROUTED THROUGH APPROPRIATE BMPS (SEDIMENT BASIN, FILTER BAG, ETC.).
15. THE FOLLOWING DISCHARGES FROM SITES ARE PROHIBITED:
 - WASTEWATER FROM WASHOUT OF CONCRETE, UNLESS MANAGED BY AN APPROPRIATE CONTROL;
 - WASTEWATER FROM WASHOUT AND CLEANOUT OF STUCCO, PAINT, FORM RELEASE OILS, CURING COMPOUNDS AND OTHER CONSTRUCTION MATERIALS;
 - FUELS, OILS, OR OTHER POLLUTANTS USED IN VEHICLE AND EQUIPMENT OPERATION AND MAINTENANCE; AND
 - SOAPS OR SOLVENTS USED IN VEHICLE AND EQUIPMENT WASHING.
16. AFTER CONSTRUCTION ACTIVITIES BEGIN, INSPECTIONS MUST BE CONDUCTED AT A MINIMUM OF AT LEAST ONCE EVERY CALENDAR WEEK AND MUST BE CONDUCTED UNTIL FINAL STABILIZATION IS REACHED ON ALL AREAS OF THE CONSTRUCTION SITE.
17. IF EXISTING BMPS NEED TO BE MODIFIED OR IF ADDITIONAL BMPS ARE NECESSARY TO COMPLY WITH THE REQUIREMENTS OF THIS PERMIT AND/OR SC'S WATER QUALITY STANDARDS, IMPLEMENTATION MUST BE COMPLETED BEFORE THE NEXT STORM EVENT WHENEVER PRACTICABLE. IF IMPLEMENTATION BEFORE THE NEXT STORM EVENT IS IMPRACTICABLE, THE SITUATION MUST BE DOCUMENTED IN THE SWPPP AND ALTERNATIVE BMPS MUST BE IMPLEMENTED AS SOON AS REASONABLY POSSIBLE.
18. A PRE-CONSTRUCTION CONFERENCE MUST BE HELD FOR EACH CONSTRUCTION SITE WITH AN APPROVED ON-SITE SWPPP PRIOR TO THE IMPLEMENTATION OF CONSTRUCTION ACTIVITIES. FOR NON-LINEAR PROJECTS THAT DISTURB 10 ACRES OR MORE, THIS CONFERENCE MUST BE HELD ON-SITE UNLESS THE DEPARTMENT HAS APPROVED OTHERWISE.
19. CONTRACTOR MUST FIELD VERIFY THAT THE EXISTING FIELD CONTOUR ELEVATIONS ARE ACCURATE WITHIN ONE-HALF ($\frac{1}{2}$) OF THE EXISTING CONDITION CONTOUR ELEVATION SHOWN ON THE PLANS. IF THE ELEVATIONS ARE NOT WITHIN ONE-HALF ($\frac{1}{2}$) OF THE CONTOUR ELEVATIONS, NO LAND DISTURBING ACTIVITY CAN CONTINUE ON THE SITE UNTIL THE PLAN PREPARER HAS BEEN INFORMED. THE PLAN PREPARER MUST APPROVE IN WRITING THE USE OF THE EXISTING SWPPP ELEVATIONS AND NOTIFY THE TOWN OF PENDELTON STORMWATER MANAGEMENT OF THEIR APPROVAL PRIOR TO WORK CONTINUING. IF THE EXISTING SWPPP WILL NOT FUNCTION AS DESIGNED DUE TO THE ELEVATION CHANGE, A NEW SURVEY MUST BE CONDUCTED AND THE SWPPP MUST BE MODIFIED BY THE PLAN PREPARER.

- RECEIVE NOTICE OF NPDES COVERAGE FROM NCDEQ.
- ENGINEER TO SCHEDULE ON-SITE PRE-CONSTRUCTION MEETING WITH NCDEQ A MINIMUM OF 72 HOURS PRIOR TO THE START OF LAND DISTURBING ACTIVITIES.
- SET LIMITS OF DISTURBANCE (LOD) AND MARK IN FIELD.
- INSTALL CONSTRUCTION ENTRANCE AND CLEAR GRUB FOR PERIMETER CONTROLS.
- INSTALL SILT FENCE AND INLET PROTECTION FOR EXISTING STORM DRAIN.
- INSTALL CONCRETE WASHOUT AND MARK LOCATION ON PLANS.
- REMOVE/DEMOLISH EXISTING STRUCTURES, ETC. AS SHOWN ON PLAN.
- COMMENCE WITH PHASE 2.

C-601



EROSION CONTROL STANDARD NOTES

1. NECESSARY, SLOPES, WHICH EXCEED EIGHT (8) VERTICAL FEET SHOULD BE STABILIZED WITH SYNTHETIC OR VEGETATIVE MATS, IN ADDITION TO HYDROSEEDING. IT MAY BE NECESSARY TO INSTALL TEMPORARY SLOPE DRAINS DURING CONSTRUCTION. TEMPORARY BERMS MAY BE NEEDED UNTIL THE SLOPE IS BROUGHT TO GRADE.
2. STABILIZATION MEASURES SHALL BE INITIATED AS SOON AS PRACTICABLE IN PORTIONS OF THE SITE WHERE CONSTRUCTION ACTIVITIES HAVE TEMPORARILY OR PERMANENTLY CEASED, BUT IN NO CASE MORE THAN FOURTEEN (14) DAYS AFTER WORK HAS CEASED, EXCEPT AS STATED BELOW.
3. WHERE STABILIZATION BY THE 14TH DAY IS PRECLUDED BY SNOW COVER OR FROZEN GROUND CONDITIONS STABILIZATION MEASURES MUST BE INITIATED AS SOON AS PRACTICABLE.
4. WHERE CONSTRUCTION ACTIVITY ON A PORTION OF THE SITE IS TEMPORARILY CEASED, AND EARTH-DISTURBING ACTIVITIES WILL BE RESUMED WITHIN 14 DAYS, TEMPORARY STABILIZATION MEASURES DO NOT HAVE TO BE INITIATED ON THAT PORTION OF THE SITE.
5. ALL SEDIMENT AND EROSION CONTROL DEVICES SHALL BE INSPECTED EVERY CALENDAR WEEK. IF PERIODIC INSPECTION OR OTHER INFORMATION INDICATES THAT A BM HAS BEEN INAPPROPRIATELY OR INCORRECTLY INSTALLED, THE PERMITTEE MUST ADDRESS THE NECESSARY REPLACEMENT OR MODIFICATION REQUIRED TO CORRECT THE BMP WITHIN 48 HOURS OF IDENTIFICATION.
6. PROVIDE SILT FENCE AND/OR OTHER CONTROL DEVICES, AS MAY BE REQUIRED, TO CONTROL SOIL EROSION DURING UTILITY CONSTRUCTION. ALL DISTURBED AREAS SHALL BE CLEANED, GRADED, AND STABILIZED WITH GRASSING IMMEDIATELY AFTER THE UTILITY INSTALLATION. FILL, COVER, AND TEMPORARY SEEDING AT THE END OF EACH DAY ARE RECOMMENDED. IF WATER IS ENUNCIATED AND/OR TRENCHING OF WATER SHOULD BE FILTERED TO REMOVE ANY SEDIMENTS BEFORE BEING RUN BACK INTO THE WATERS OF THE STATE.
7. ALL EROSION CONTROL DEVICES SHALL BE PROPERLY MAINTAINED DURING ALL PHASES OF CONSTRUCTION UNTIL THE COMPLETION OF ALL CONSTRUCTION ACTIVITIES AND ALL DISTURBED AREAS HAVE BEEN STABILIZED.
8. REMOVE DEPOSITED SEDIMENT FROM SEDIMENT TRAPS OR SEDIMENTATION WHEN THE DESIGN CAPACITY HAS BEEN REDUCED BY 50% OR THE SEDIMENT HAS REACHED THE CLEAN OUT POINT ON THE CLEANOUT STAKE (WHICHEVER OCCURS FIRST).
9. REMOVE DEPOSITED SEDIMENT COLLECTED BY SEDIMENT CONTROL MEASURE (SILT FENCE, CHECK DAMS, SEDIMENT TUBES, ETC.) WHEN THE DEPOSITED SEDIMENT REACHES $\frac{2}{3}$ THE HEIGHT OF THE ABOVE-GROUND PORTION OF THESE BMPs, OR BEFORE IT REACHES A LOWER HEIGHT.
10. ADDITIONAL CONTROL DEVICES MAY BE REQUIRED DURING CONSTRUCTION IN ORDER TO CONTROL EROSION AND/OR OFFSITE SEDIMENTATION. ALL TEMPORARY CONTROL DEVICES SHALL BE REMOVED ONCE CONSTRUCTION IS COMPLETE AND THE SITE IS STABILIZED.
11. THE CONTRACTOR MUST TAKE NECESSARY ACTION TO MINIMIZE THE TRACKING OF MUD ONTO PAVED AREAS (S) OF ROADWAY CONSTRUCTION AREAS AND THE GENERATION OF DUST. THE CONTRACTOR SHALL DAILY REMOVE MUD/SOIL FROM PAVEMENT, AS MAY BE REQUIRED.
12. TEMPORARY DIVERSION BERMS AND/OR DITCHES WILL BE PROVIDED AS NEEDED DURING CONSTRUCTION TO PROTECT WORK AREAS FROM UPSLOPE RUNOFF AND/OR TO DIVERT SEDIMENT-LADEN WATER TO APPROPRIATE TRAPS OR STABLE OUTLETS.
13. ALL WATERS OF THE STATE (WOS), INCLUDING WETLANDS, ARE TO BE FLAGGED OR OTHERWISE CLEARLY MARKED IN THE FIELD. A DOUBLE ROW OF SILT FENCE IS TO BE INSTALLED IN ALL AREAS WHERE A 50-FOOT BUFFER CAN'T BE MAINTAINED BETWEEN THE DISTURBED AREA AND ALL WOS. A 10-FOOT BUFFER SHOULD BE MAINTAINED BETWEEN THE LAST ROW OF SILT FENCE AND ALL WOS.
14. LITTER, CONSTRUCTION DEBRIS, OILS, FUELS, AND BUILDING PRODUCTS WITH SIGNIFICANT POTENTIAL FOR IMPACT (SUCH AS STOCKPILES OF FRESHLY TREATED LUMBER) AND CONSTRUCTION CHEMICALS THAT COULD BE EXPOSED TO STORM WATER MUST BE PREVENTED FROM BECOMING A POLLUTANT SOURCE IN STORM WATER DISCHARGES.
15. A COPY OF THE SWPPP, INSPECTIONS RECORDS, AND RAINFALL DATA MUST BE RETAINED AT THE CONSTRUCTION SITE OR A NEARBY LOCATION EASILY ACCESSIBLE DURING NORMAL BUSINESS HOURS FROM THE DATE OF COMMENCEMENT OF CONSTRUCTION ACTIVITIES TO THE DATE THAT FINAL STABILIZATION IS REACHED.
16. INITIATE STABILIZATION MEASURES ON ANY EXPOSED STEEP SLOPE (3H:1V OR GREATER) WHERE LAND-DISTURBING ACTIVITIES HAVE PERMANENTLY OR TEMPORARILY CEASED, AND WILL NOT RESUME FOR A PERIOD OF 7 CALENDAR DAYS.
17. MINIMIZE SOIL COMPACTION AND, UNLESS INFEASIBLE, PRESERVE TOPSOIL.
18. MINIMIZE THE DISCHARGE OF POLLUTANTS FROM EQUIPMENT AND VEHICLE WASHING. WHEEL WASH WATER, AND OTHER WASH WATERS. WASH WATERS MUST BE TREATED IN A SEDIMENT BASIN OR ALTERNATIVE CONTROL THAT PROVIDES EQUIVALENT OR BETTER TREATMENT PRIOR TO DISCHARGE.
19. MINIMIZE THE DISCHARGE OF POLLUTANTS FROM DEWATERING OF TRENCHES AND EXCAVATED AREAS. THESE DISCHARGES ARE TO BE ROUTED THROUGH APPROPRIATE BMPs (SEDIMENT BASIN, FILTER BAG, ETC.).
20. THE FOLLOWING DISCHARGES FROM SITES ARE PROHIBITED:
 - a. WASTEWATER FROM WASHOUT OF CONCRETE, UNLESS MANAGED BY AN APPROPRIATE CONTROL.
 - b. WASTEWATER FROM WASHOUT AND CLEANOUT OF STUCCO, PAINT, FORM RELEASE OILS, CURING COMPOUNDS AND OTHER CONSTRUCTION MATERIALS.
 - c. FUELS, OILS, OR OTHER POLLUTANTS USED IN VEHICLE AND EQUIPMENT OPERATION AND MAINTENANCE; AND
 - d. SOAPS OR SOLVENTS USED IN VEHICLE AND EQUIPMENT WASHING.
21. AFTER CONSTRUCTION ACTIVITIES BEGIN, INSPECTIONS MUST BE CONDUCTED AT A MINIMUM OF AT LEAST ONCE EVERY CALENDAR WEEK AND MUST BE CONDUCTED UNTIL FINAL STABILIZATION IS REACHED ON ALL AREAS OF THE CONSTRUCTION SITE.
22. IF EXISTING BMPs NEED TO BE MODIFIED OR IF ADDITIONAL BMPs ARE NECESSARY TO COMPLY WITH THE REQUIREMENTS OF THIS PERMIT AND/OR SC'S WATER QUALITY STANDARDS, IMPLEMENTATION MUST BE COMPLETED BEFORE THE NEXT STORM EVENT WHENEVER PRACTICABLE. IF IMPLEMENTATION BEFORE THE NEXT STORM EVENT IS IMPRACTICABLE, THE SITUATION MUST BE DOCUMENTED IN THE SWPPP AND ALTERNATIVE BMPs MUST BE IMPLEMENTED AS SOON AS REASONABLY POSSIBLE.
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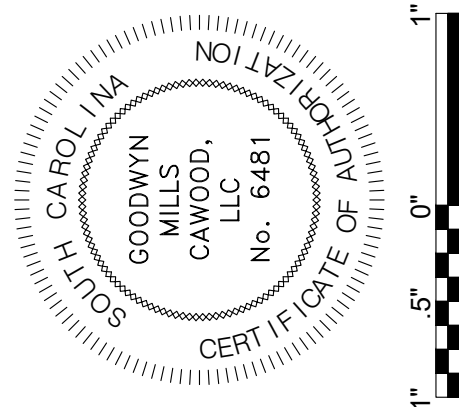
SEQUENCE OF CONSTRUCTION - PHASE 2/3:

- MAKE SURE ALL INSTALLED EROSION CONTROL MEASURES ARE IN CORRECT WORKING ORDER.
- COMPLETE INSTALLATION OF ALL UTILITIES AND REMAINING CURB AND GUTTER.
- PREPARE THE REMAINING SITE FOR PAVING AND PAVE SITE.
- COMPLETE REMAINING GRADING AND INSTALL PERMANENT SEEDING AND LANDSCAPING.
- WHEN THE SITE IS STABILIZED, CONVERT SEDIMENT BASIN INTO THE PERMANENT STORMWATER FACILITY PER THE PERMANENT POND DETAILS AND CLEAN OUT SEDIMENT AS NECESSARY.
- CONTRACTOR TO HAVE AN AS-BUILT OF THE STORM WATER FACILITIES COMPLETED & CERTIFIED BY THE ENGINEER.
- REMOVE ALL TEMPORARY EROSION AND SEDIMENT CONTROL DEVICES ONCE SITE IS STABILIZED (80% STABILIZATION IS REQUIRED PRIOR TO PROJECT BEING CLOSED OUT).
- COMPLETE AND SUBMIT THE NOTICE OF TERMINATION.

NOTE:

- MAINTAIN ALL SEDIMENT AND EROSION CONTROL FEATURES THROUGHOUT THE LIFE OF THE PROJECT
- INSPECTIONS TO BE EVERY 7 CALENDAR DAYS AND WITHIN 24 HOURS AFTER EACH RAINFALL EVENT THAT PRODUCES $\frac{1}{8}$ INCHES OR MORE OF PRECIPITATION.

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117 Welborn St.
Greenville, SC 29601
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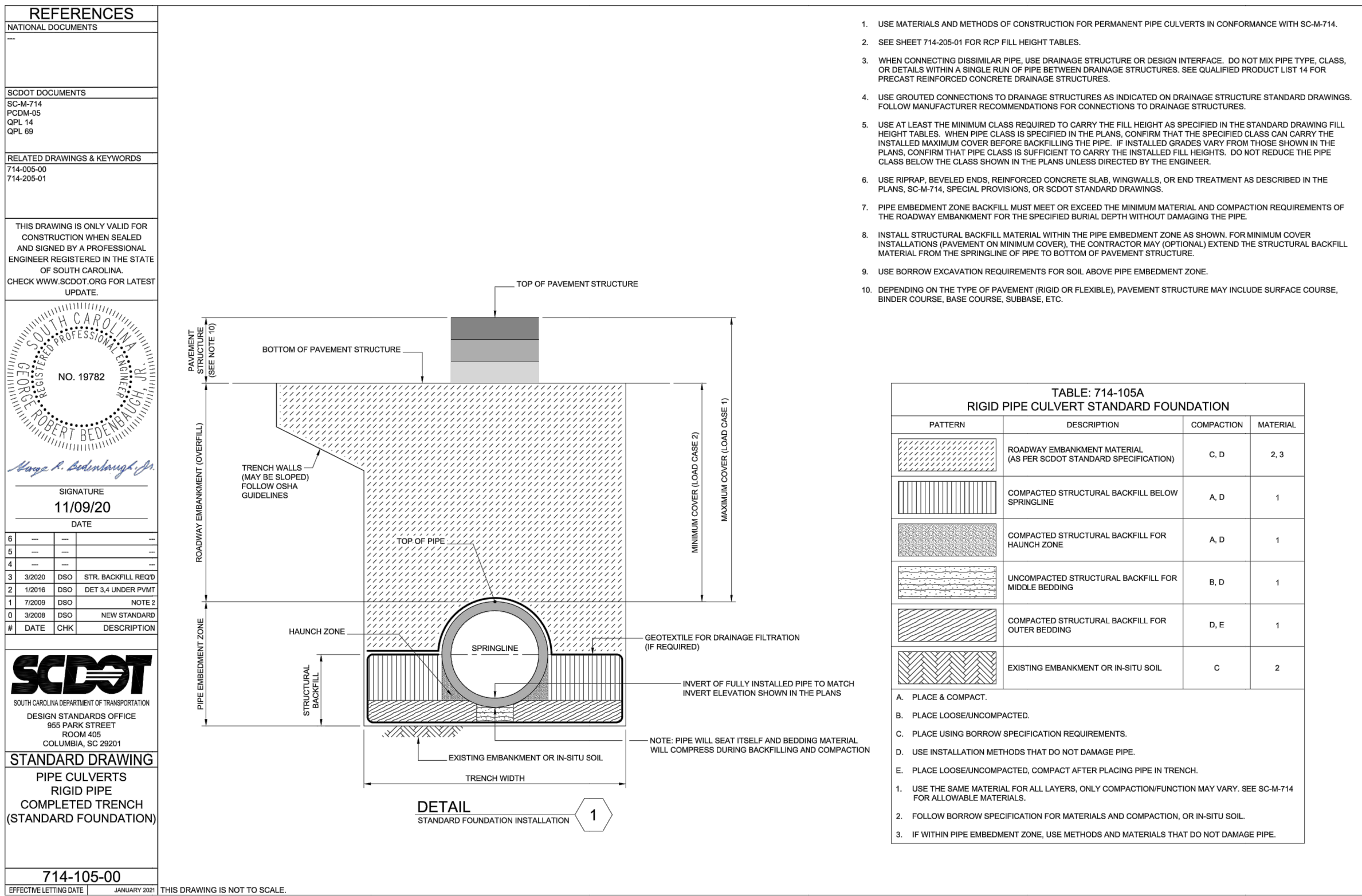
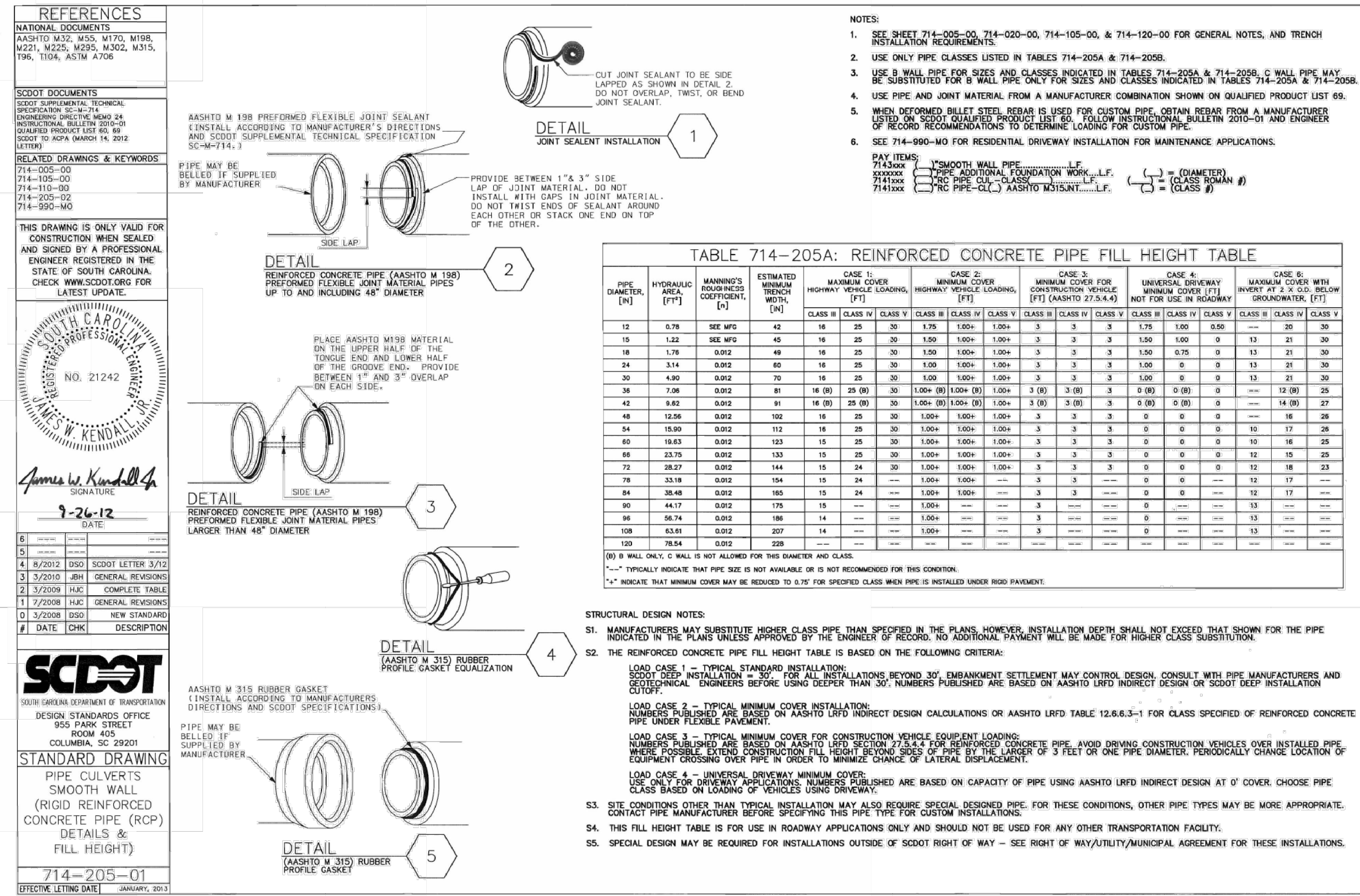


ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

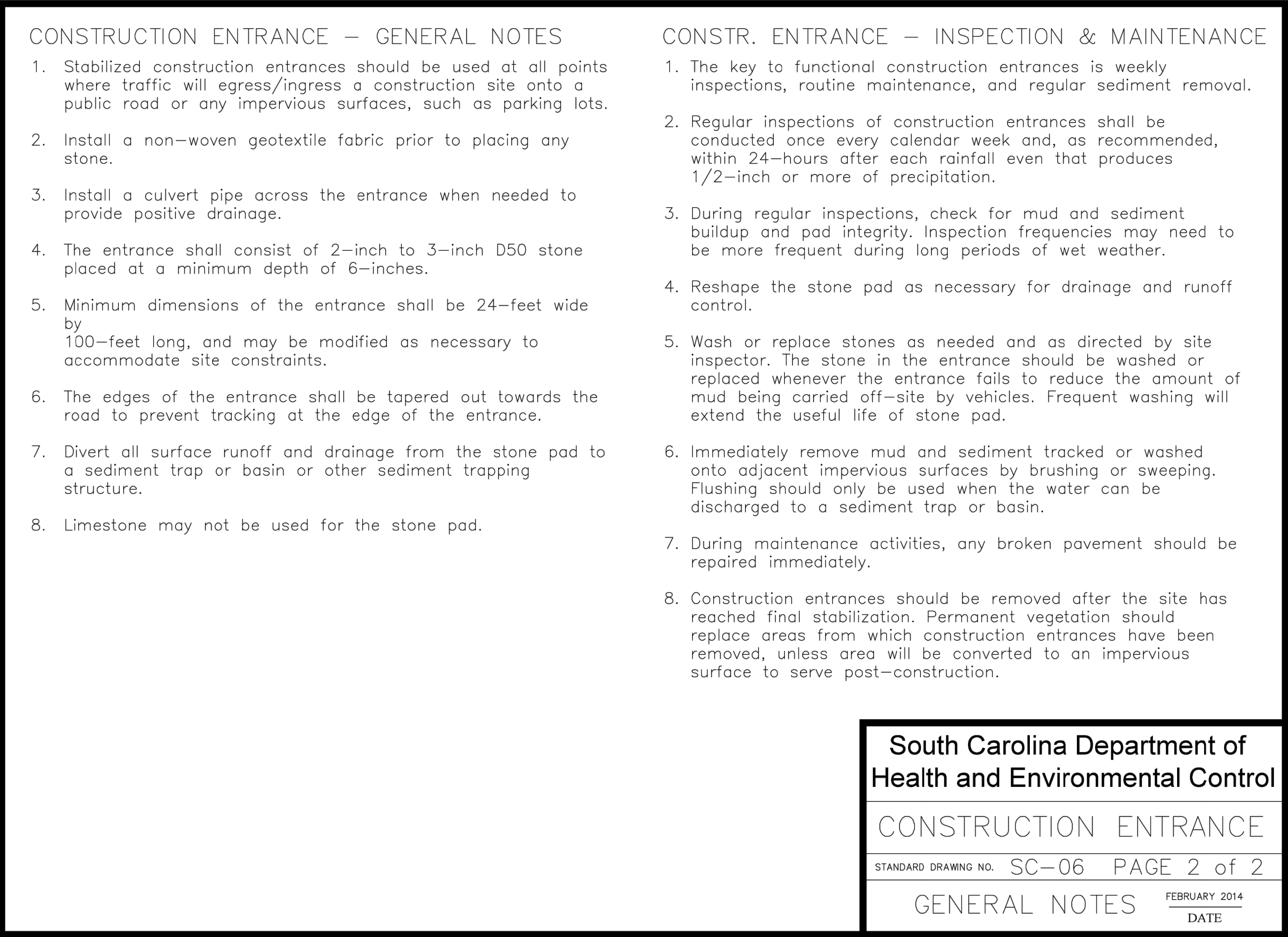
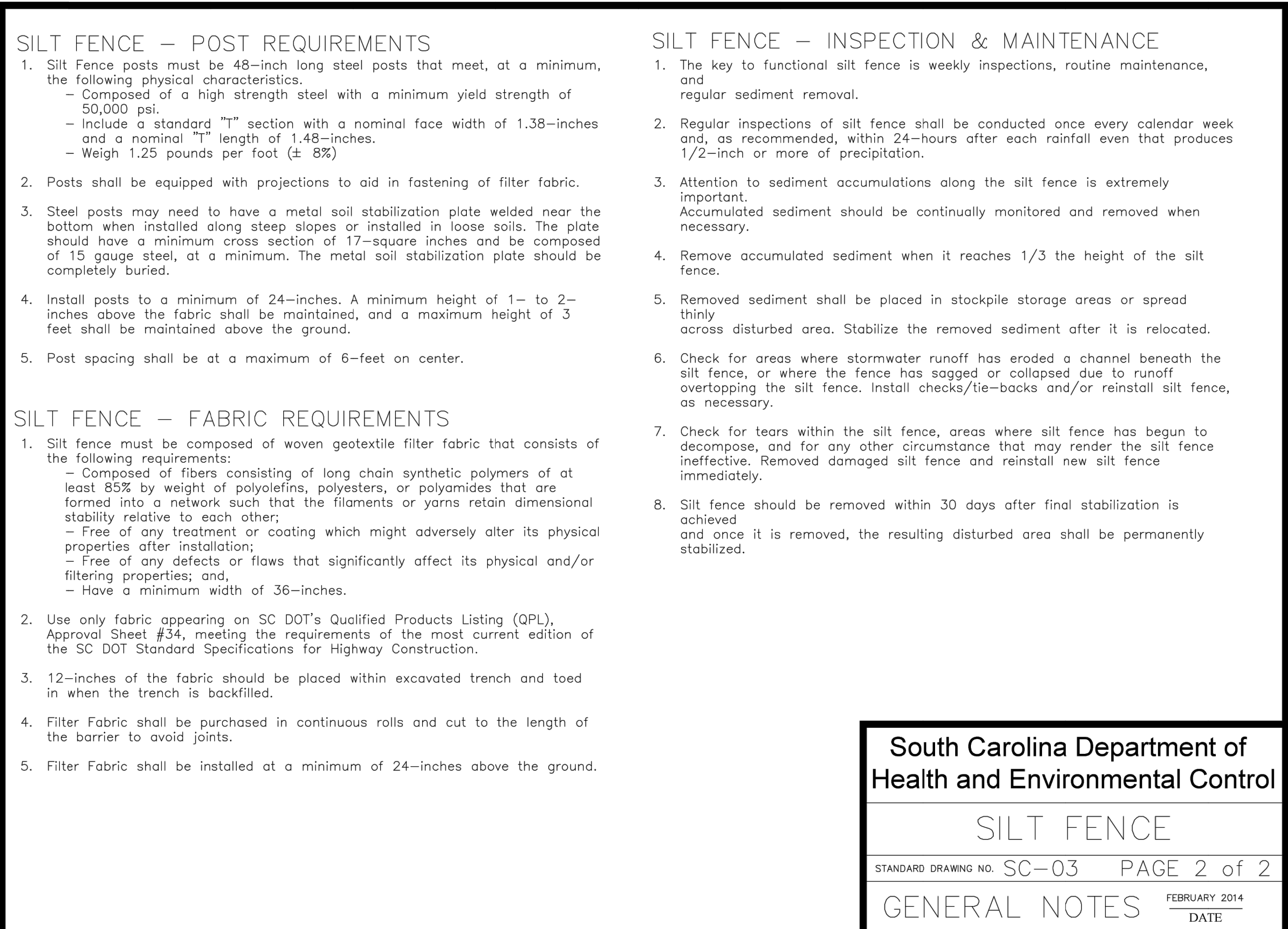
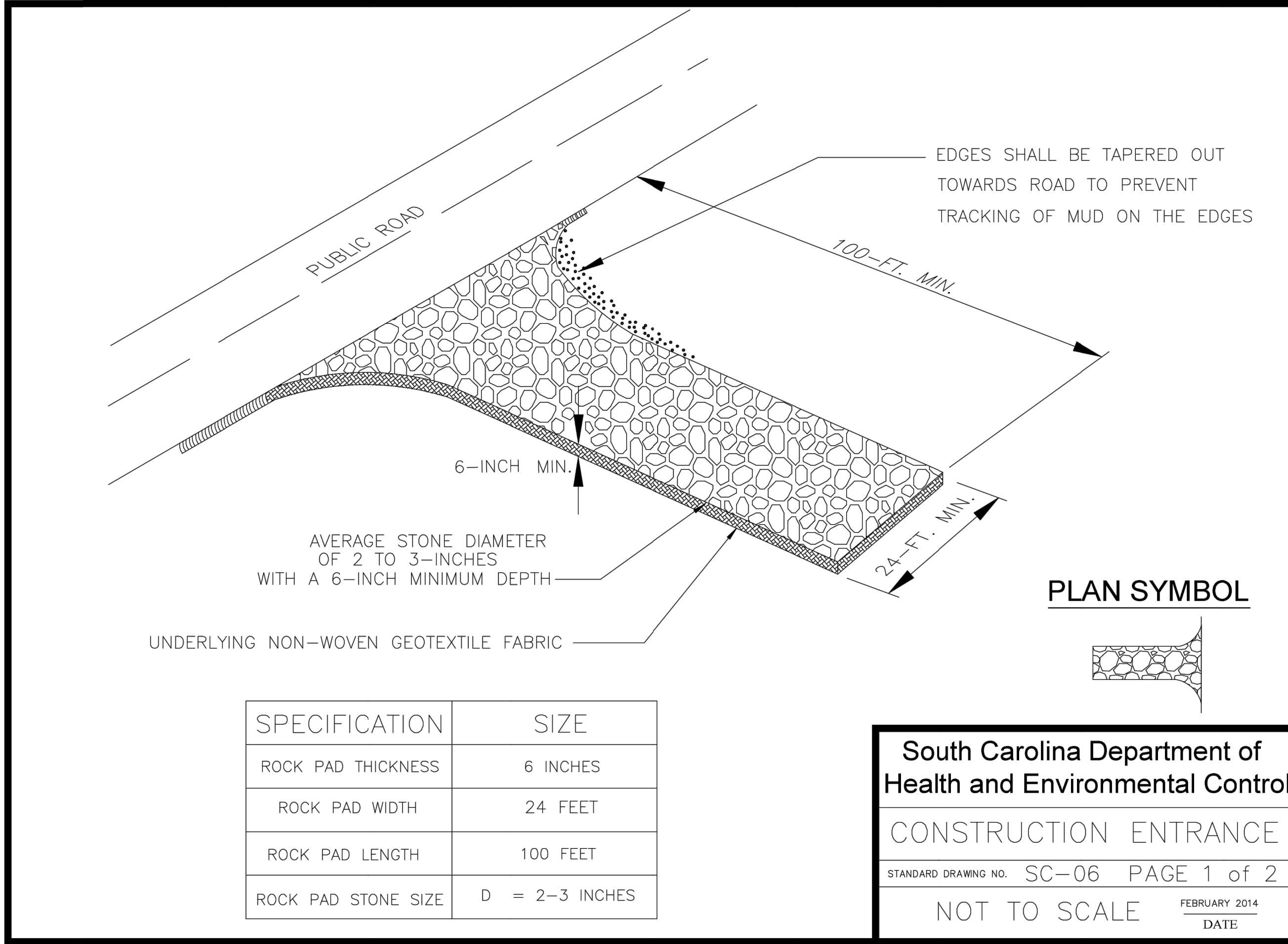
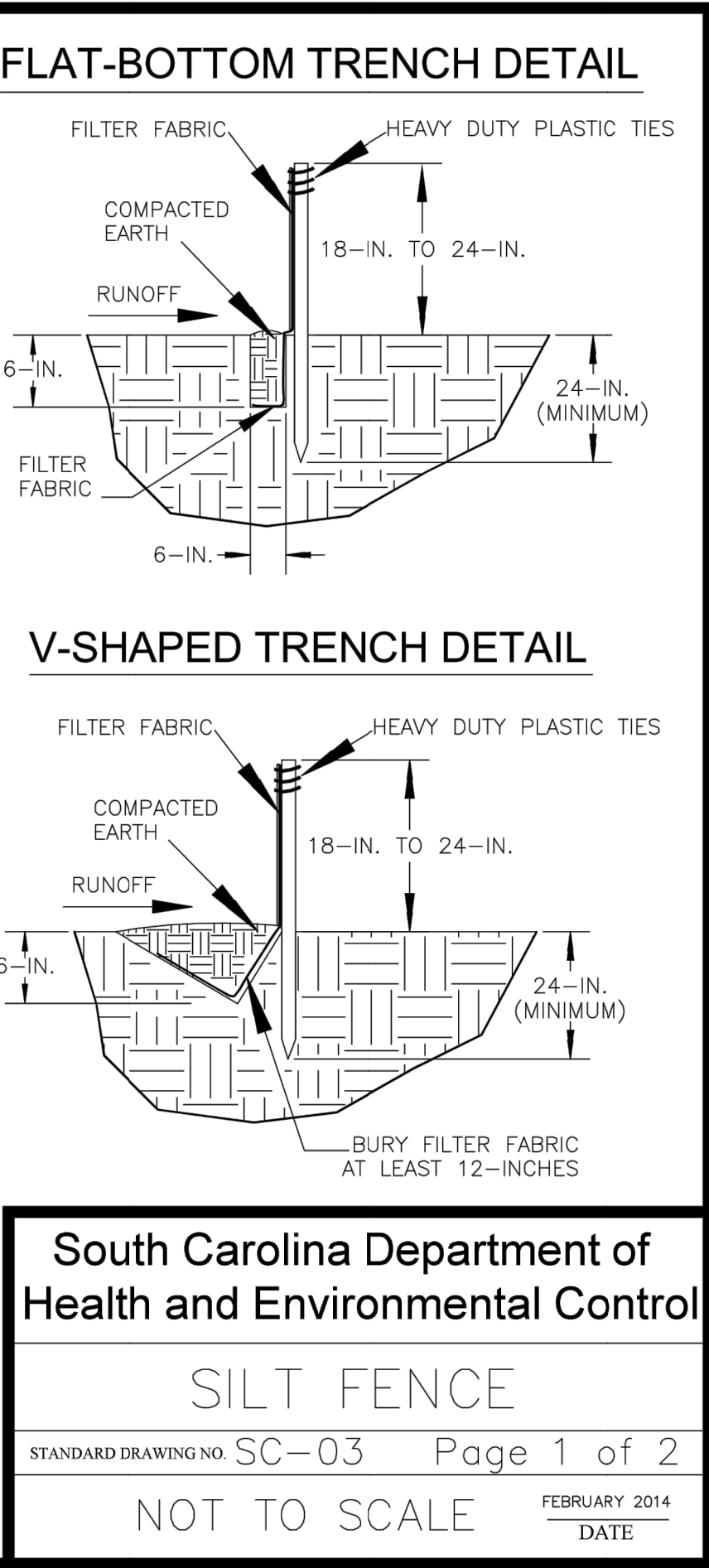
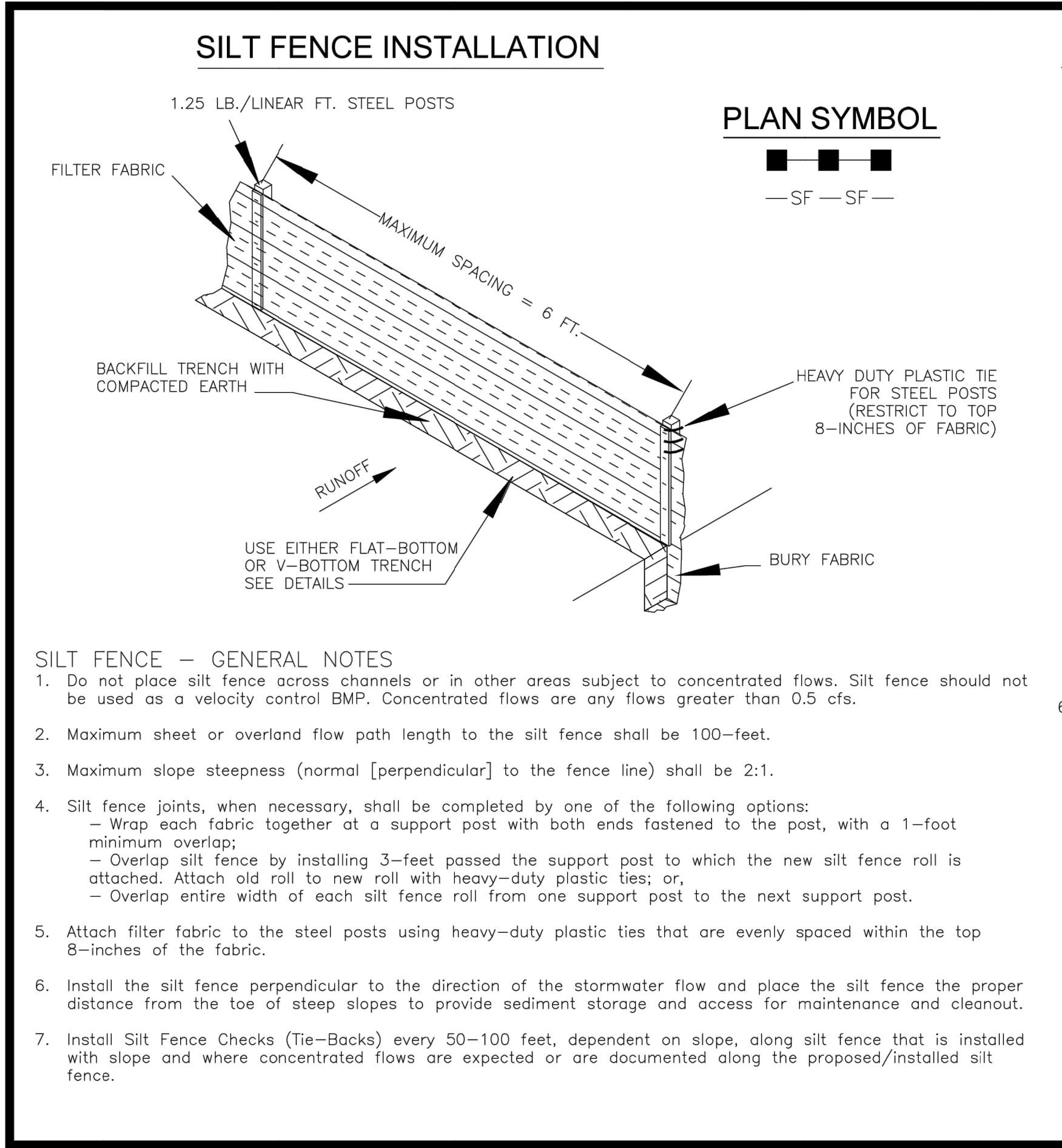
GMC PROJECT #CGRE220027

C-602

C-602



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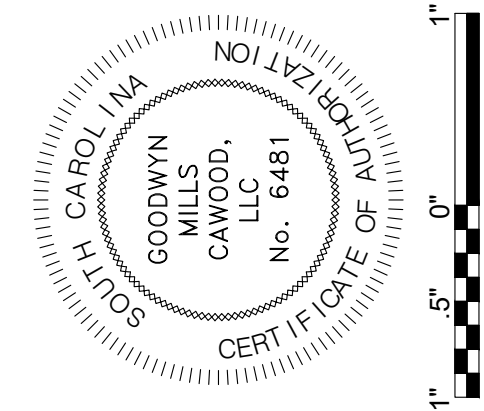
CIVIL SITE PLAN
EROSION CONTROL
DETAILS
(1 OF 2)

C-902

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

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117 Welborn St.
Greenville, SC 29601
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10" (TYP.)

3:1

SOIL/SEDIMENT STOCKPILE AREA

3:1

SILT FENCE (SEE DETAIL)

ORIGINAL GROUND SURFACE

1. SILT FENCE TO EXTEND AROUND ENTIRE PERIMETER OF STOCKPILE, OR IF STOCKPILE AREA IS LOCATED ON/NEAR A SLOP THE SILT FENCE IS TO EXTEND ALONG CONTOURS OF THE DOWN-GRADIENT AREA.
2. IF STOCKPILE IS TO REMAIN FOR MORE THAN 14 DAYS, TEMPORARY STABILIZATION MEASURES MUST BE IMPLEMENTED.
3. SILT FENCE SHALL BE MAINTAINED UNTIL STOCKPILE AREA HAS EITHER BEEN REMOVED OR PERMANENTLY STABILIZED.
4. THE KEY TO FUNCTIONAL TEMPORARY STOCKPILE AREAS IS WEEKLY INSPECTIONS, ROUTINE MAINTENANCE, AND REGULAR SEDIMENT REMOVAL.

FEBRUARY 2014

DATE

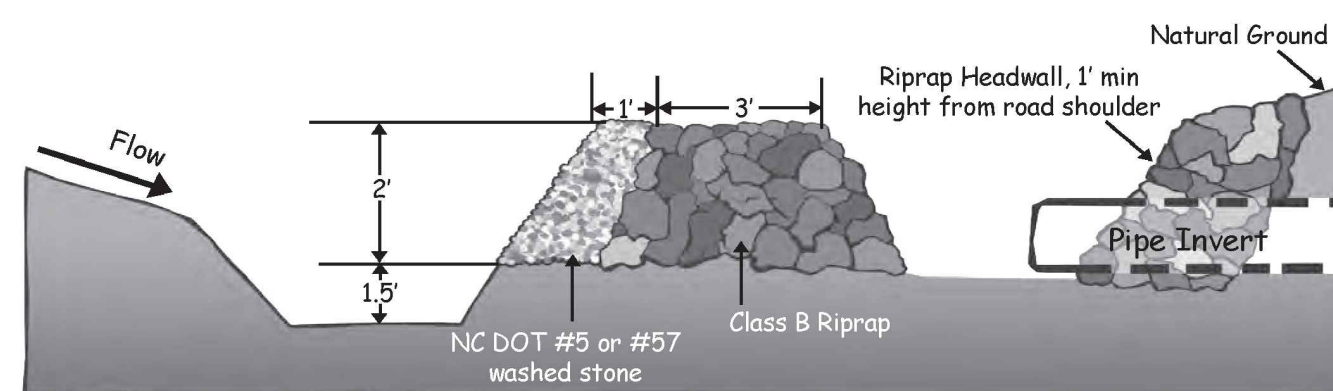


Figure 6.55a Rock pipe inlet protection plan view and cross-section view

Rev. 6/06

1. CLEAR THE AREA OF ALL DEBRIS THAT MIGHT HINDER EXCAVATION AND DISPOSAL OF SPOIL.
2. GRADE SHALLOW DEPRESSION UNIFORMLY TOWARDS THE INLET WITH SIDE SLOPES NO GREATER THAN 2:1.
3. GRADE A 1-FOOT WIDE LEVEL AREA SET 4 INCHES BELOW THE AREA ADJACENT TO THE INLET. INSTALL THE CLASS B OR CLASS I RIPRAP IN A CIRCLE AROUND THE INLET. THE MINIMUM CREST WIDTH OF THE RIPRAP SHOULD BE 18 INCHES, WITH A MINIMUM BOTTOM WIDTH OF 7.5 FEET. THE MINIMUM HEIGHT OF THE STONE IS 2 FEET.
4. THE OUTSIDE FACE OF THE RIPRAP IS THEN LINED WITH 12 INCHES OF NC DOT #5 OR #57 WASHED STONE.

INSPECT ROCK DOUGHNUT INLET PROTECTION AT LEAST WEEKLY AND AFTER EACH SIGNIFICANT INCH OR GREATER) RAINFALL EVENT AND REPAIR IMMEDIATELY.

TO PROVIDE SATISFACTORY INLET PROTECTION EFFICIENCY, REMOVE SEDIMENT FROM THE SEDIMENT POOL AREA WHEN THE VOLUME IS DECREASED BY HALF. THIS WILL HELP PROVIDE ADEQUATE STORAGE VOLUME FOR THE NEXT RAIN. STABILIZE EXCAVATED MATERIAL APPROPRIATELY.

TAKE CARE NOT TO DAMAGE OR UNDERCUT THE STRUCTURE DURING SEDIMENT REMOVAL. REMOVE DEBRIS FROM THE INLET AND REPLACE STONE AS NEEDED. IF THE INLET WAS COVERED WITH WIRE MESH THE MESH SHOULD BE CLEANED OF DEBRIS.

WHEN THE CONTRIBUTING DRAINAGE AREA HAS BEEN ADEQUATELY STABILIZED, REMOVE ALL MATERIALS AND DISPOSE OF SEDIMENT PROPERLY. BRING THE DISTURBED AREA TO THE GRADE OF THE DROP INLET. SMOOTH AND COMPACT IT AS NEEDED.

APPROPRIATELY STABILIZE ALL BARE AREAS AROUND THE INLET
WITH GROUND COVER

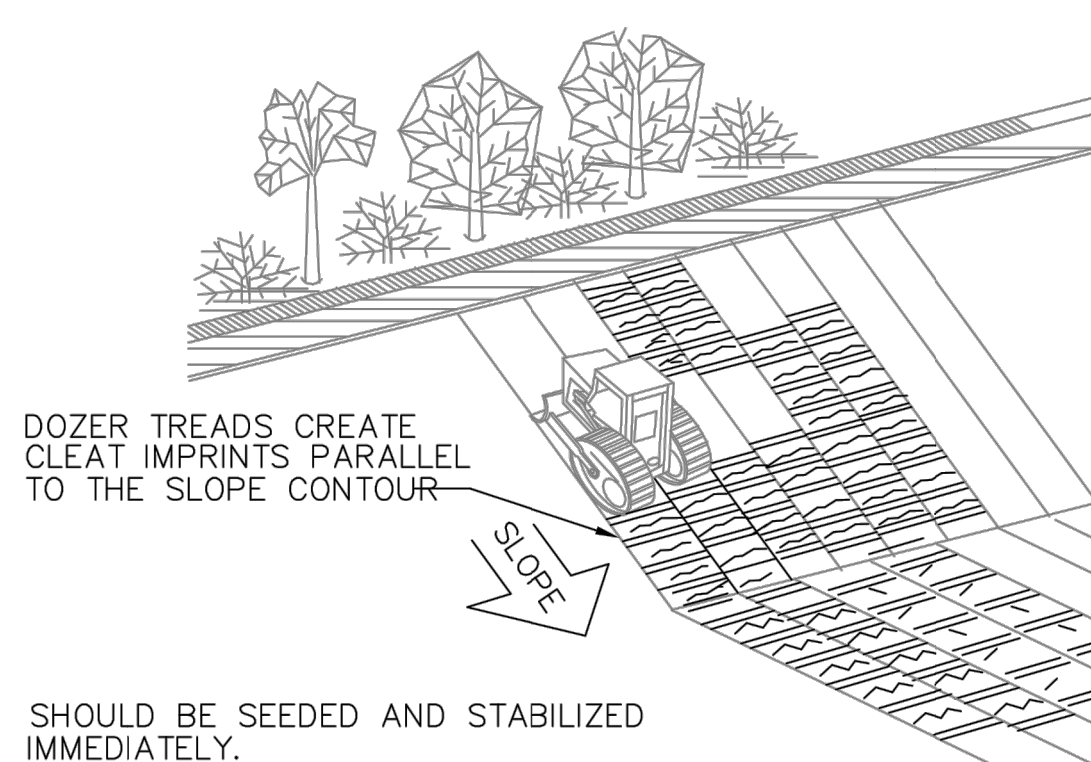
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**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

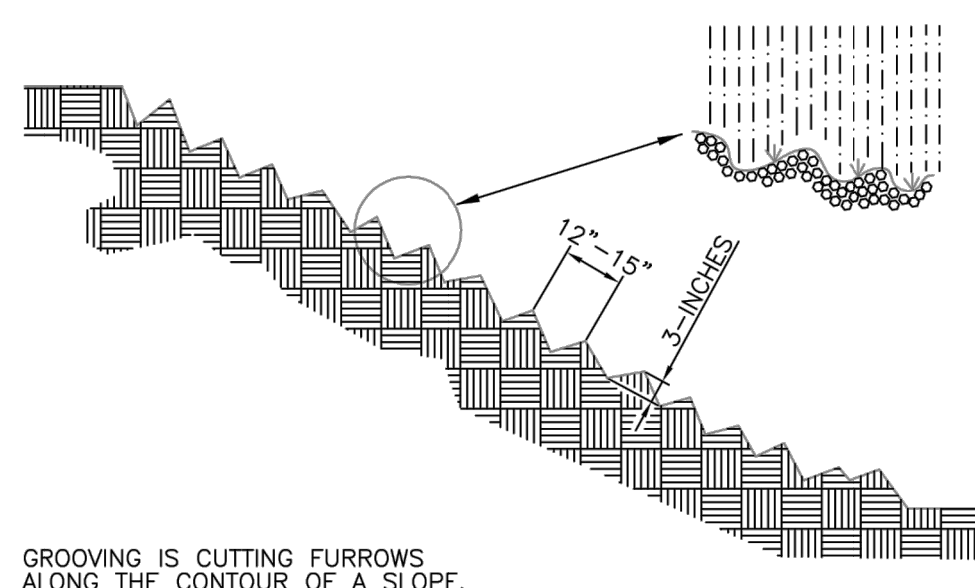
**CIVIL SITE PLAN
EROSION CONTROL
DETAILS
(2 OF 2)**

C-903



STANDARD DRAWING NO. EC-01 Page 1

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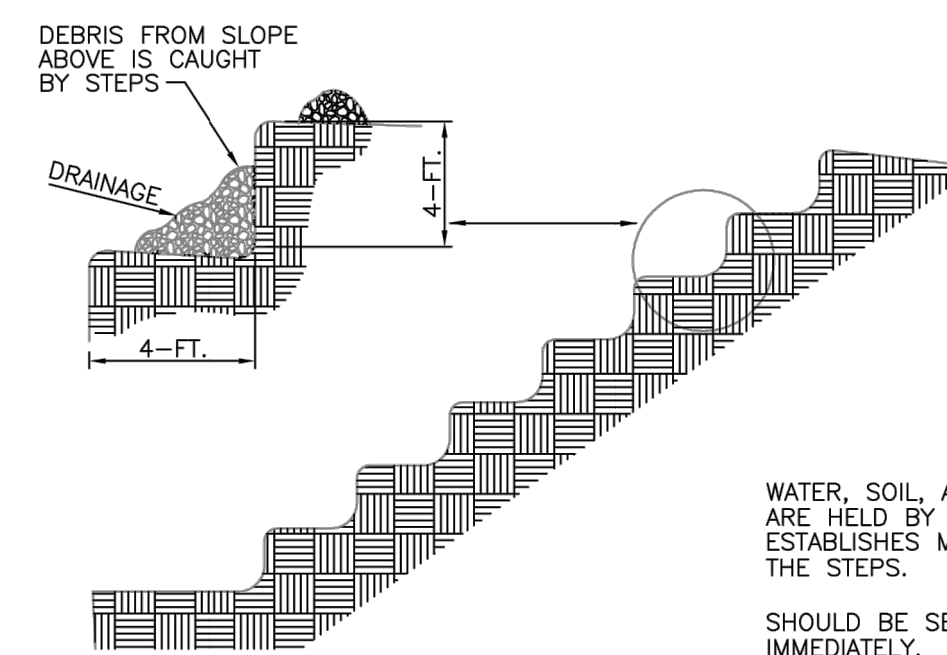


GROOVING IS CUTTING FURROWS ALONG THE CONTOUR OF A SLOPE. IRREGULARITIES IN THE SOIL SURFACE CATCH RAINWATER AND PROVIDE SOME COVERAGE OF LIME, FERTILIZER AND SEED.

SHOULD BE SEEDED AND STABILIZED IMMEDIATELY.

STANDARD DRAWING NO. EC-03 Page 1

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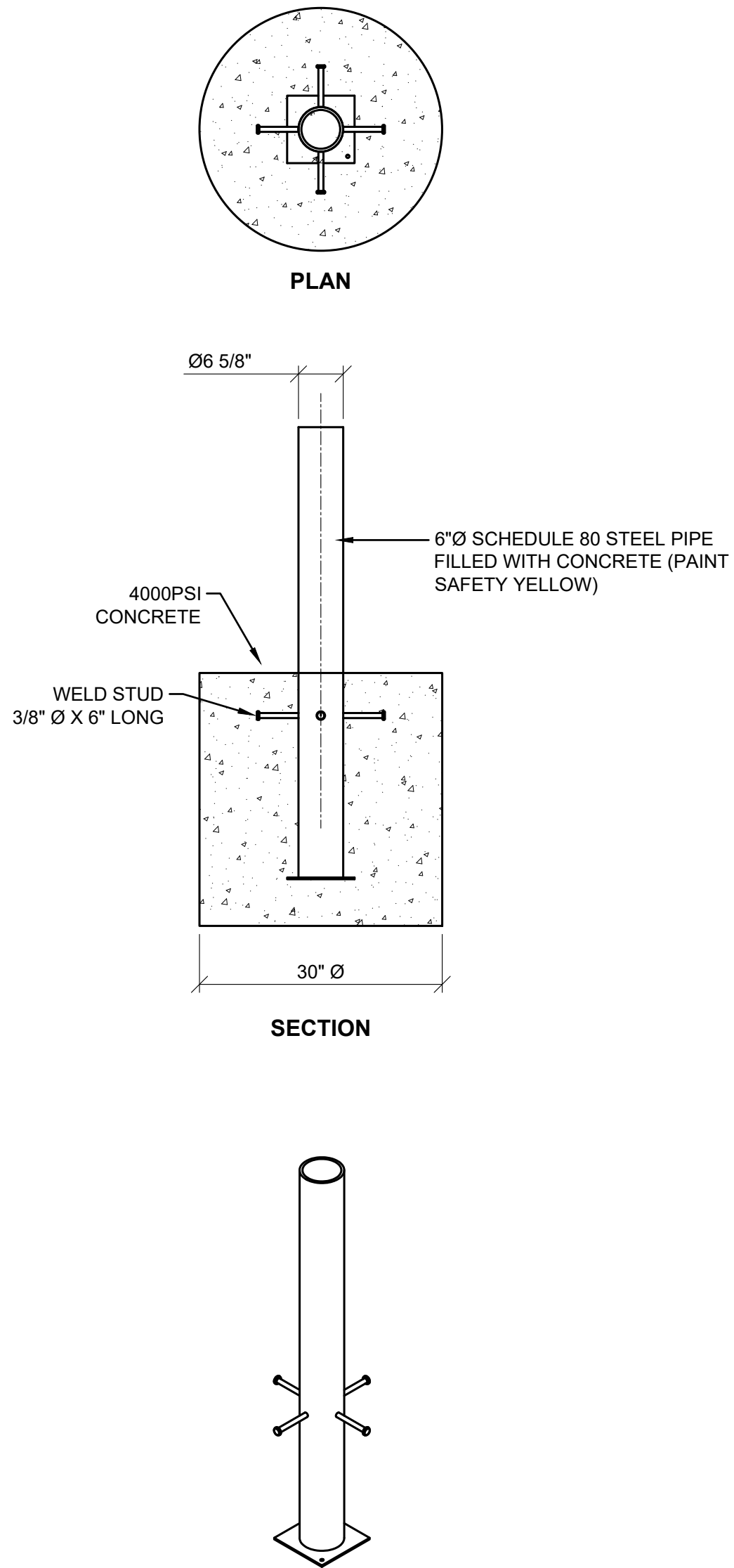
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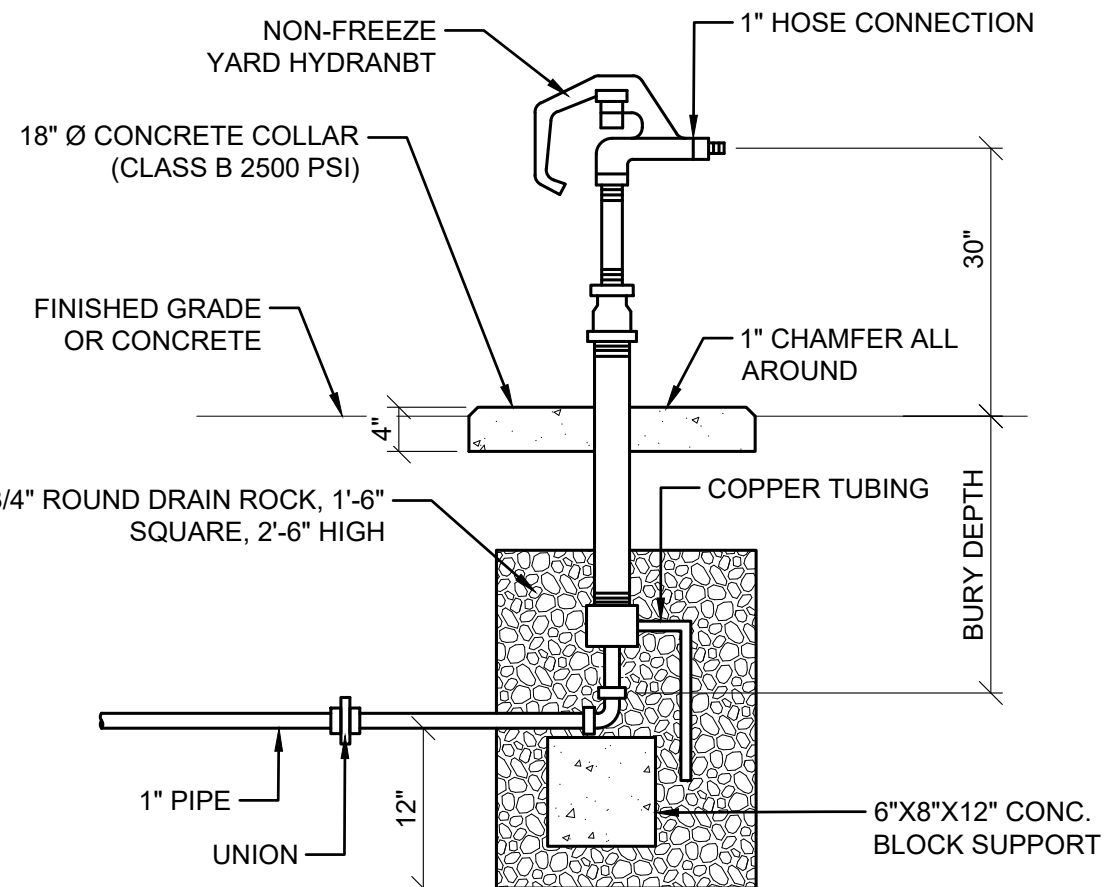
A
C-911

FIXED BOLLARD
SCALE: NOT TO SCALE



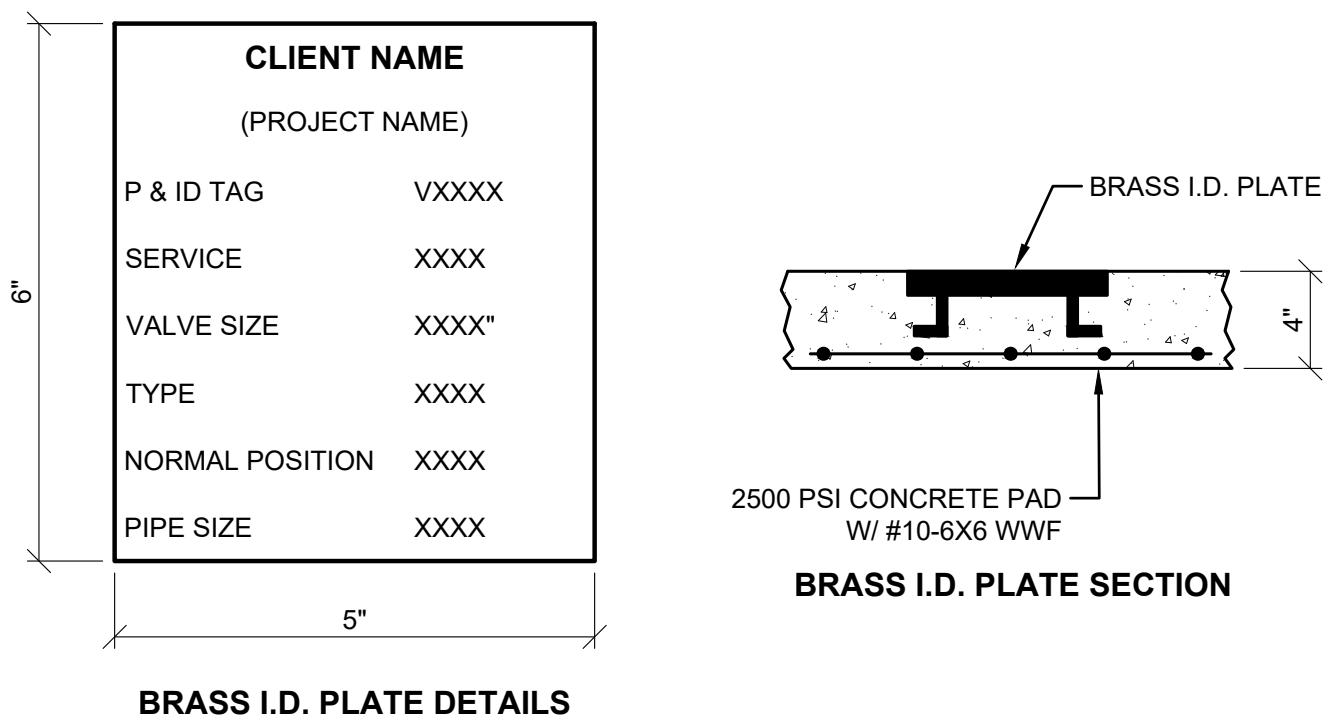
B
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FROST PROOF YARD HYDRANT
SCALE: NOT TO SCALE



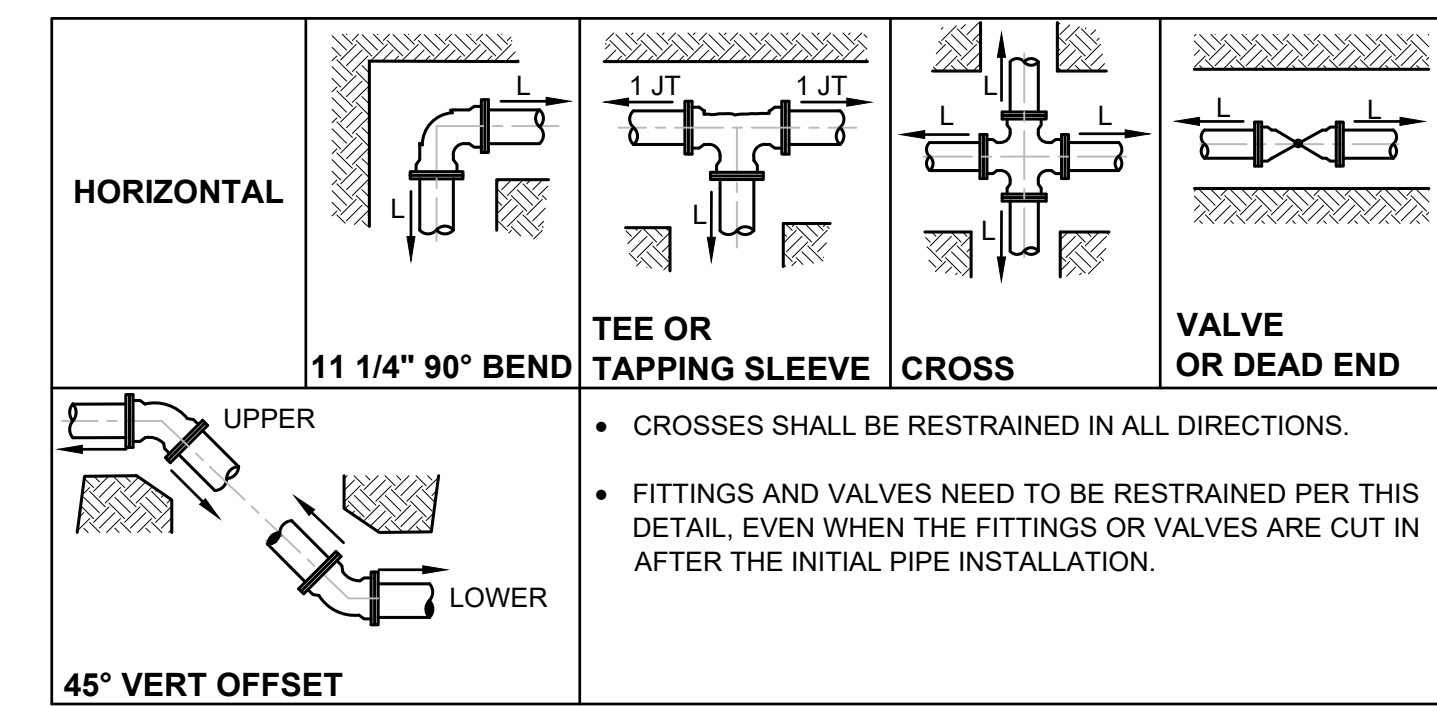
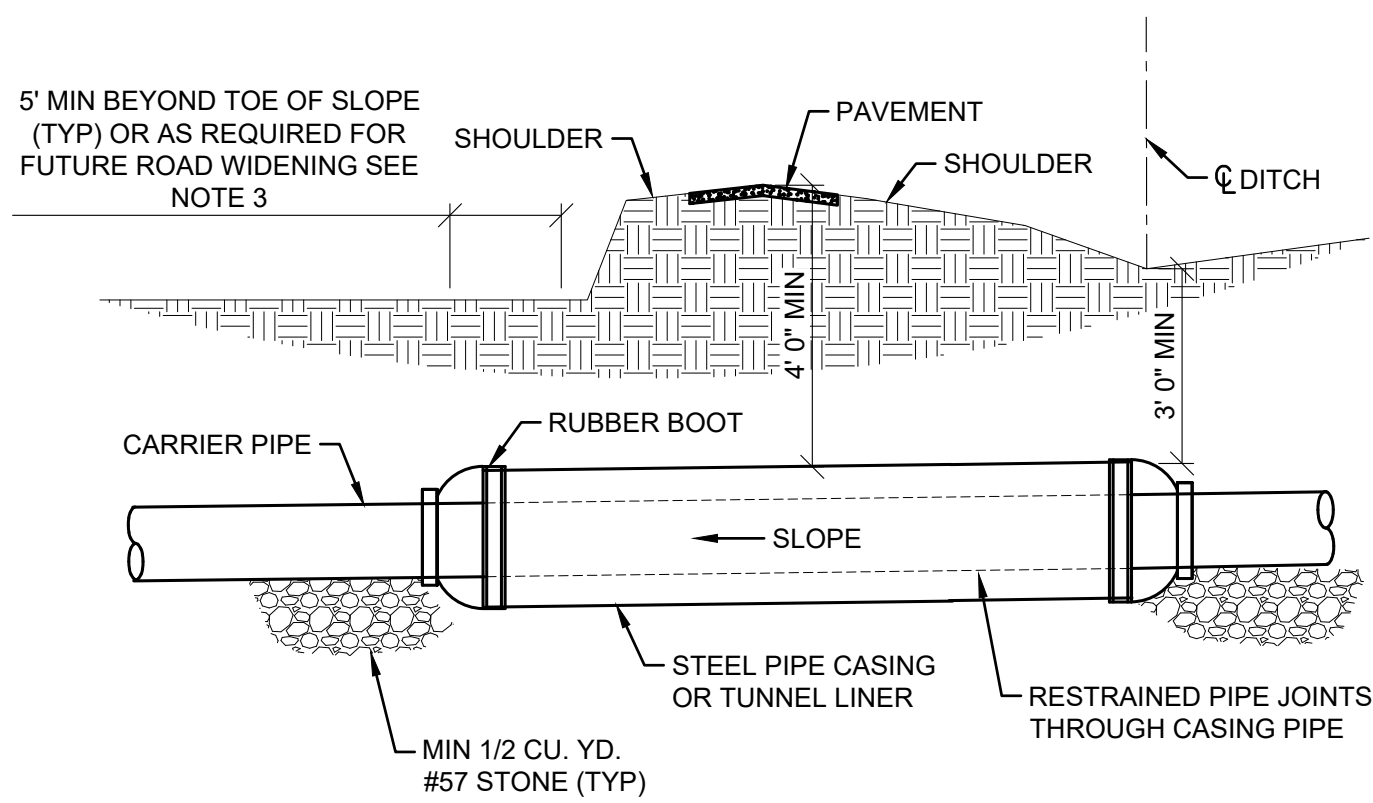
C
C-911

VALVE AND VALVE BOX
SCALE: NOT TO SCALE



D
C-911

CASING & CARRIER PIPE UNDER PAVED ROADS
SCALE: NOT TO SCALE



HORIZONTAL DUCTILE IRON PIPE - LINEAR FEET						45° VERTICAL OFFSET (FEET)	
DIAMETER (INCHES)	45°	90°	TEES OR CROSS	VALVES & DEAD ENDS	REDUCERS LARGE SIDE	UPPER	LOWER
8	22	28	30	55	—	22	22
12	30	35	35	78	—	30	30
24	65	80	124	144	—	65	65
30	80	100	154	174	—	80	80
36	100	120	270	300	—	100	100
42	112	138	140	230	—	112	112
42 x 24	—	—	105	—	153	—	—
42 X 30	—	—	143	—	111	—	—
42 X 36	—	—	—	N/A	89	—	—

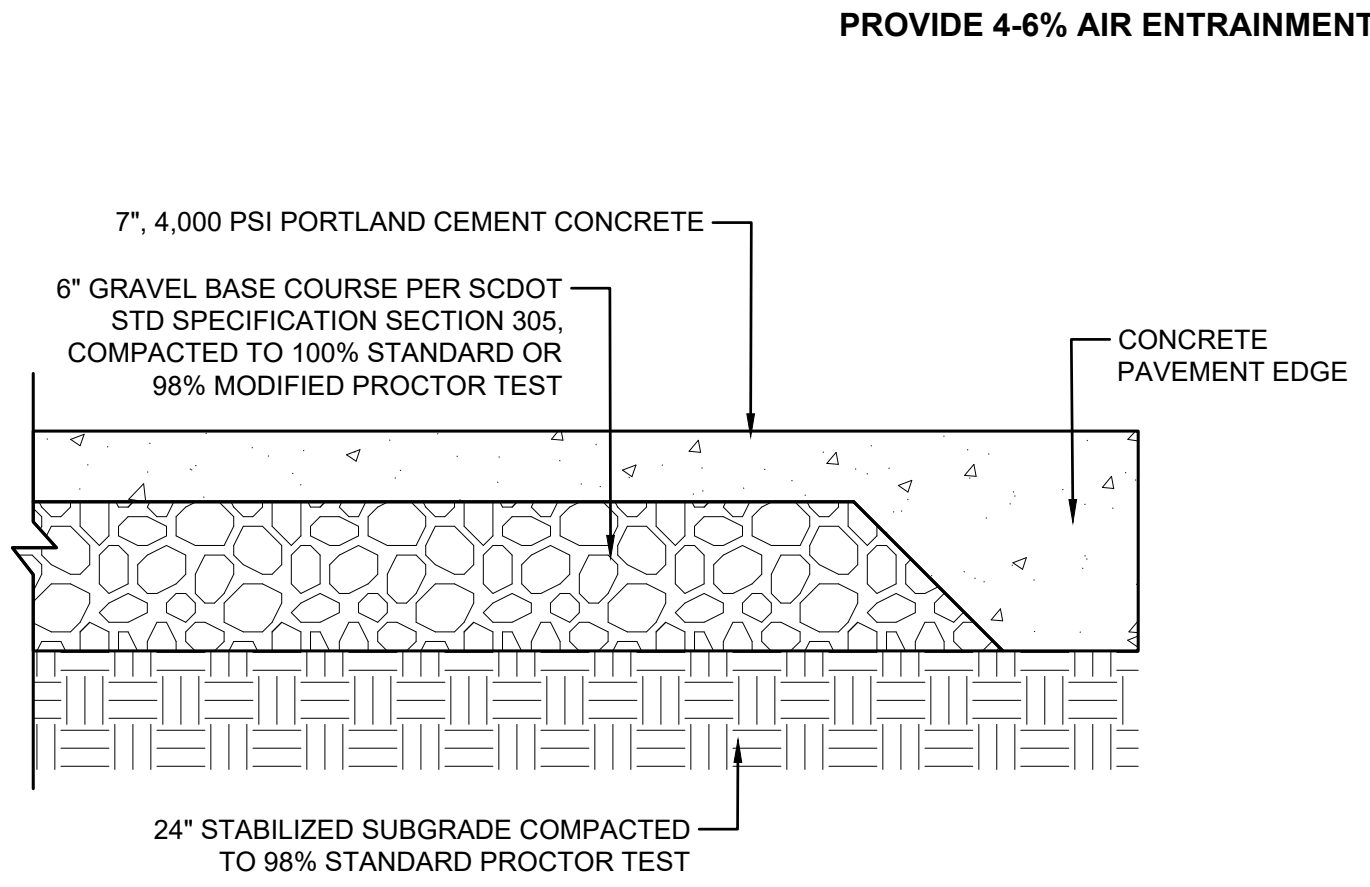
THE NOTED REQUIREMENTS WERE CALCULATED IN ACCORDANCE WITH THRUST RESTRAINT CALCULATOR v7.1.2 BY EBAA IRON WITH THE FOLLOWING ASSUMPTIONS:

- SOIL CONDITIONS: SANDS (SM, SP)
- LAYING CONDITION: 3, LOOSE SOIL BEDDING, BACKFILL LIGHTLY CONSOLIDATED TO TOP OF THE PIPE.
- MINIMUM COVER: 4.0 FT
- SAFETY FACTOR: 1.5, BARE PIPE.
- TEST PRESSURE: 150 PSI

IF FIELD CONDITIONS OR TEST PRESSURE DIFFER FROM THE ABOVE, CONTRACTOR SHALL NOTIFY ENGINEER.

E
SHT

CONCRETE PAVING
SCALE: NOT TO SCALE



FIXED BOLLARD NOTES:

- FOUNDATION SHALL EXTEND A MINIMUM OF 2 FEET BEYOND THE BOLLARD IN A SET.
- MAXIMUM BOLLARD SPACING IS 48".
- PAINT SAFETY YELLOW
- REBAR REQUIRED: 105LB
- IN FOUNDATION PARTS ARE FINISHED W/ EPOXY

VALVE & VALVE BOX NOTES:

- ALL BURIED VALVES W/ MANUAL NUT SHALL RECEIVE A BRASS I.D. PLATE.

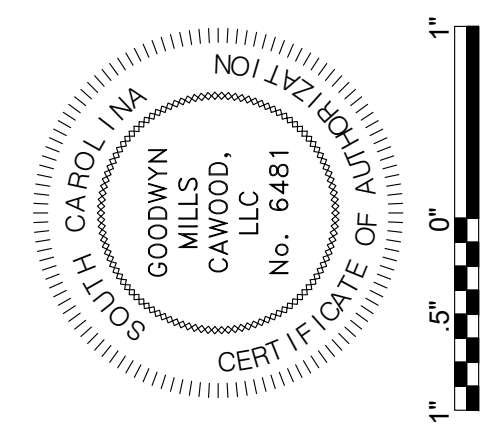
CASING & CARRIER PIPE UNDER PAVED ROADS NOTES:

- THIS DETAIL ILLUSTRATES A TYPICAL SEWER INSTALLATION UNDER A HIGHWAY. EACH HIGHWAY CROSSING WILL BE DIFFERENT AND SHALL BE SPECIFICALLY DESIGNED. ALL CROSSINGS SHALL BE APPROVED BY SCDOT, THE COUNTY AND/OR THE CITY AND SHALL MEET ALL OF THEIR REQUIREMENTS.
- REFER TO THE DRAWINGS FOR THE LOCATION, SIZE AND LENGTH OF STEEL PIPE CASINGS AND TUNNEL LINERS. REFER TO THE STANDARD SPECIFICATIONS FOR MATERIAL AND INSTALLATION REQUIREMENTS.
- THE NEAR EDGE OF THE PIT FOR INSTALLING THE CASING/TUNNEL SHALL BE NO CLOSER TO THE EDGE OF THE TRAVELED WAY THAN ITS DEPTH BELOW THE SURFACE OF THE TRAVELED WAY UNLESS SPECIAL, APPROVED BULKHEADS ARE PROVIDED.

**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**

PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

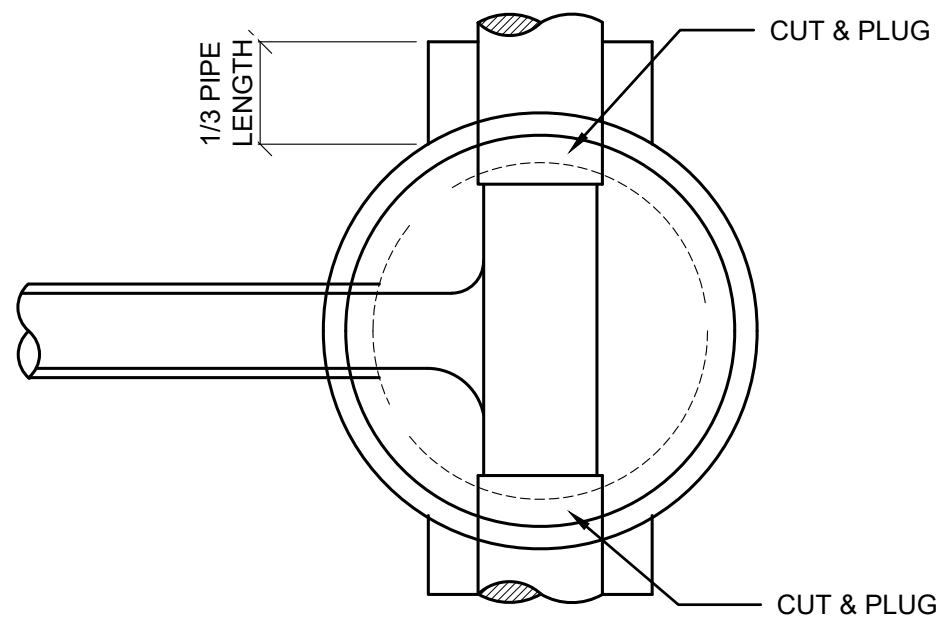
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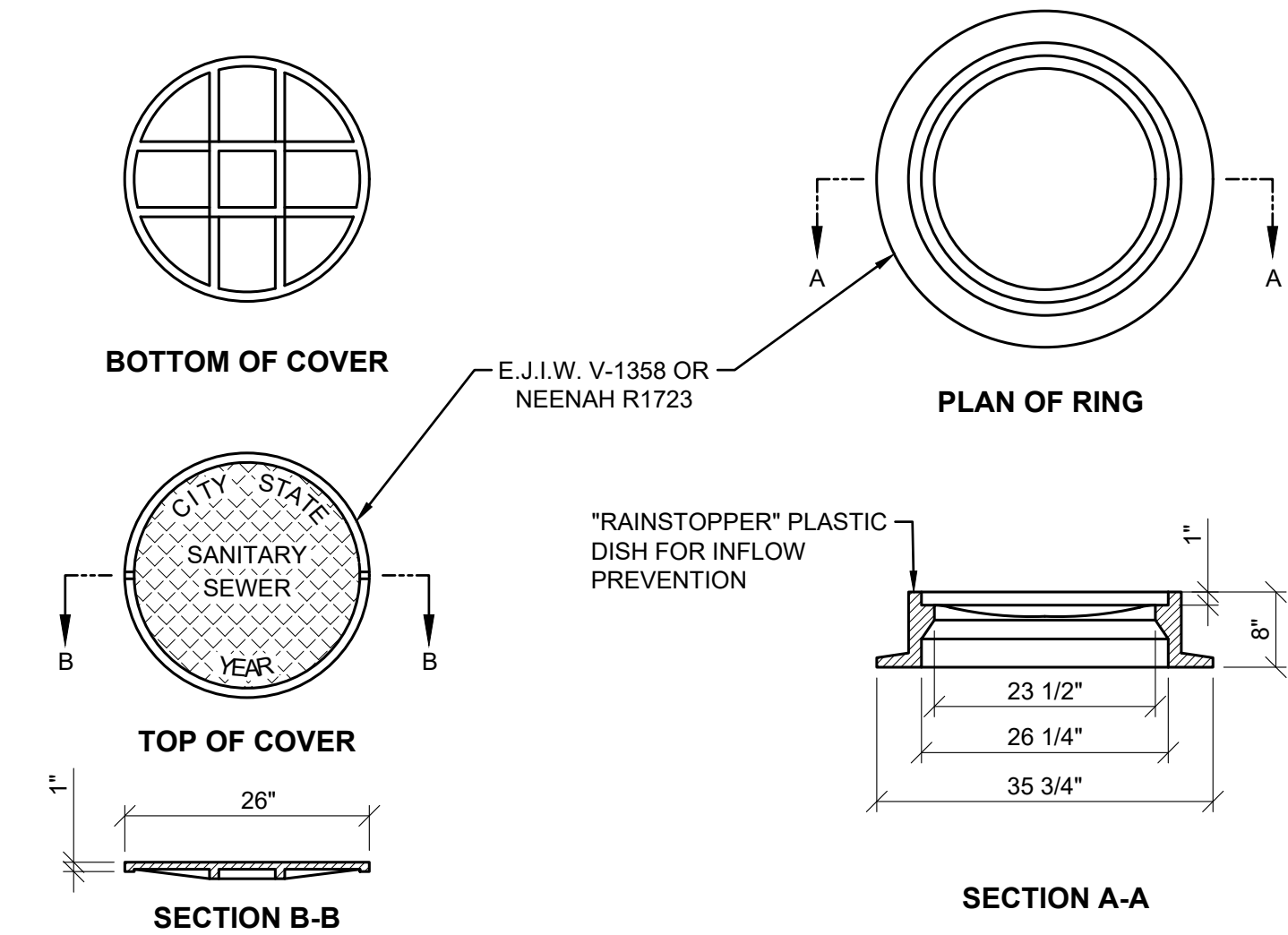
**CIVIL
DETAILS**

C-911

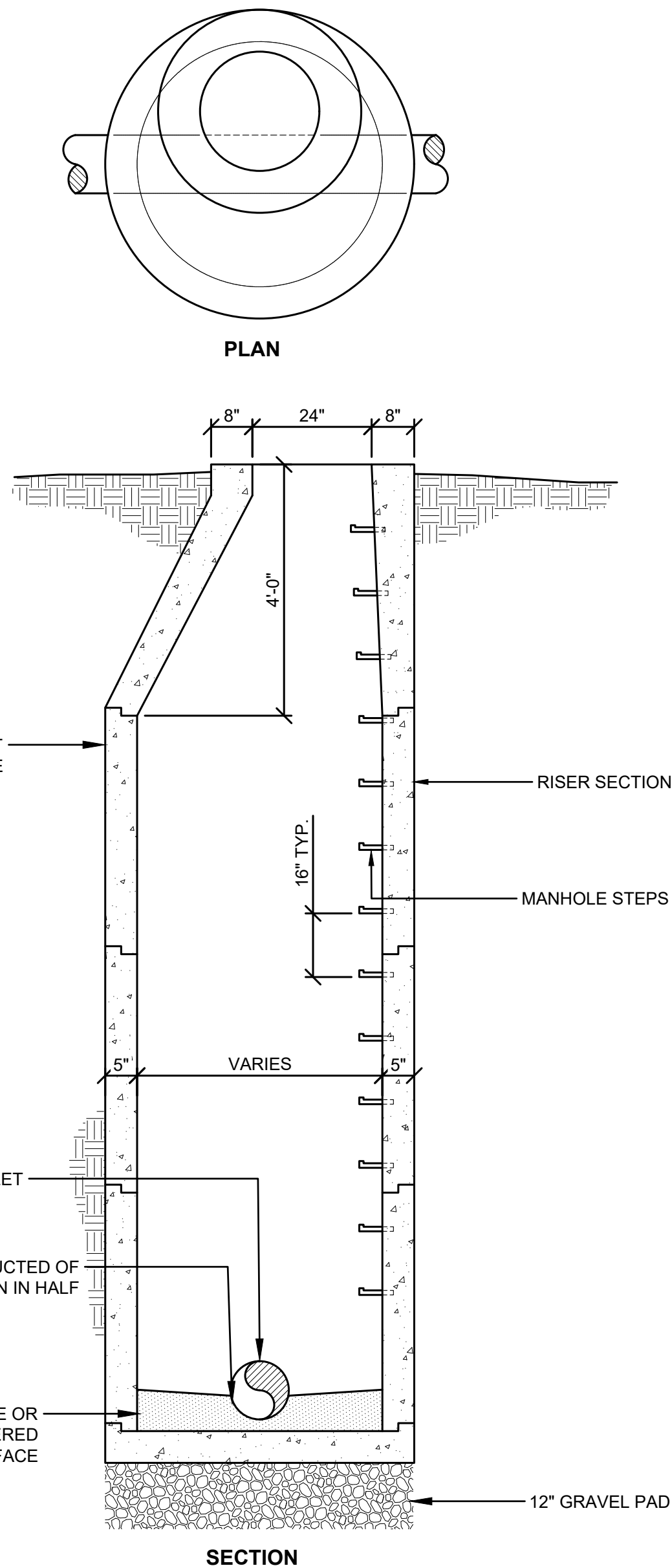
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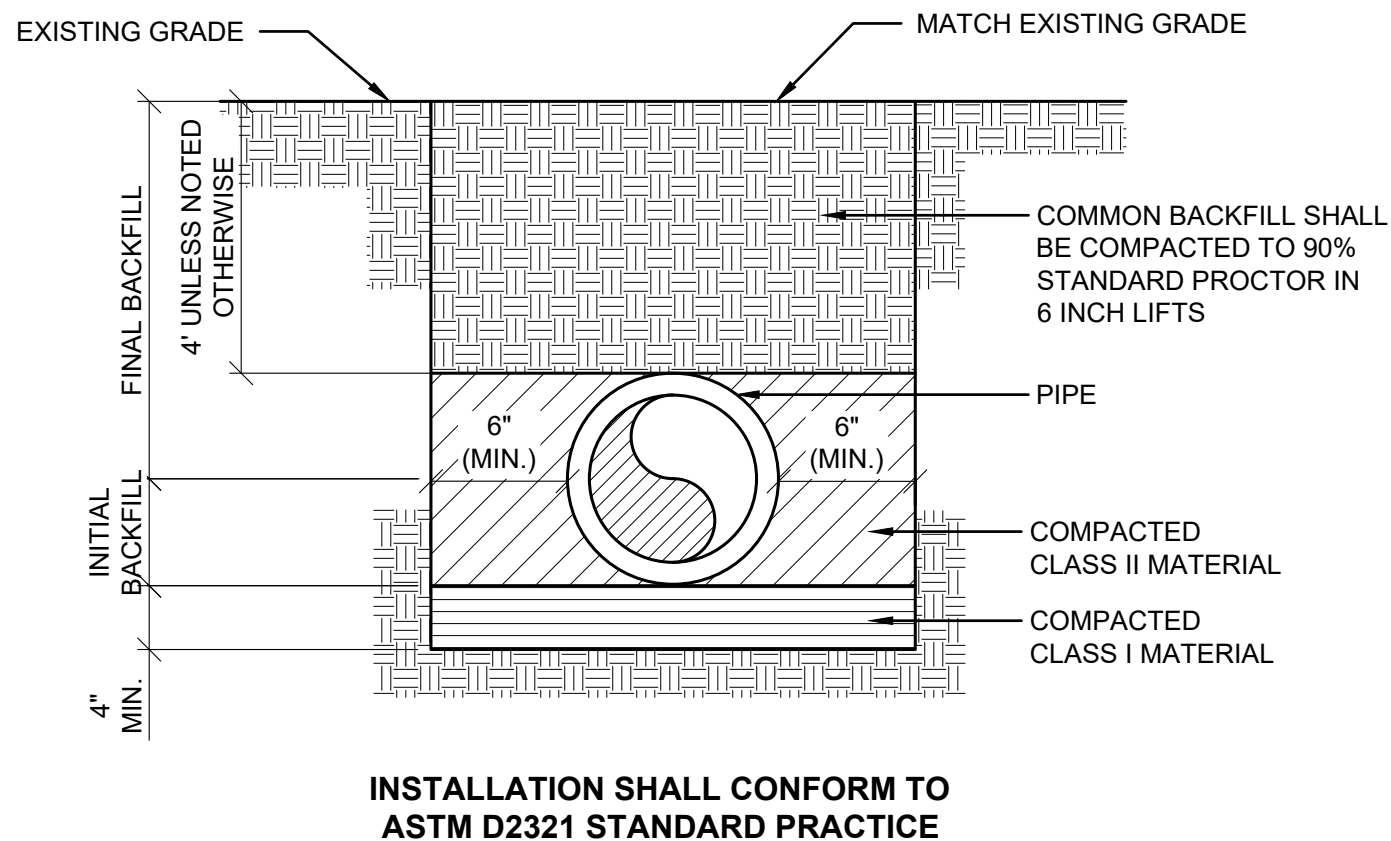
F DOGHOUSE MANHOLE
C-912 SCALE: NOT TO SCALE



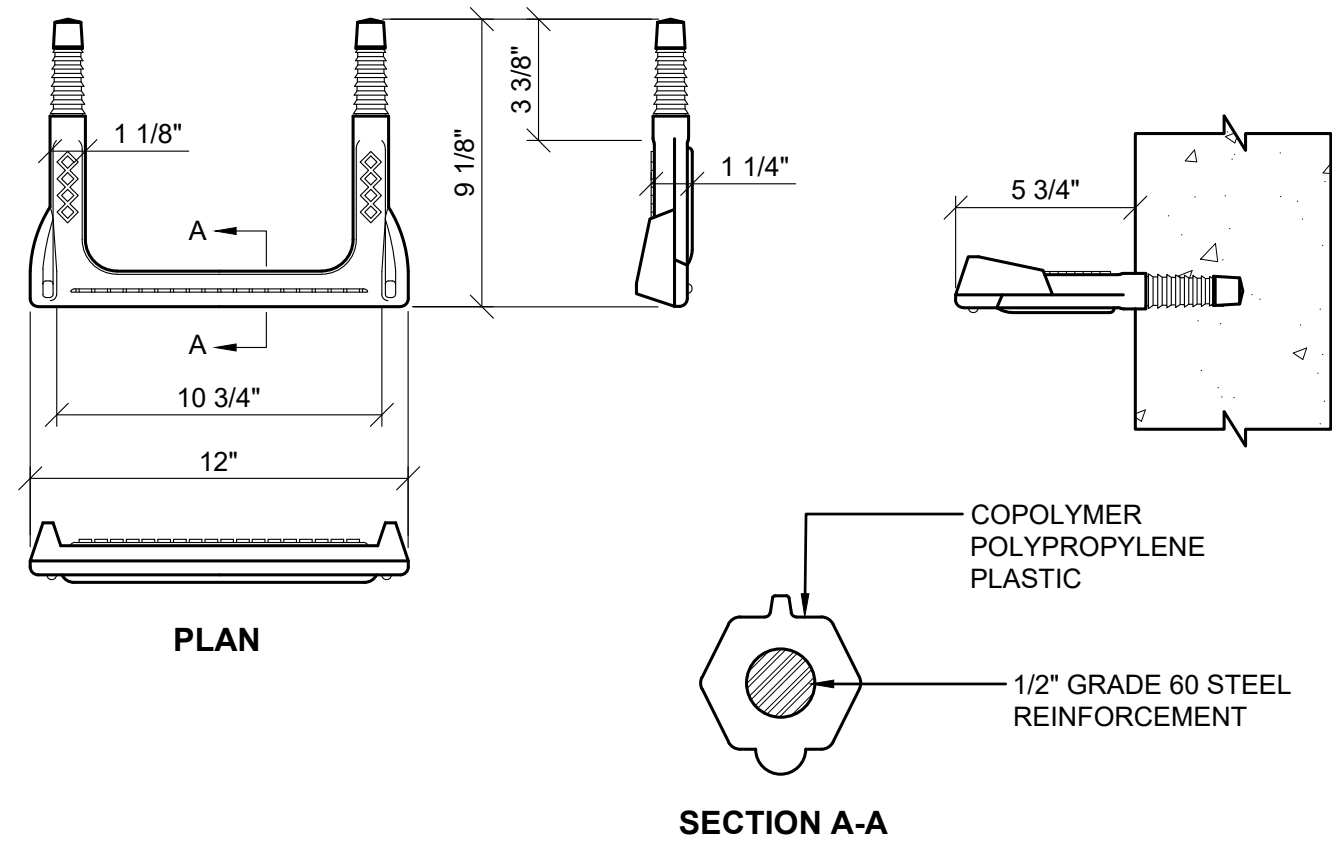
J MANHOLE COVER & RING
C-912 SCALE: NOT TO SCALE



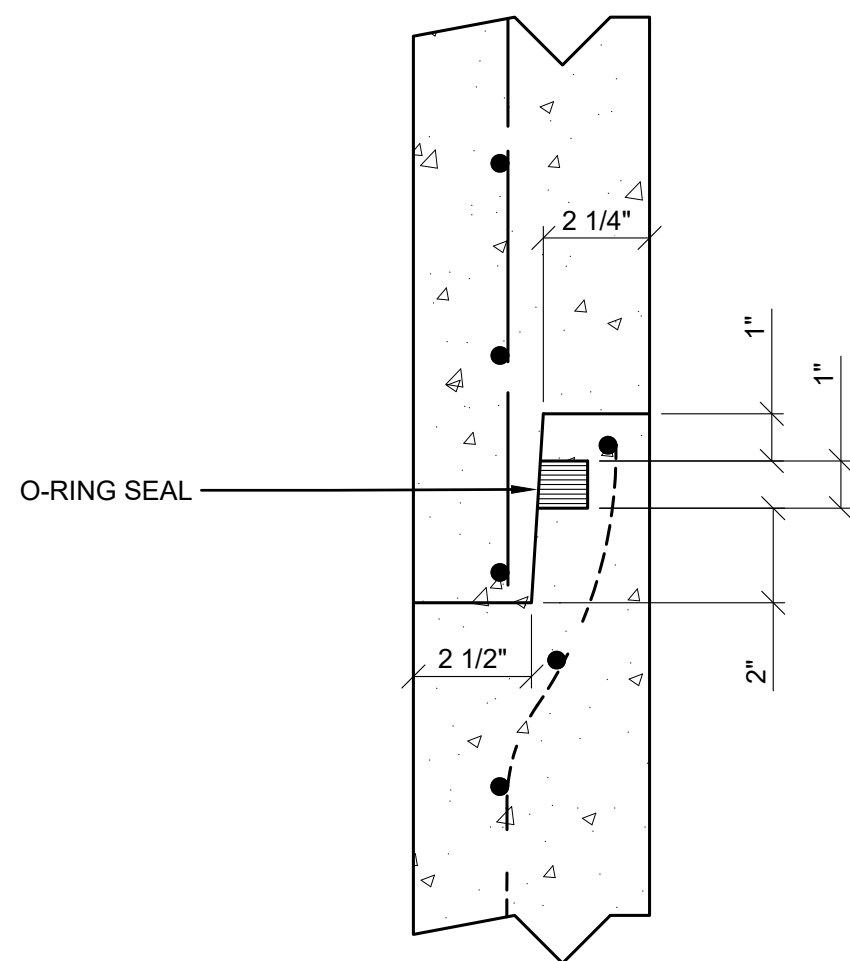
G STANDARD INLET MANHOLE
C-912 SCALE: NOT TO SCALE



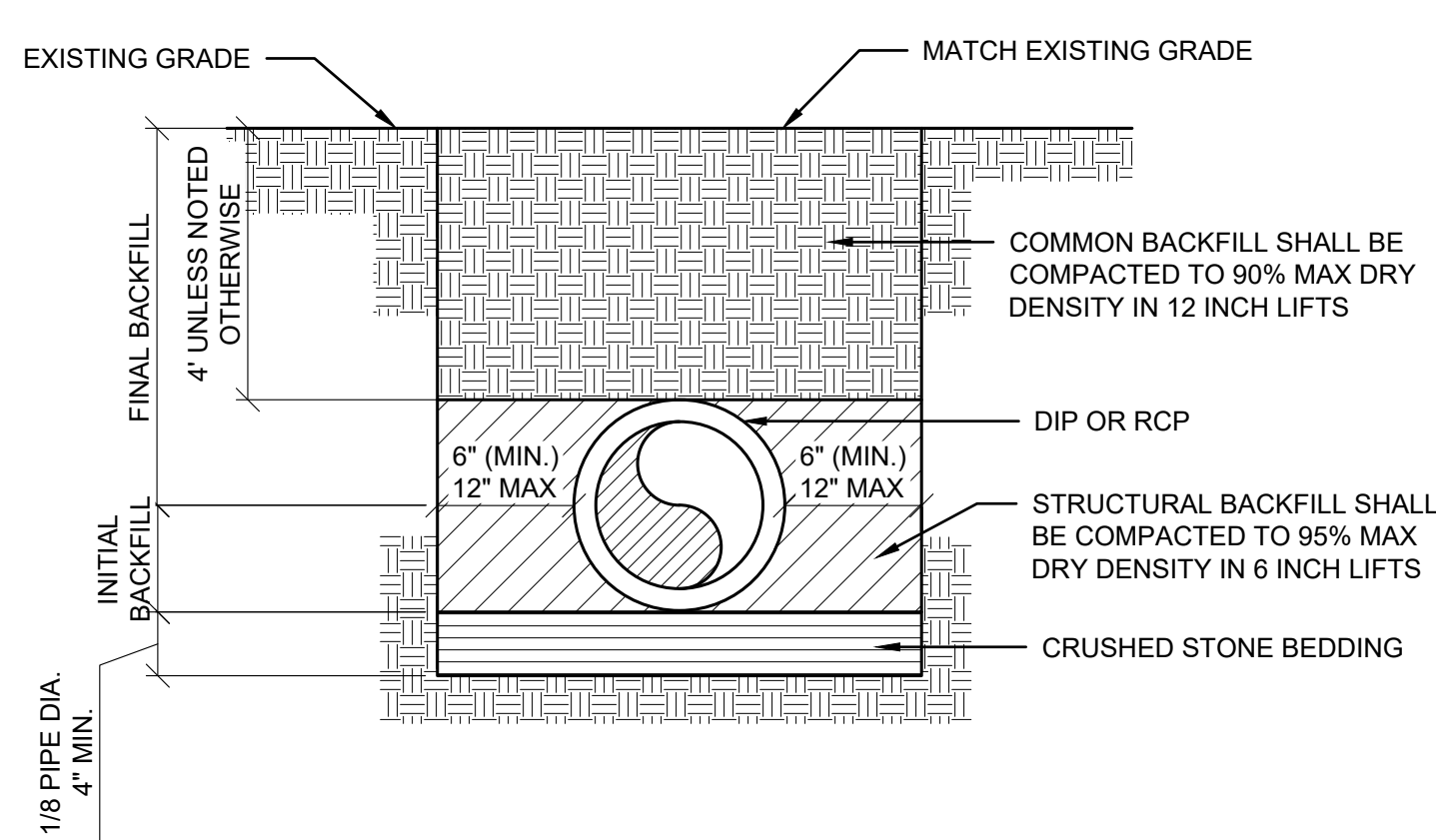
K EMBEDMENT FOR THERMOPLASTIC PIPE
C-912 SCALE: NOT TO SCALE



H MANHOLE STEPS
C-912 SCALE: NOT TO SCALE



I TYPICAL MANHOLE JOINT
C-912 SCALE: NOT TO SCALE



L EMBEDMENT FOR DIP OR RCP (GRAVITY OR PRESSURE PIPE)
C-912 SCALE: NOT TO SCALE

DOGHOUSE MANHOLE:

1. CONCRETE IS MINIMUM 4000 PSI COMPRESSIVE STRENGTH.
2. MATERIAL USED TO SEAL AROUND PIPE SHALL BE NON-SHRINK GROUT.
3. MANHOLES GREATER THAN 12' IN DEPTH SHALL HAVE MIN. 6" EXTENDED BASE.

MANHOLE STEP NOTES:

STEP IS MANUFACUTRED BY AMERICAN STEP COMPANY, INC. OR EQUAL AS APPROVED BY ENGINEER.

AMERICAN MANHOLE STEPS CONFORM TO THE FOLLOWING:

- ASTM C478, MANHOLE STEP SECTION, WHEN PROPERLY INSTALLED
- ASTM D4101 PP034B44743 COPOLYMER POLYPROPYLENE PLASTIC
- ASTM A615 GRADE 60 1/2 INCH STEEL REINFORCEMENT

MODEL:

- ML-10 TDS NCR MECHANICAL LOCK INSTALLATION METHODS
- MINIMUM CONCRETE STRENGTH SHALL BE 3000 PSI

PRE FORMED HOLES:

- TWO PRE-FORMED HOLES ON 10" CENTERS
- HOLES MUST BE PARALLEL
- DIAMETER OF HOLES ARE 1.1" TAPERING TO 7/8" IN 3 1/2" OF DEPTH

DRILLED HOLES:

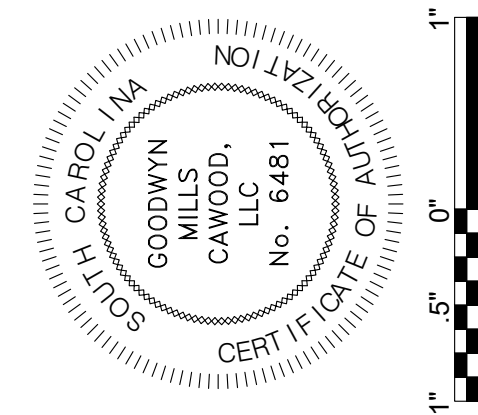
- DRILL TWO 1" HOLES ON 10" CENTERS WITH A MINIMUM DEPTH OF 3 3/4"
- USE 1" MASONRY BIT FOR DRILLING
- HOLES MUST BE PARALLEL

1. DRIVE STEP WITH SLEDGE HAMMER UNTIL BOTH LEGS ARE COMPLETELY SEATED AND THE TOP DEPTH STOP IS TOUCHING THE WALL.
2. ALL STEPS SHALL BE IN VERTICAL ALIGNMENT AND INSTALLED DIRECTLY BELOW THE MANHOLE COVER. THE STEPS SHALL BE INSTALLED PERPINDICULAR TO THE FLOW LINE OF SEWER.

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Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

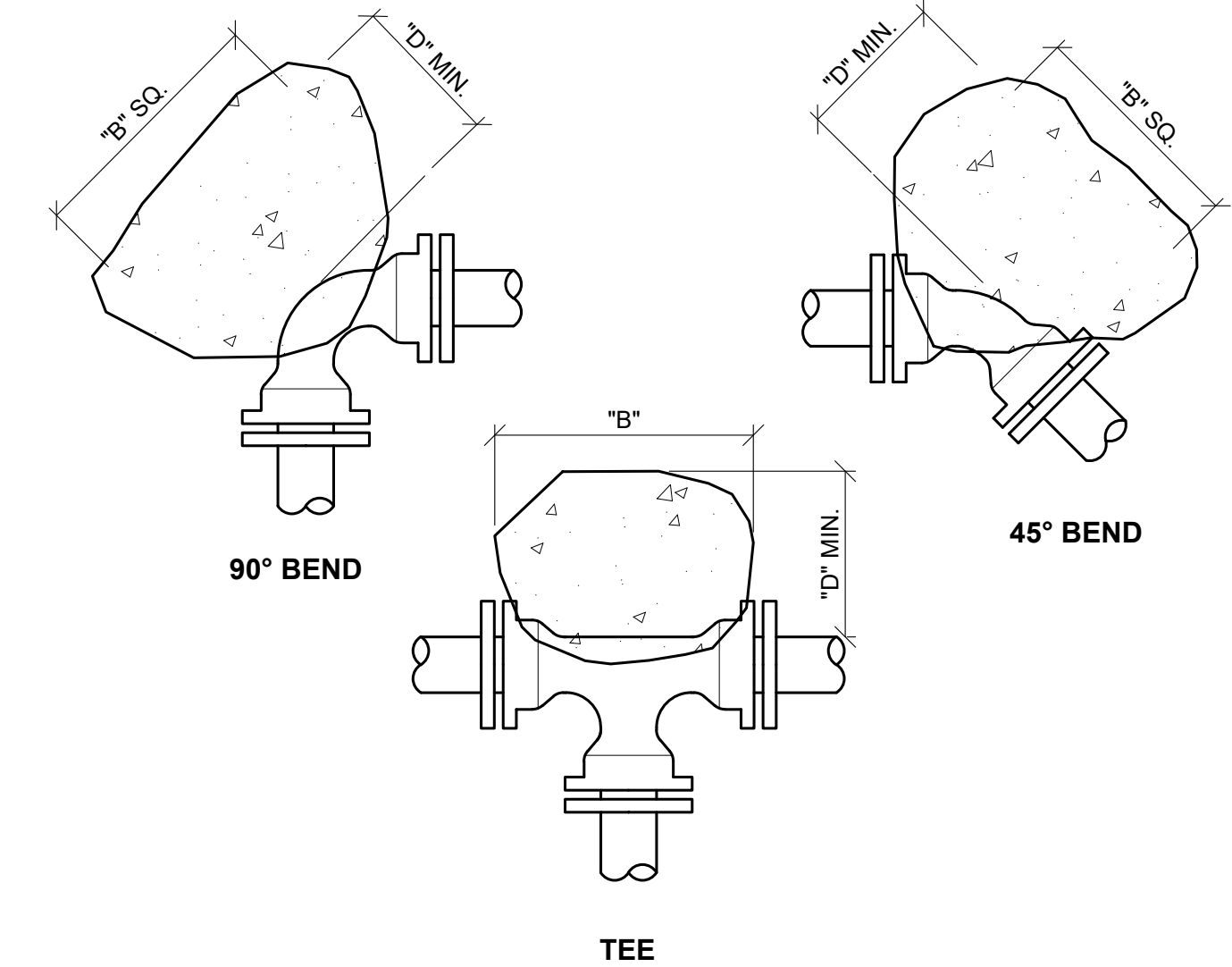


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CIVIL
DETAILS

C-912

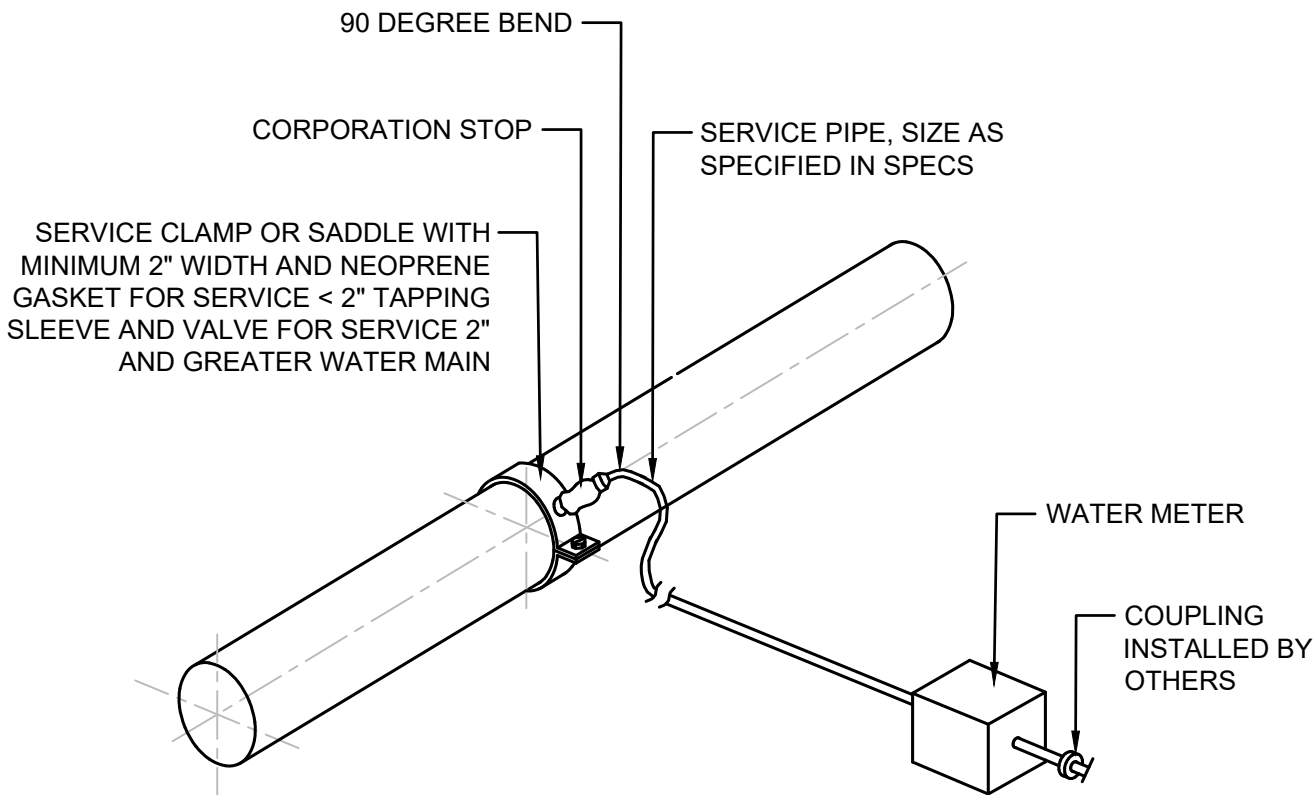
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M
C-913 THRUST BLOCK
SCALE: NOT TO SCALE

PIPE SIZE (IN.)	THRUST BLOCKS (MINIMUM DIMENSIONS IN FEET)											
	90° BENDS			45° BENDS			22.5° BENDS			TEE		
	B	D	REINF. (EA WAY)	B	D	REINF. (EA WAY)	B	D	REINF. (EA WAY)	B	D	REINF. (EA WAY)
2	1.0	0.7	-	1.0	0.7	-	1.0	0.7	-	1.0	0.7	-
3	1.0	0.7	-	1.0	0.7	-	1.0	0.7	-	1.0	0.7	-
4	1.0	0.7	-	1.0	0.7	-	1.0	0.7	-	1.2	0.7	-
6	1.4	0.7	-	1.0	0.7	-	1.0	0.7	-	1.6	0.7	-
8	1.8	0.8	-	1.4	0.7	-	1.0	0.7	-	2.2	1.0	-
10	2.3	1.0	-	1.7	0.8	-	1.2	0.7	-	2.7	1.0	-
12	2.7	1.0	-	2.0	0.8	-	1.4	0.7	-	3.2	1.0	-
14	3.2	1.0	4-#5'S	2.4	1.0	3-#5'S	1.7	0.7	-	3.8	1.0	5-#5'S
16	3.6	1.0	5-#5'S	2.7	1.0	3-#5'S	1.9	0.8	2-#5'S	4.3	1.2	5-#5'S
18	4.1	1.2	5-#5'S	3.0	1.0	4-#5'S	2.2	1.0	3-#5'S	4.9	1.2	6-#5'S
20	4.5	1.2	5-#5'S	3.4	1.0	4-#5'S	2.4	1.0	3-#5'S	5.4	1.2	6-#5'S
24	5.5	1.2	6-#5'S	4.0	1.0	5-#5'S	2.9	1.0	3-#5'S	6.5	1.5	8-#5'S
30	6.8	1.5	8-#5'S	5.0	1.2	6-#5'S	3.6	1.0	5-#5'S	8.1	1.7	9-#5'S
36	8.2	1.7	9-#5'S	6.0	1.3	7-#5'S	4.3	1.2	5-#5'S	9.7	1.8	10-#5'S
42	9.6	1.8	10-#5'S	7.0	1.5	8-#5'S	5.0	1.2	6-#5'S	11.3	2.0	12-#5'S

N
C-913 SERVICE CONNECTION TO WATER MAIN
SCALE: NOT TO SCALE



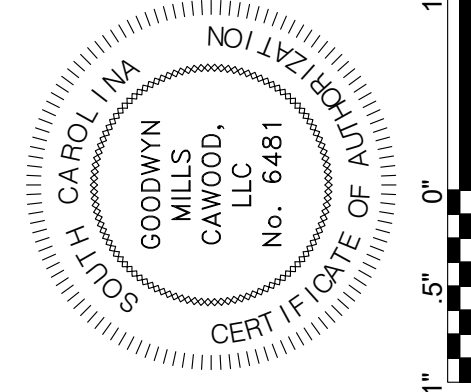
CIVIL
DETAILS

C-913

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Drawn By:	HKD

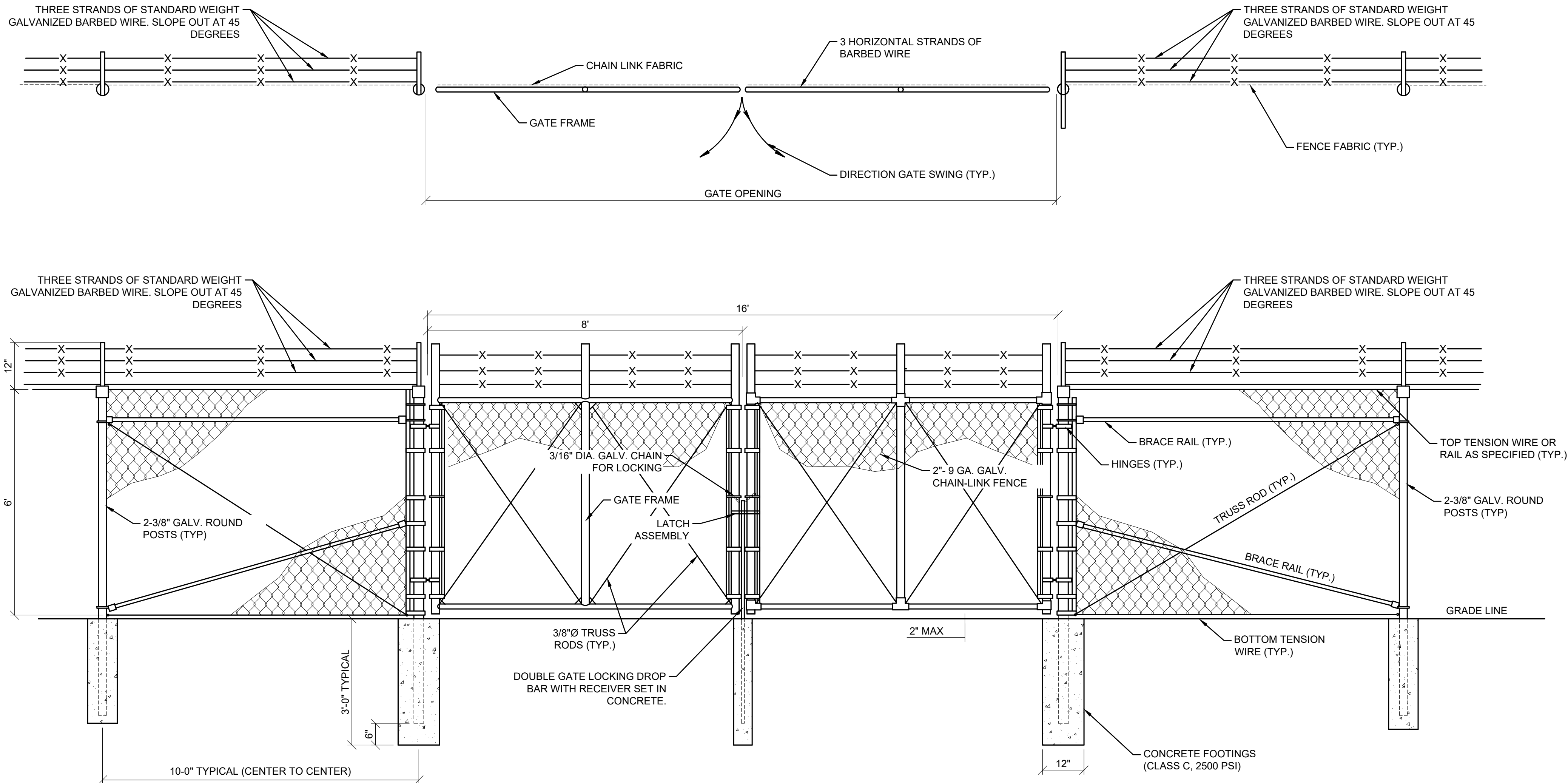


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DOUBLE SWING GATE
SCALE: NOT TO SCALE



CIVIL
DETAILS

C-914

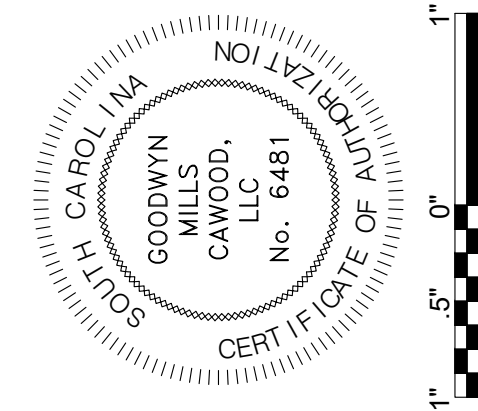
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REGIONAL WWTP EXPANSION

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Anderson County

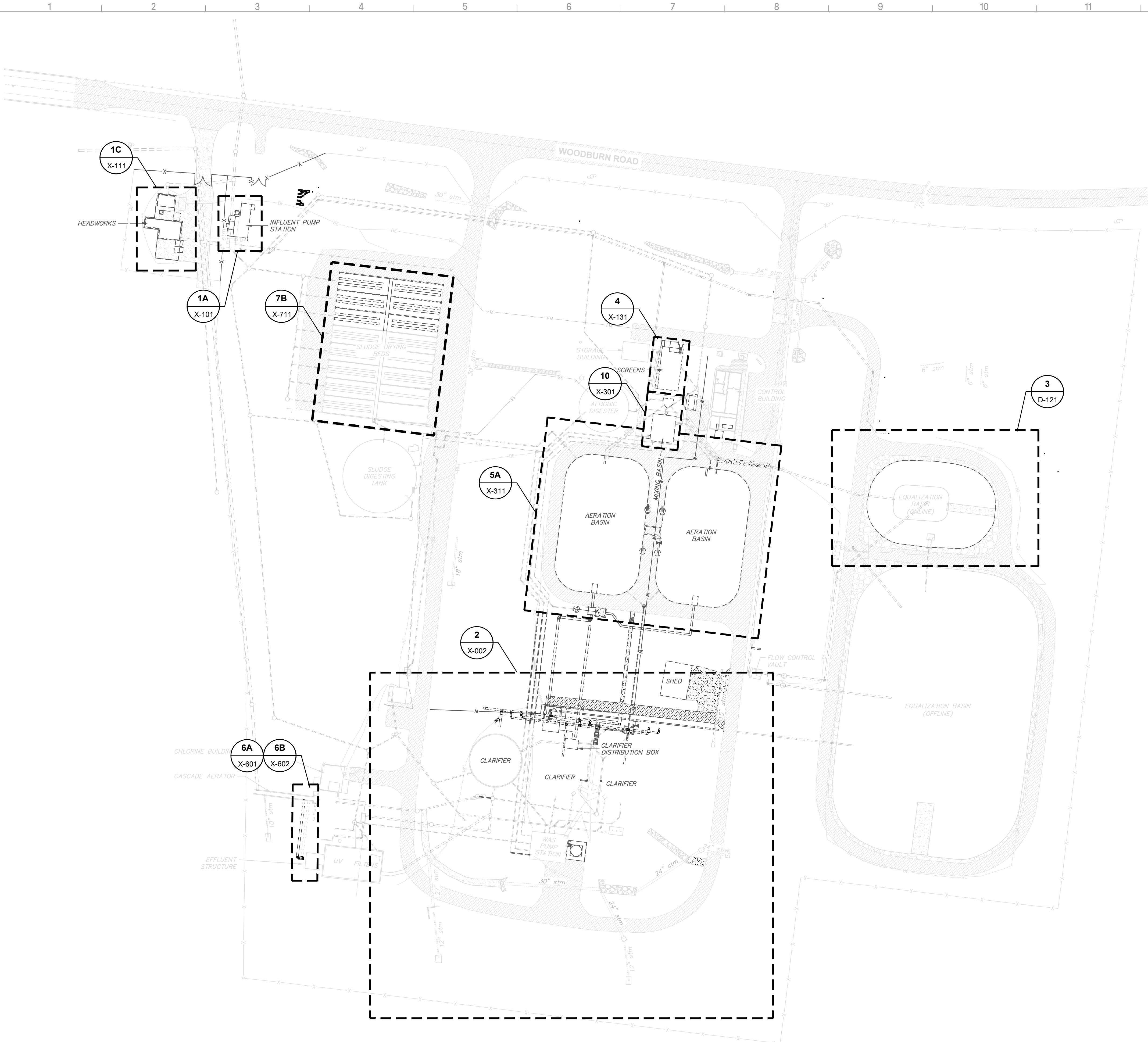
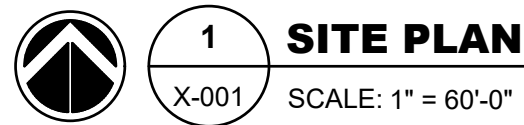
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DEMOLITION NOTES:

1. THE CONTRACTOR SHALL SUBMIT A DEMOLITION/DECONSTRUCTION PLAN TO BE APPROVED BY THE ENGINEER.
2. BEFORE STARTING DEMOLITION, THE CONTRACTOR MUST CHECK TO DETERMINE THAT ALL UTILITY SERVICES, SUCH AS WATER, GAS, ELECTRICITY, TELEPHONE, ETC. ARE DISCONNECTED AT THE SERVICE MAIN, IN ACCORDANCE WITH THE RULES AND REGULATIONS GOVERNING THE UTILITY INVOLVED.
3. CONTRACTOR SHALL PROVIDE SAFEGUARDS, INCLUDING WARNING SIGNS, BARRICADES, TEMPORARY FENCES, WARNING LIGHTS AND OTHER ITEMS THAT ARE REQUIRED FOR PROTECTION OF ALL PERSONNEL DURING DEMOLITION AND REMOVAL OPERATIONS.
4. ACCEPTABLE METHODS FOR DEMOLITION SHALL BE APPROVED BY THE ENGINEER. HAND DISMANTLING, PNEUMATIC AND HYDRAULIC BREAKERS, SAW CUTTING, MECHANICAL BREAKING, WATER JETTING, AND THERMAL LANCING ARE ACCEPTABLE. THE USE OF CHEMICALS AND EXPLOSIVES ARE NOT ACCEPTABLE.
5. ANY DAMAGE TO SURROUNDING EQUIPMENT, STRUCTURES, UTILITIES OR ADJACENT ITEMS SHALL BE RESTORED TO THE ENTITIES ORIGINAL CONDITION AT NO COST TO THE OWNER.
6. BEFORE CUTTING, EXAMINE THE SURFACES TO BE CUT AND PATCHED AND THE CONDITIONS UNDER WHICH THE WORK IS TO BE PERFORMED. IF UNSAFE OR OTHERWISE UNSATISFACTORY CONDITIONS ARE ENCOUNTERED, TAKE CORRECTIVE ACTION BEFORE PROCEEDING WITH THE WORK.
7. USE METHODS THAT ARE LEAST LIKELY TO DAMAGE WORK TO BE RETAINED OR ADJOINING WORK. IN GENERAL, WHERE CUTTING IS REQUIRED USE HAND OR SMALL POWER TOOLS DESIGNED FOR SAWING OR GRINDING, NOT HAMMERING AND CHOPPING. CUT THROUGH CONCRETE AND MASONRY USING A CUTTING MACHINE SUCH AS A CARBORUNDUM SAW OR CORE DRILL TO INSURE A NEAT HOLE. CUT HOLES AND SLOTS NEATLY TO SIZE REQUIRED WITH MINIMUM DISTURBANCE OF ADJACENT WORK. TO AVOID MARRING EXISTING FINISHED SURFACES, CUT OR DRILL FROM THE EXPOSED OR FINISHED SIDE INTO CONCEALED SURFACES. TEMPORARILY COVER OPENINGS WHEN NOT IN USE.
8. RESTORE EXPOSED FINISHES OF PATCHED AREAS AND WHERE NECESSARY EXTEND FINISH RESTORATION INTO RETAINED ADJOINING WORK IN A MANNER WHICH WILL ELIMINATE EVIDENCE OF PATCHING AND REFINISHING.
9. SECURELY SEAL AND OR PLUG ALL STORM AND SANITARY SEWERS LEADING FROM THE STRUCTURE TO BE DEMOLISHED.
10. DEMOLISH STRUCTURES IN SUCH A MANNER AS TO AVOID HAZARDS TO PERSONS AND PROPERTY INTERFERENCE WITH THE USE OF ADJACENT BUILDINGS, AND INTERRUPTION OF FREE PASSAGE TO AND FROM SUCH BUILDINGS.
11. PROMPTLY DISPOSE OF DEBRIS, RUBBISH, AND OTHER MATERIALS RESULTING FROM BUILDING SITE DEMOLITION OPERATIONS. NO BURNING IS ALLOWED. ALL WASTE MATERIALS SHALL BE REMOVED FROM THE PROJECT SITE AND LEGALLY DISPOSED OF IN AN EPA AND OWNER-APPROVED LANDFILL OR RECYCLING FACILITY. REMOVE AND TRANSPORT DEBRIS IN A MANNER THAT WILL PREVENT SPILLAGE ON ADJACENT SURFACES AND AREAS.

KEY NOTES:

1. REMOVE:

DEMOLITION

SITE PLAN

X-001

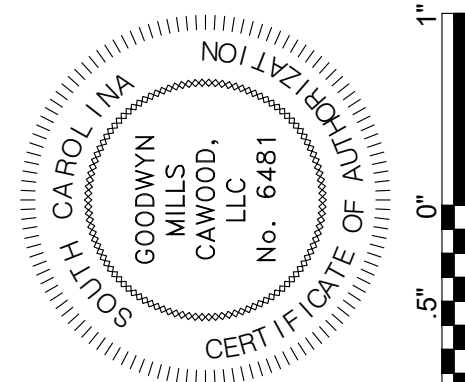
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REGIONAL WWTP EXPANSION**

PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

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Conformed Set	
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Engineer:	TR
Designer:	JX
Drawn By:	HKD



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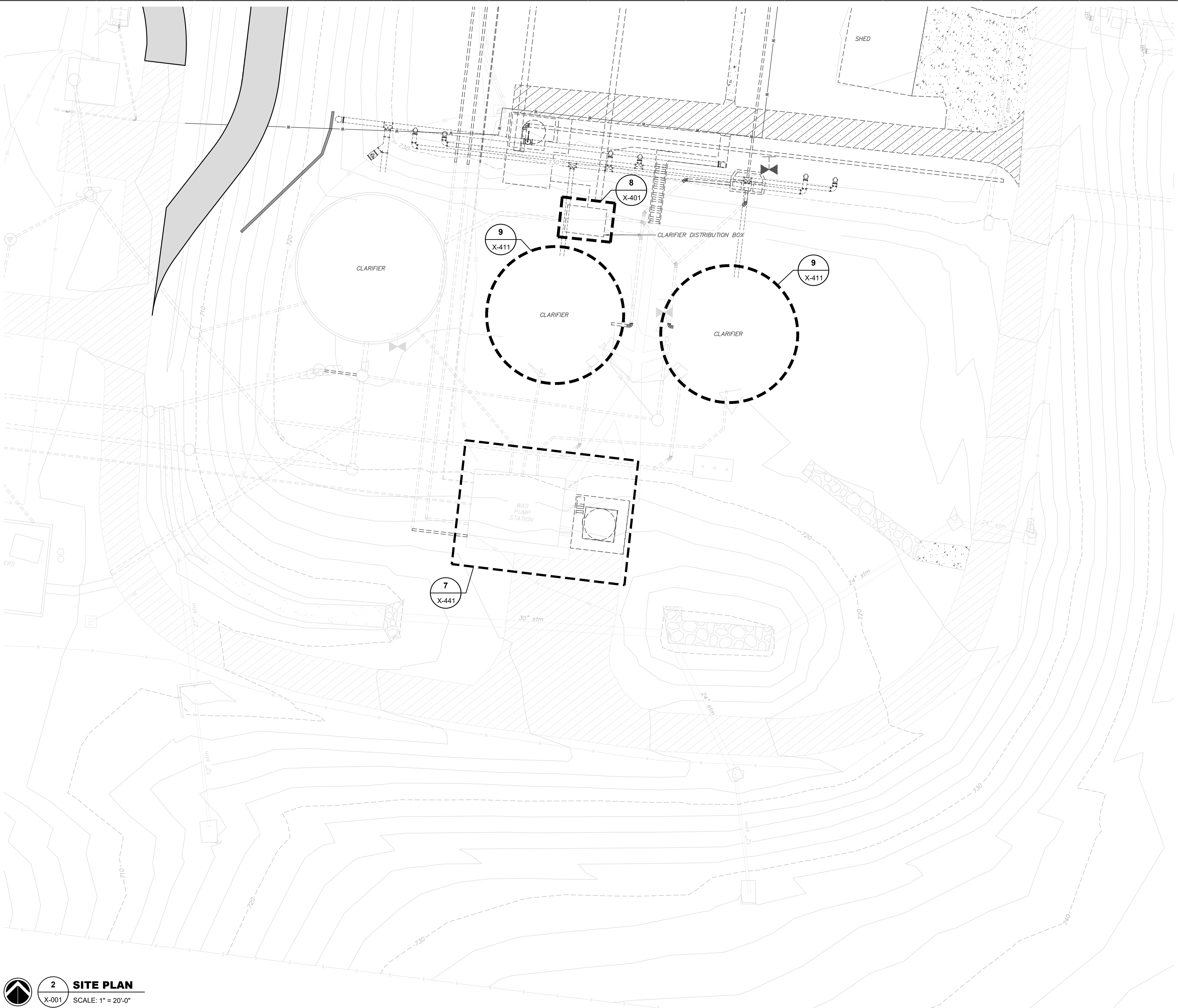


2

X-001

SITE PLAN

SCALE: 1" = 20'-0"



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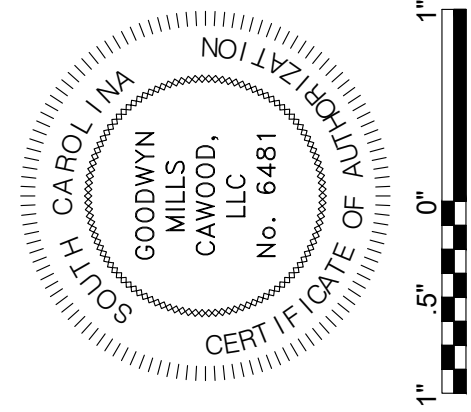
DEMOLITION
ENLARGED
SITE PLAN

X-002

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Town of Pendleton
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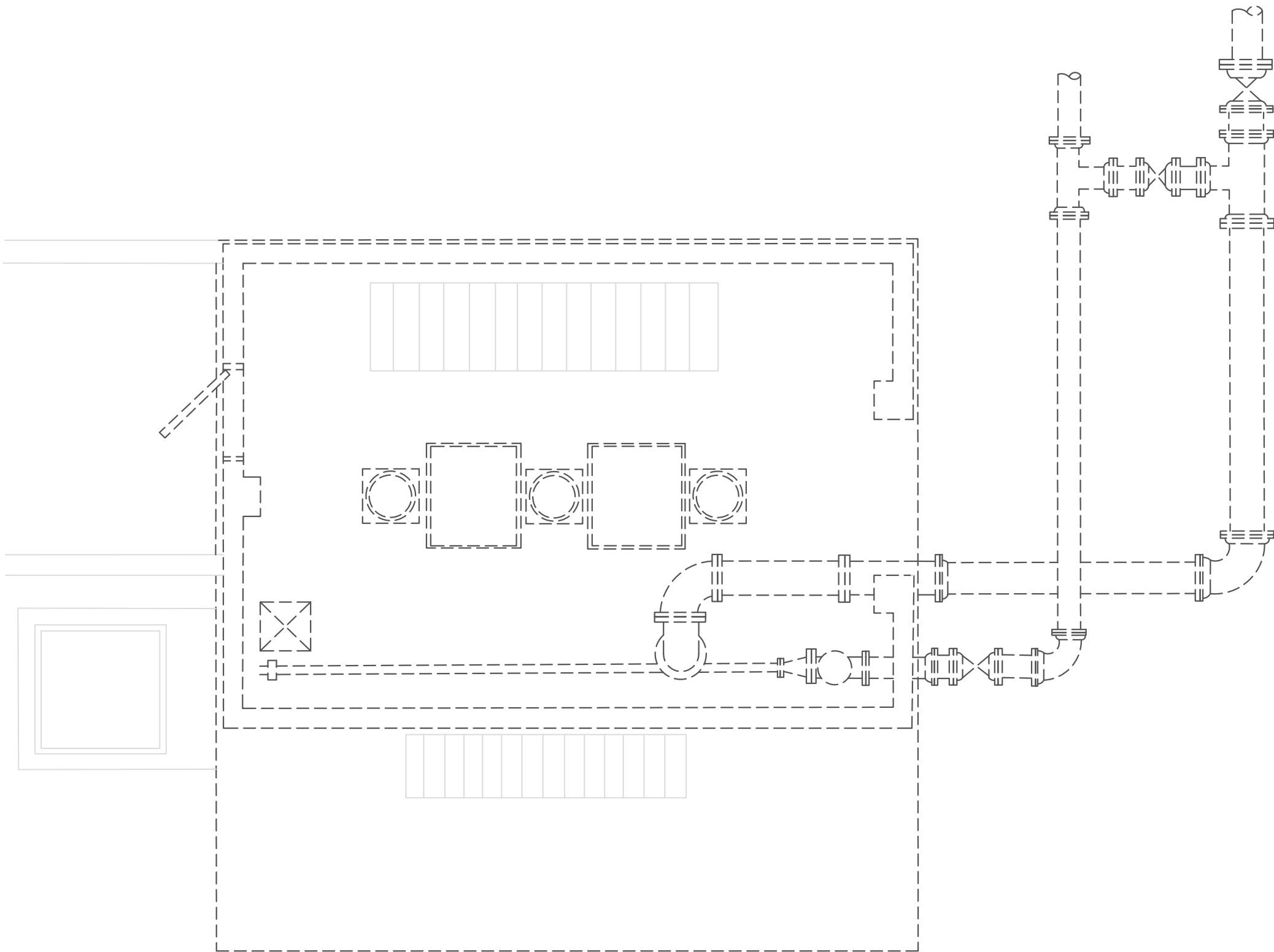
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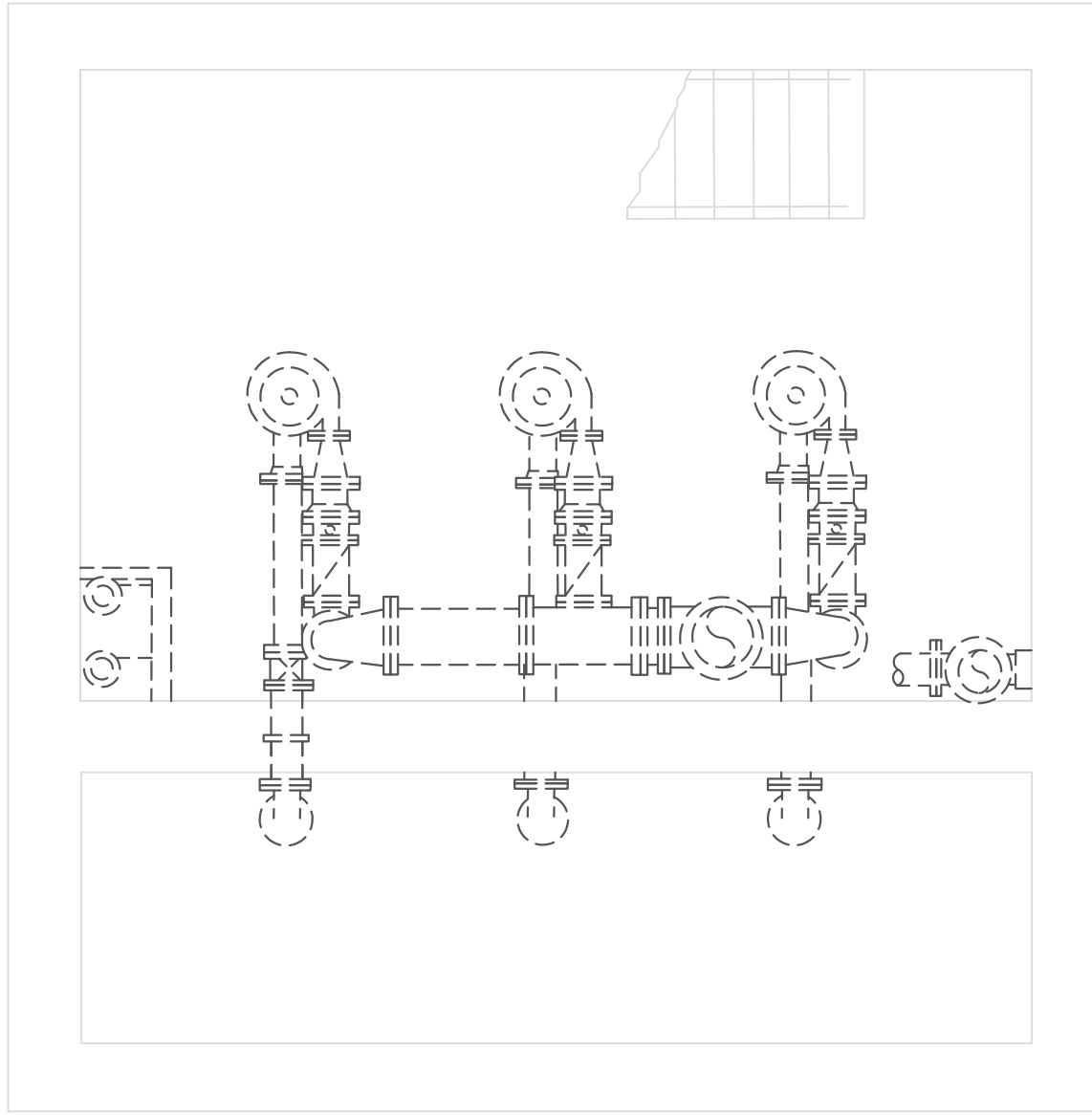


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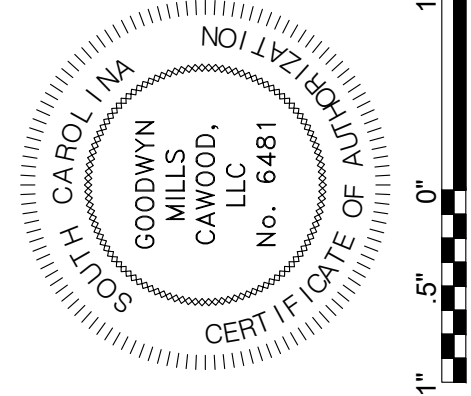
3A **PLAN**
X-001 SCALE: 1/4" = 1'-0"



3B **PLAN**
X-001 SCALE: 1/4" = 1'-0"

KEY NOTES: #

1. REMOVE: CONCRETE STRUCTURE
2. REMOVE & SALVAGE: EQUIPMENT
3. REMOVE & SALVAGE: PIPE ACCESSORIES
4. REMOVE & SALVAGE: PIPING & FITTINGS
5. REMOVE & SALVAGE: MISCELLANEOUS METALS



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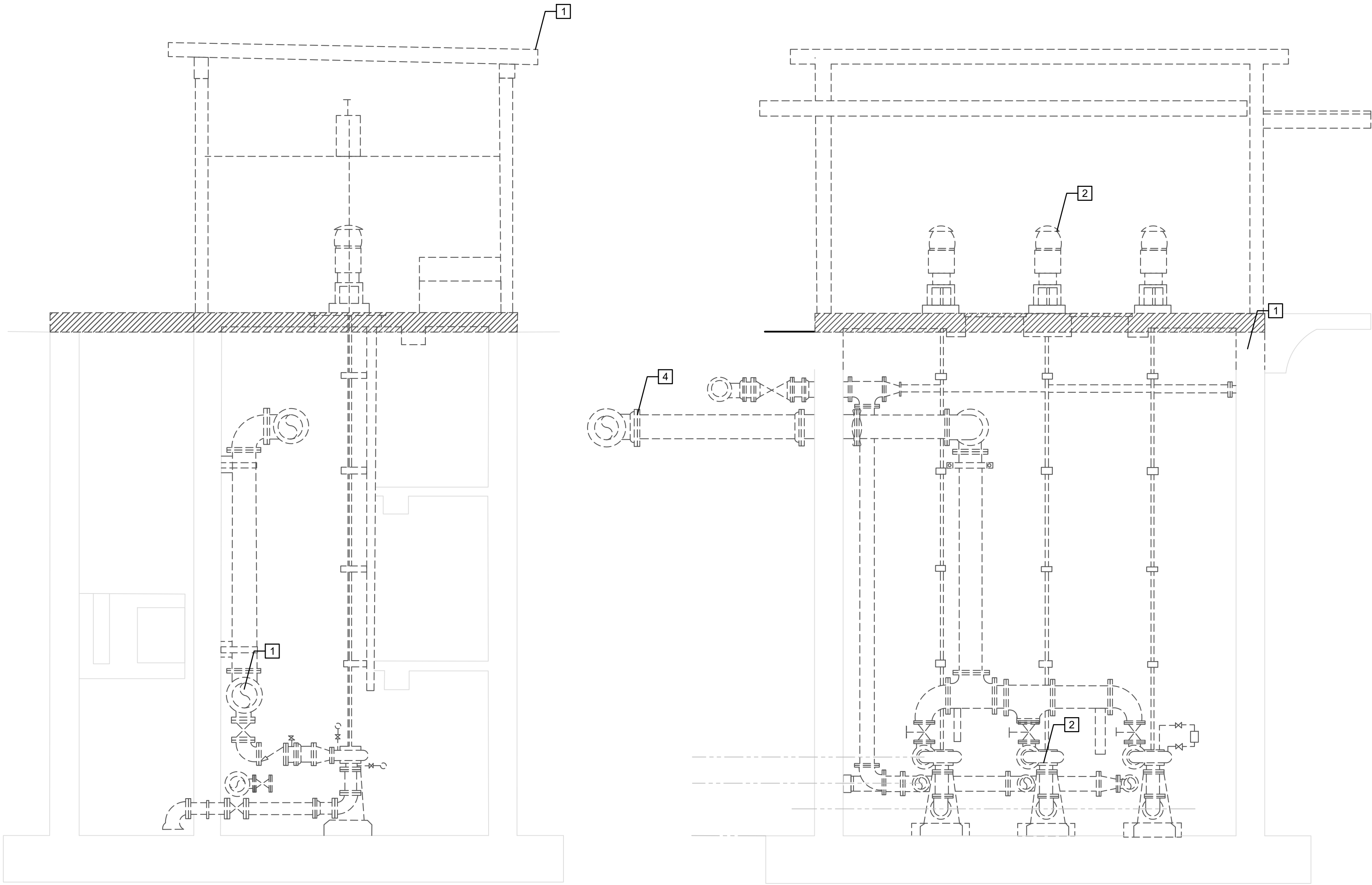
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INFLUENT PUMP
STATION - PLANS

X-101

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A SECTION
X-102 SCALE: 1/4" = 1'-0"

B SECTION
X-102 SCALE: 1/4" = 1'-0"

KEY NOTES: #

1. REMOVE: CONCRETE STRUCTURE
2. REMOVE & SALVAGE: EQUIPMENT
3. REMOVE & SALVAGE: PIPE ACCESSORIES
4. REMOVE & SALVAGE: PIPING & FITTINGS
5. REMOVE & SALVAGE: MISCELLANEOUS METALS

NOTES:

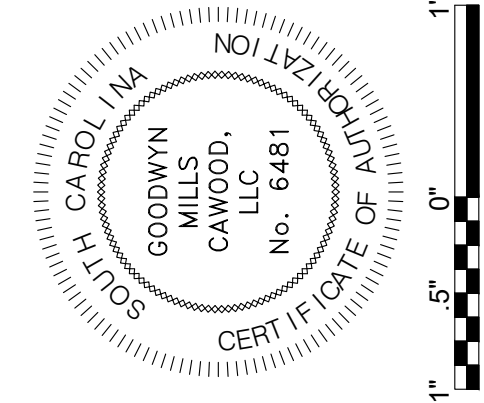
1. CONCRETE: STRUCTURE PARTIALLY TO 3 FT BELOW TOP OF WETWELL SO THE FINISHED STRUCTURE SITS FLUSH TO GRADE

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INFLUENT PUMP
STATION - SECTIONS

X-102



ISSUE	DATE
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Drawn By:	HKD

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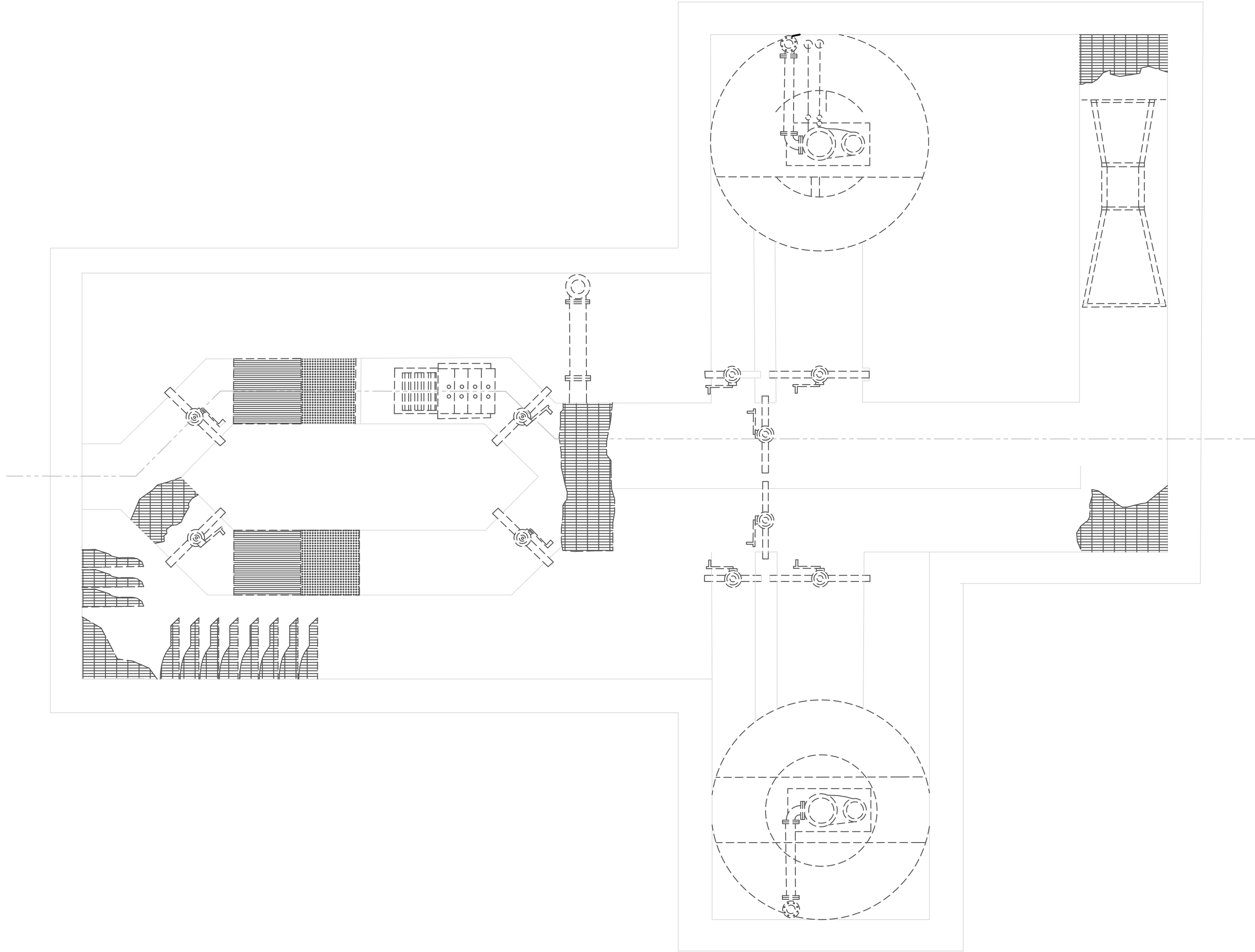
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4

X-001

PLAN

SCALE: NTS



- KEY NOTES:** #
1. REMOVE: GRATING
 2. REMOVE & SALVAGE: EQUIPMENT
 3. REMOVE & SALVAGE: PIPE ACCESSORIES
 4. REMOVE & SALVAGE: PIPING & FITTINGS
 5. REMOVE & SALVAGE: MISCELLANEOUS METALS

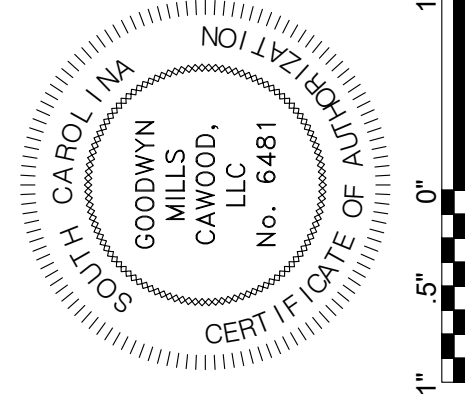
**HEADWORKS
STATION - PLANS**

X-111

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REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
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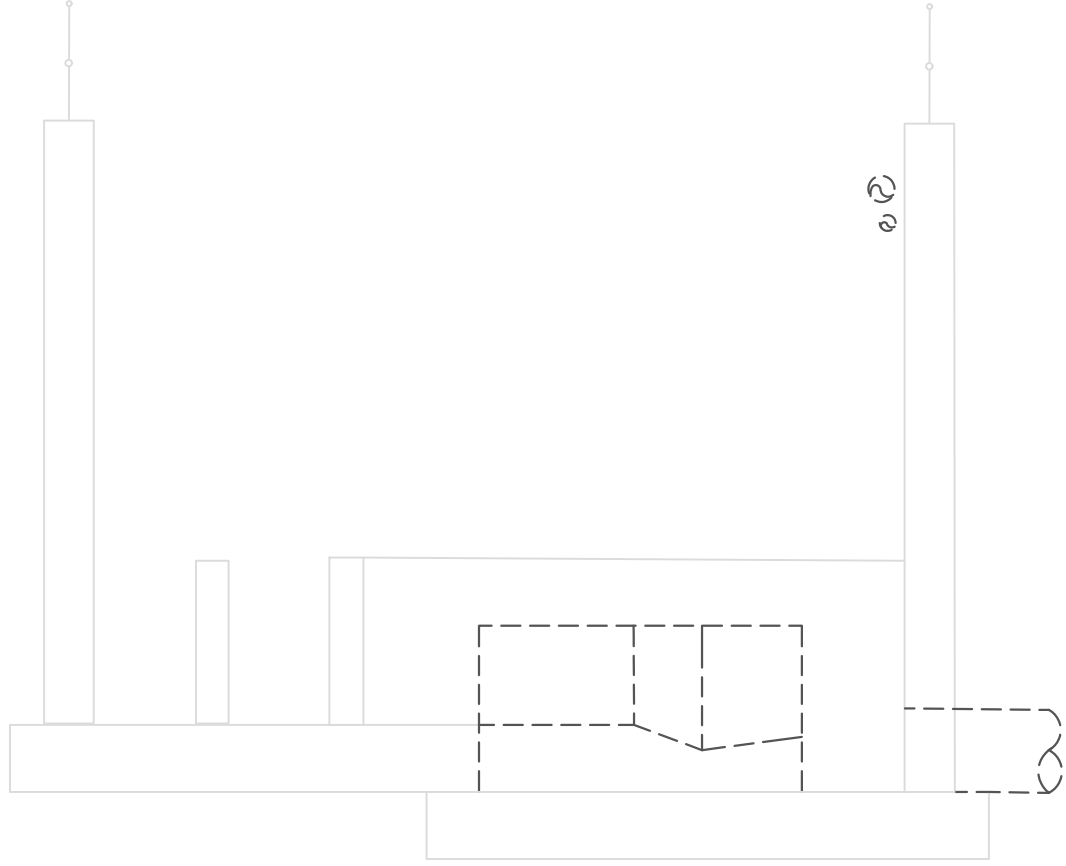
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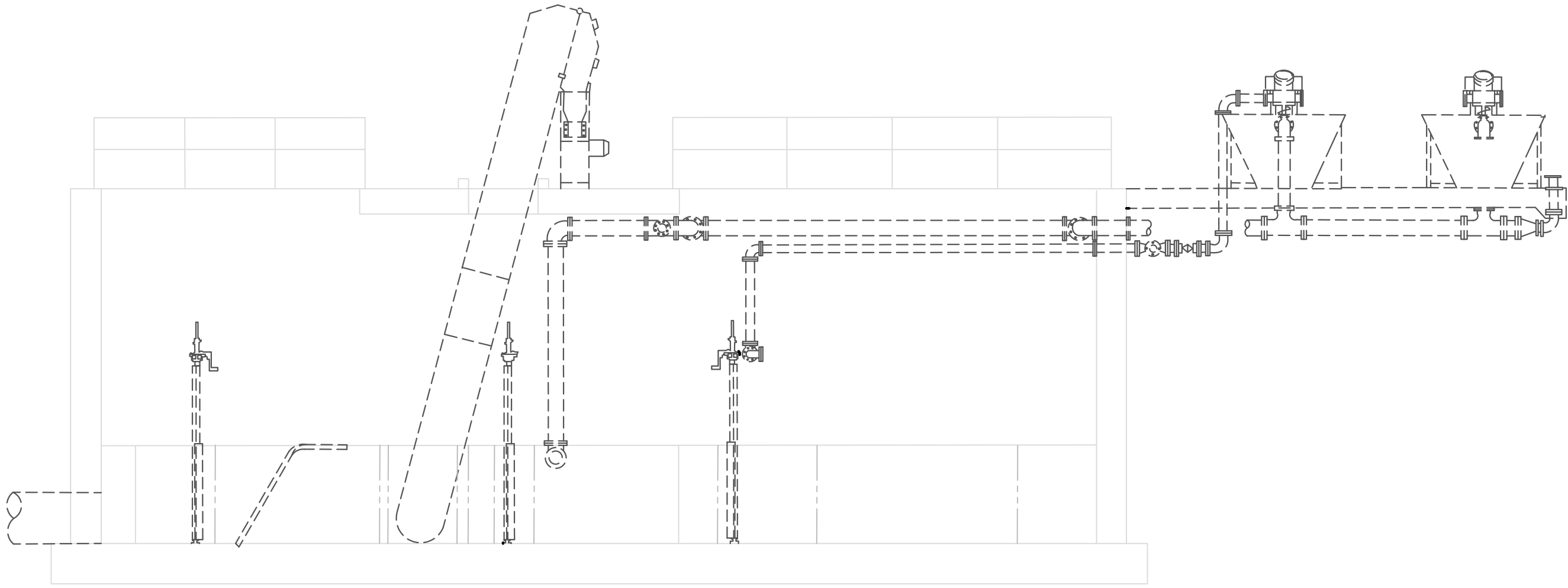


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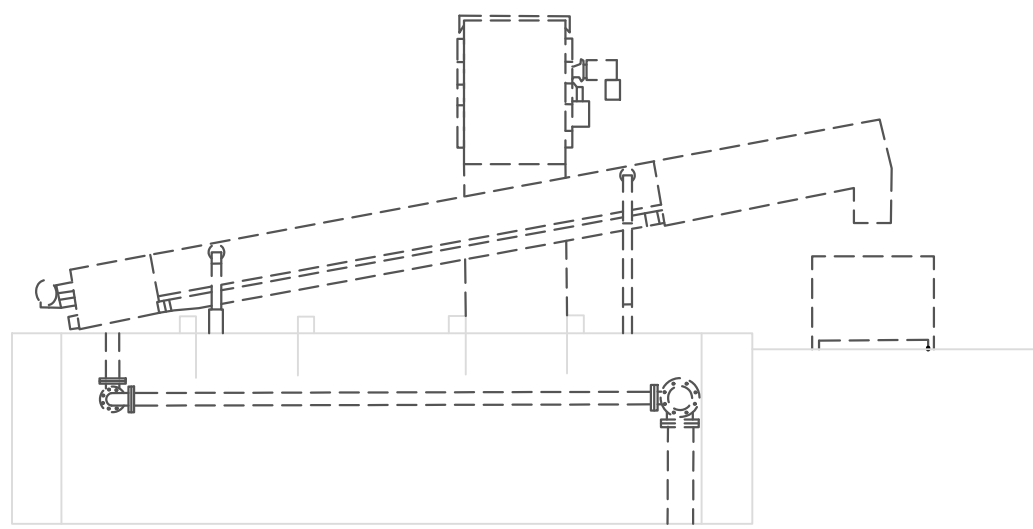
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A SECTION
X-112 SCALE: 1/4" = 1'-0"



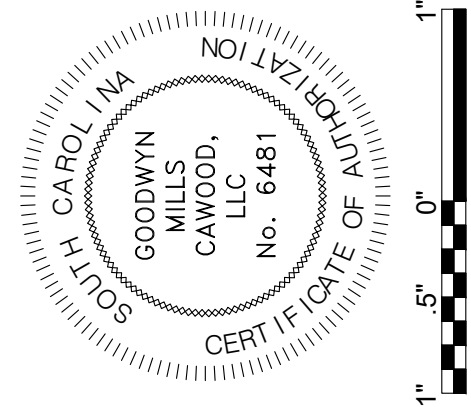
C SECTION
X-112 SCALE: 1/4" = 1'-0"



B SECTION
X-112 SCALE: 1/4" = 1'-0"

KEY NOTES: #

1. REMOVE: CONCRETE STRUCTURE
2. REMOVE & SALVAGE: EQUIPMENT
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HEADWORKS
STATION - SECTIONS

X-112

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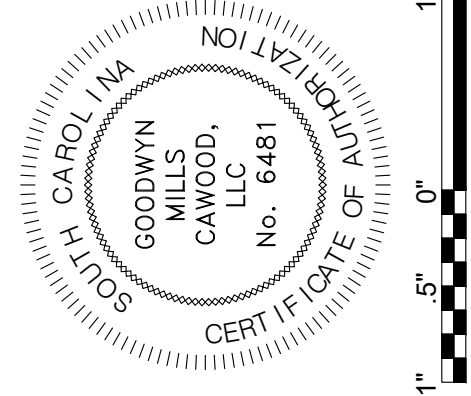
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PLOTTED: Mar 11, 2024 - 4:35pm

3
X-001
PLAN
SCALE: NOT TO SCALE

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KEY NOTES: #

1. REMOVE: POLY BASIN LINER



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Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

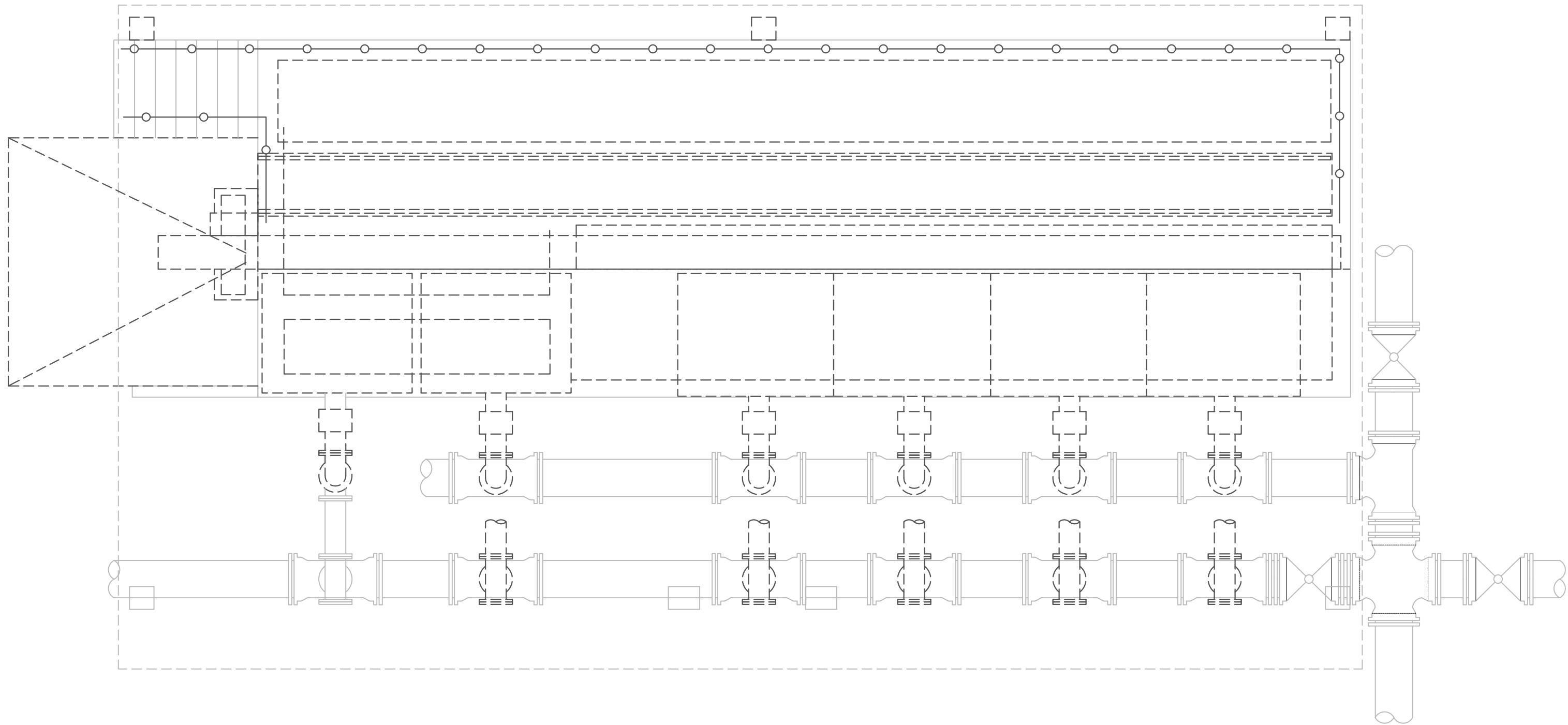
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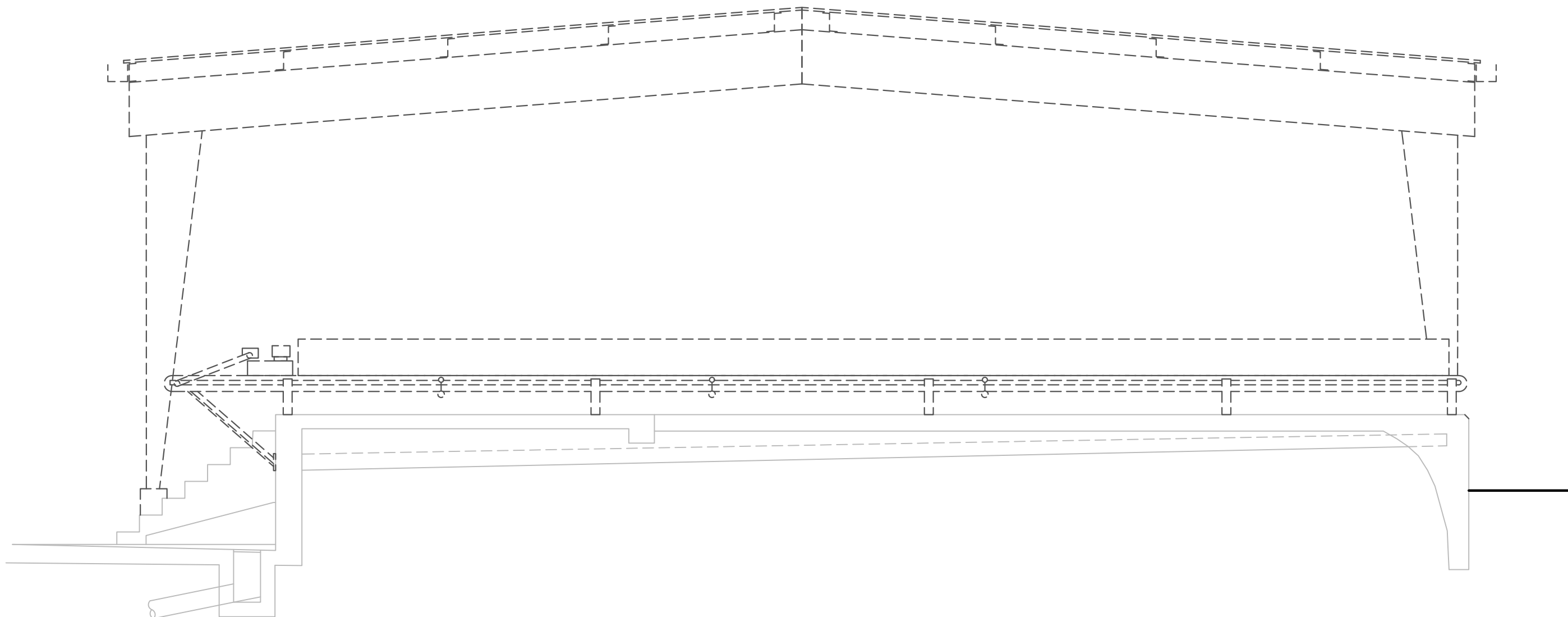
DEMOLITION
EQUALIZATION
BASIN - PLAN
X-121

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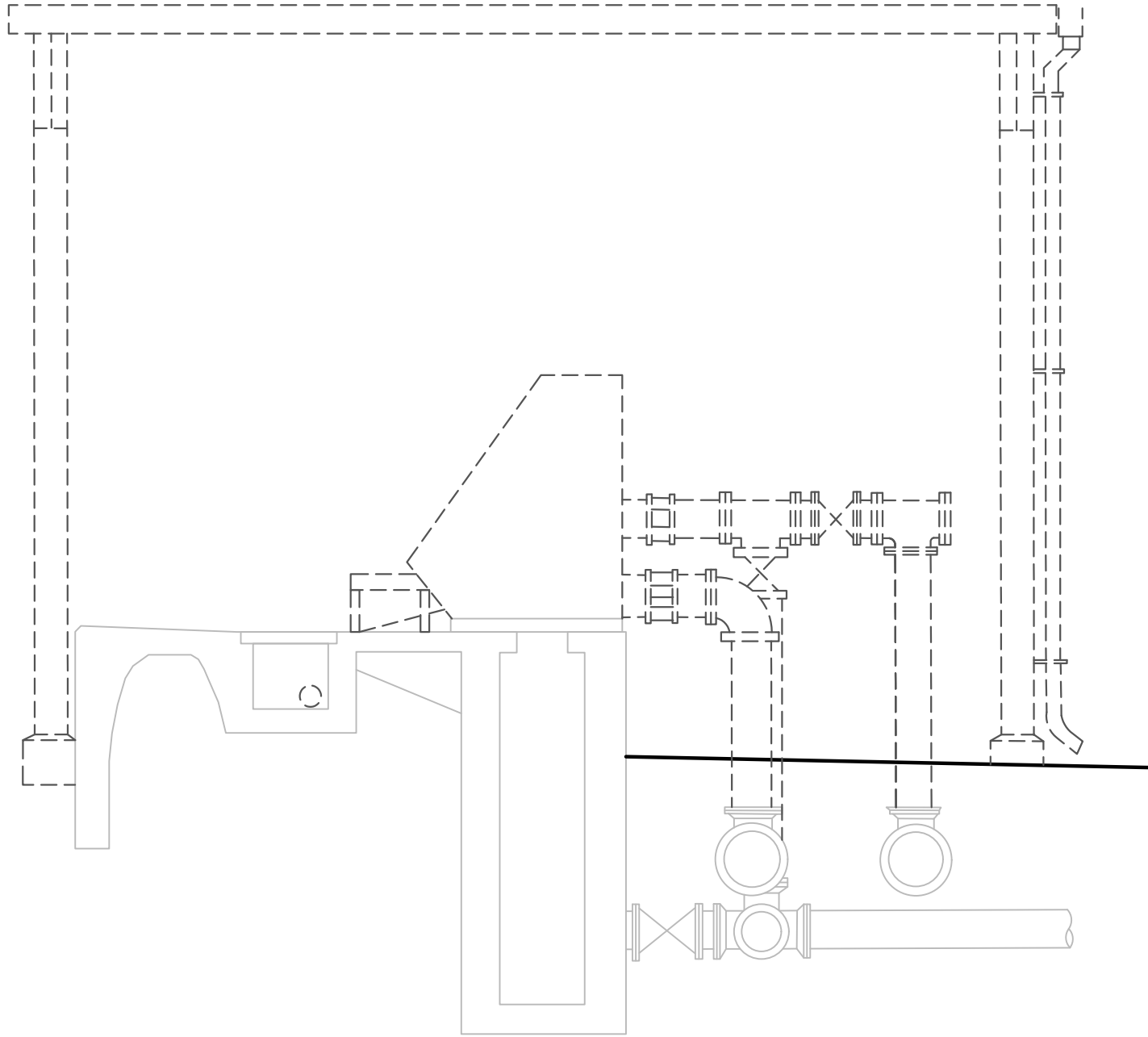
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4 PLAN
X-001 SCALE: 1/4" = 1'-0"



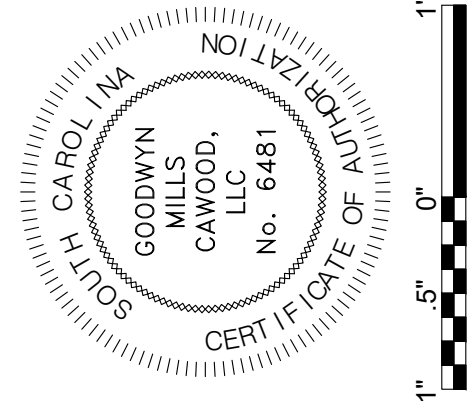
A SECTION
X-121 SCALE: 1/4" = 1'-0"



B SECTION
X-121 SCALE: 1/4" = 1'-0"

KEY NOTES: #

1. REMOVE & SALVAGE: EQUIPMENT
2. REMOVE & SALVAGE: PIPE ACCESSORIES ABOVE GROUND
3. REMOVE & SALVAGE: PIPING & FITTINGS ABOVE GROUND
4. REMOVE & SALVAGE: MISCELLANEOUS METALS



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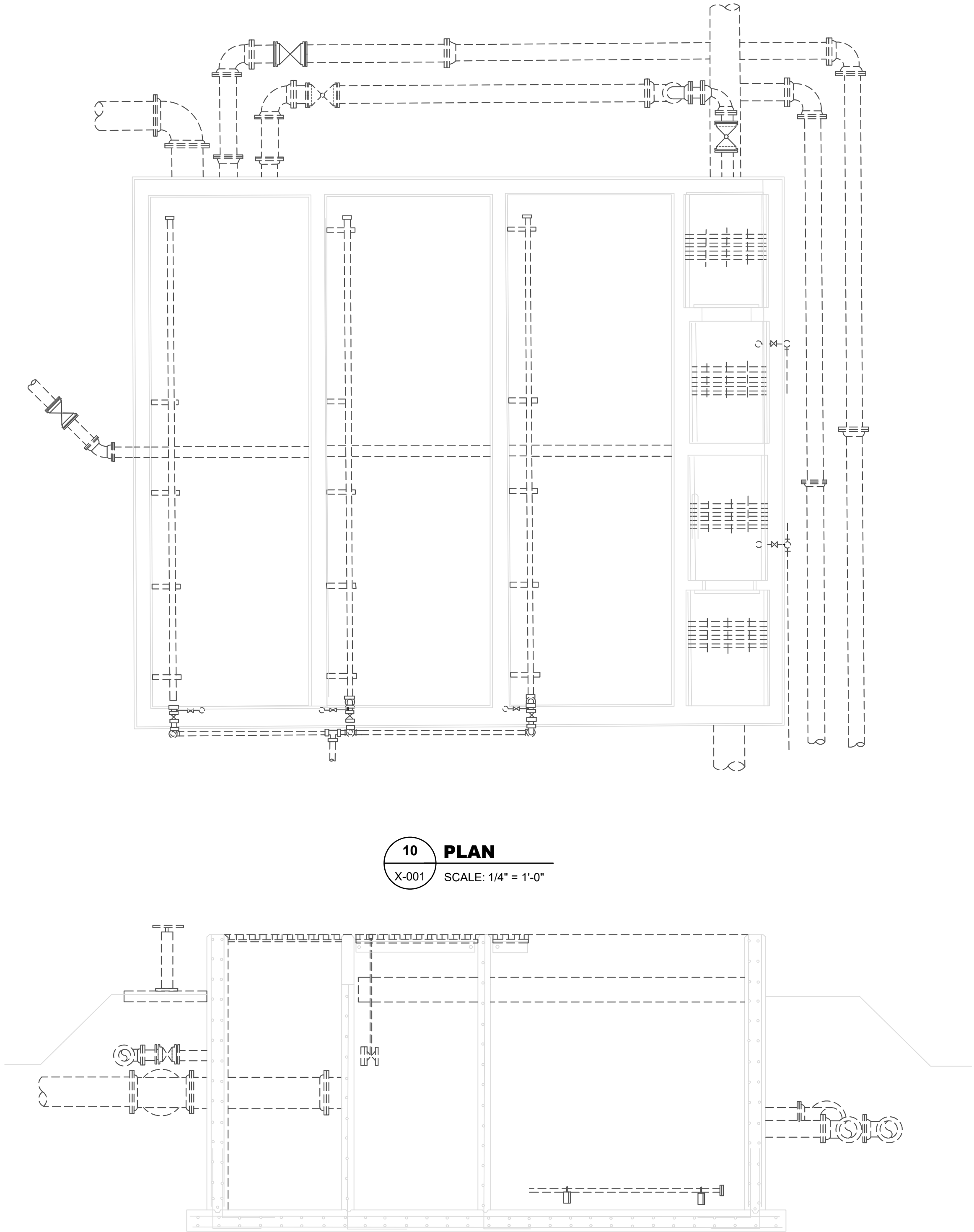
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STATIONARY
SCREENS
PLAN & SECTIONS

X-131

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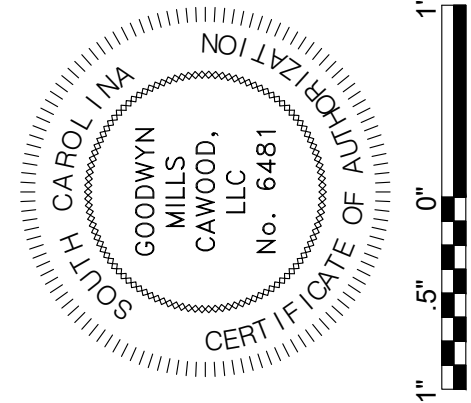


10 PLAN
X-001 SCALE: 1/4" = 1'-0"

A SECTION
X-301 SCALE: 1/4" = 1'-0"

KEY NOTES: #

1. REMOVE: CONCRETE STRUCTURE
2. REMOVE & SALVAGE: EQUIPMENT
3. REMOVE & SALVAGE: PIPE ACCESSORIES
4. REMOVE & SALVAGE: PIPING & FITTINGS
5. REMOVE & SALVAGE: MISCELLANEOUS METALS



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Designer:	JX
Drawn By:	HKD

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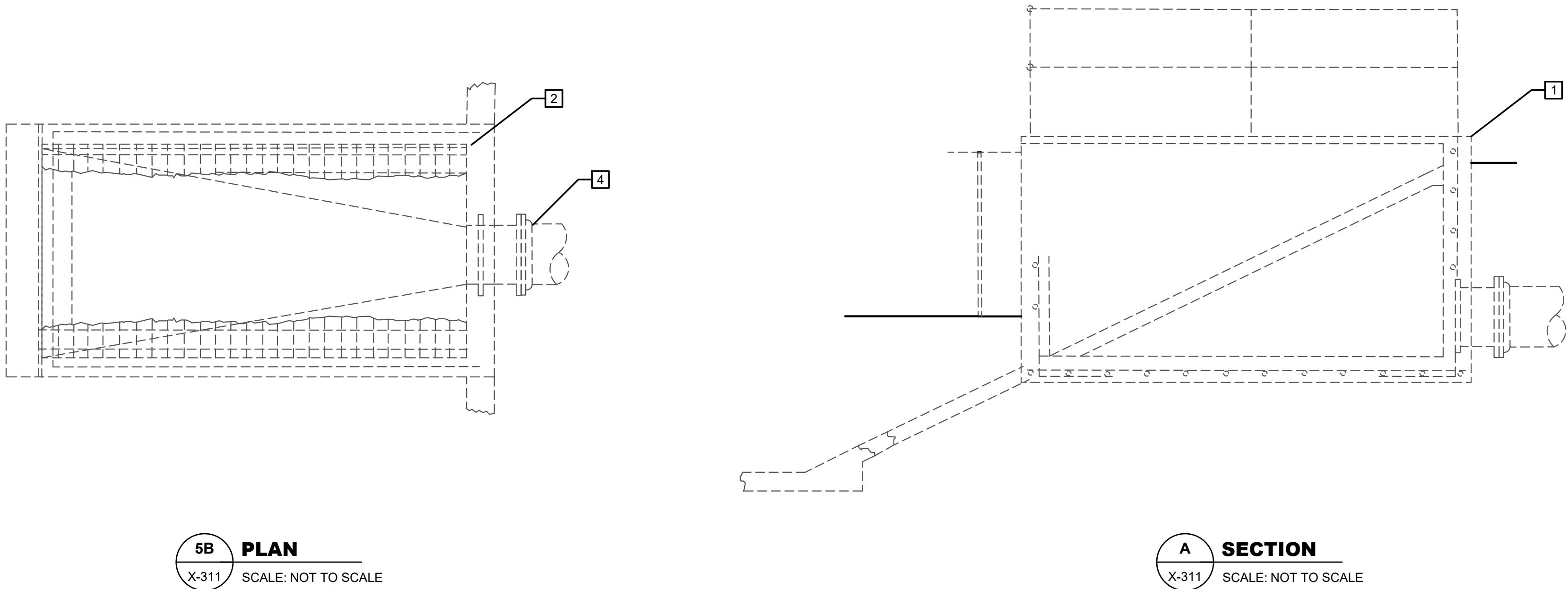
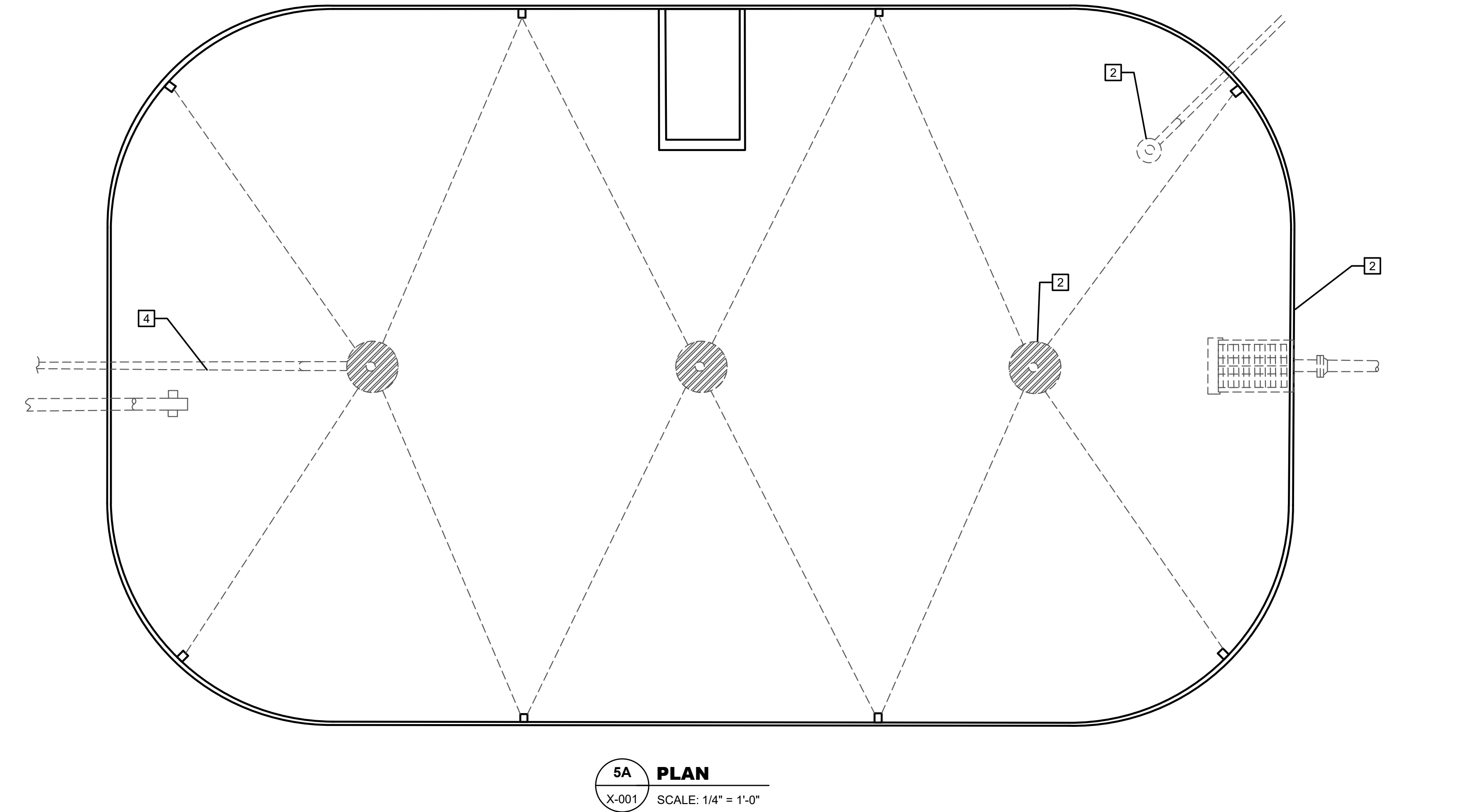
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ANOXIC MIXING BASIN
PLAN & SECTION

X-301

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PLOTTED: Mar 11, 2024 - 4:35pm



KEY NOTES: #

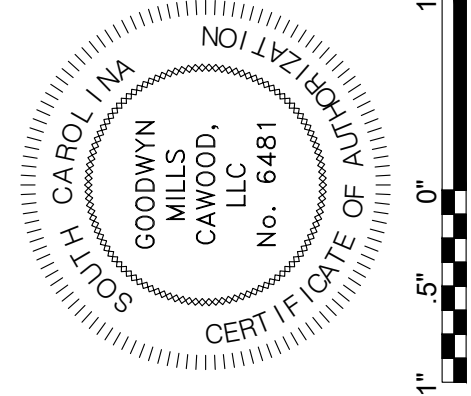
1. REMOVE: CONCRETE STRUCTURE
2. REMOVE & SALVAGE: EQUIPMENT
3. REMOVE & SALVAGE: PIPE ACCESSORIES
4. REMOVE & SALVAGE: PIPING & FITTINGS
5. REMOVE & SALVAGE: MISCELLANEOUS METALS

**AERATION BASIN
PLAN & SECTIONS**

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X-311

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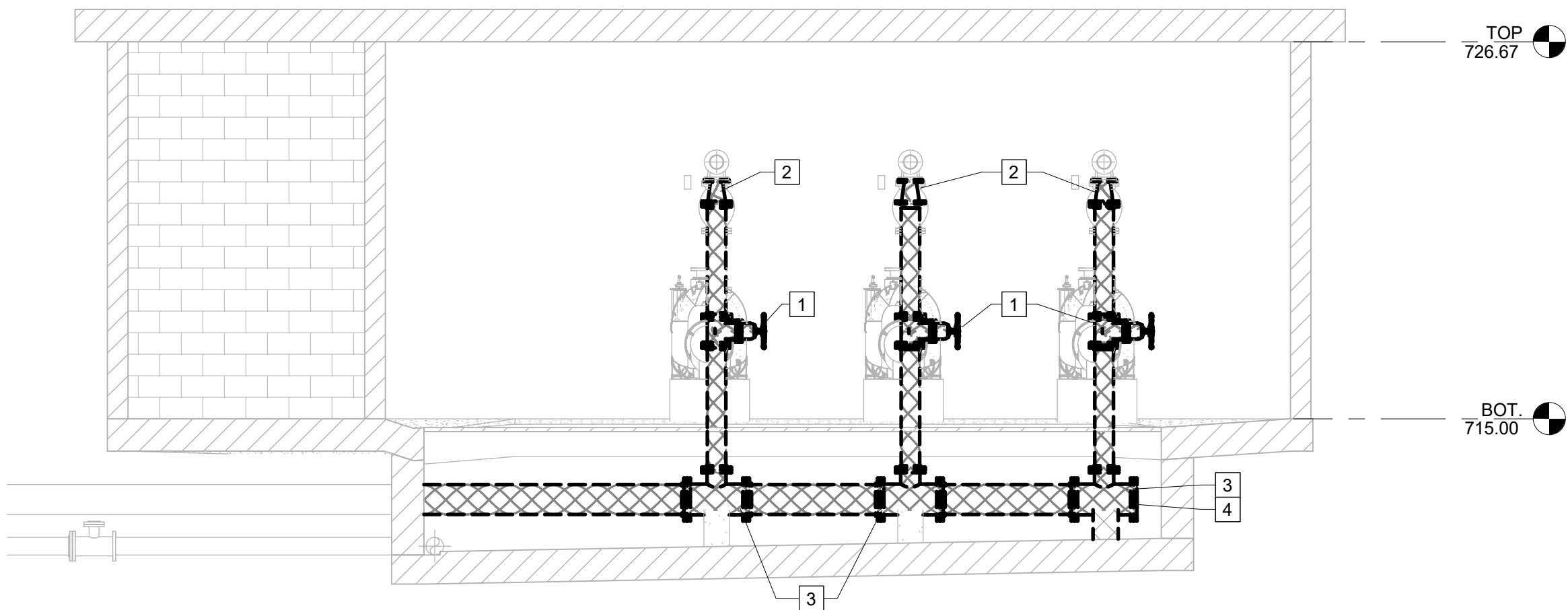
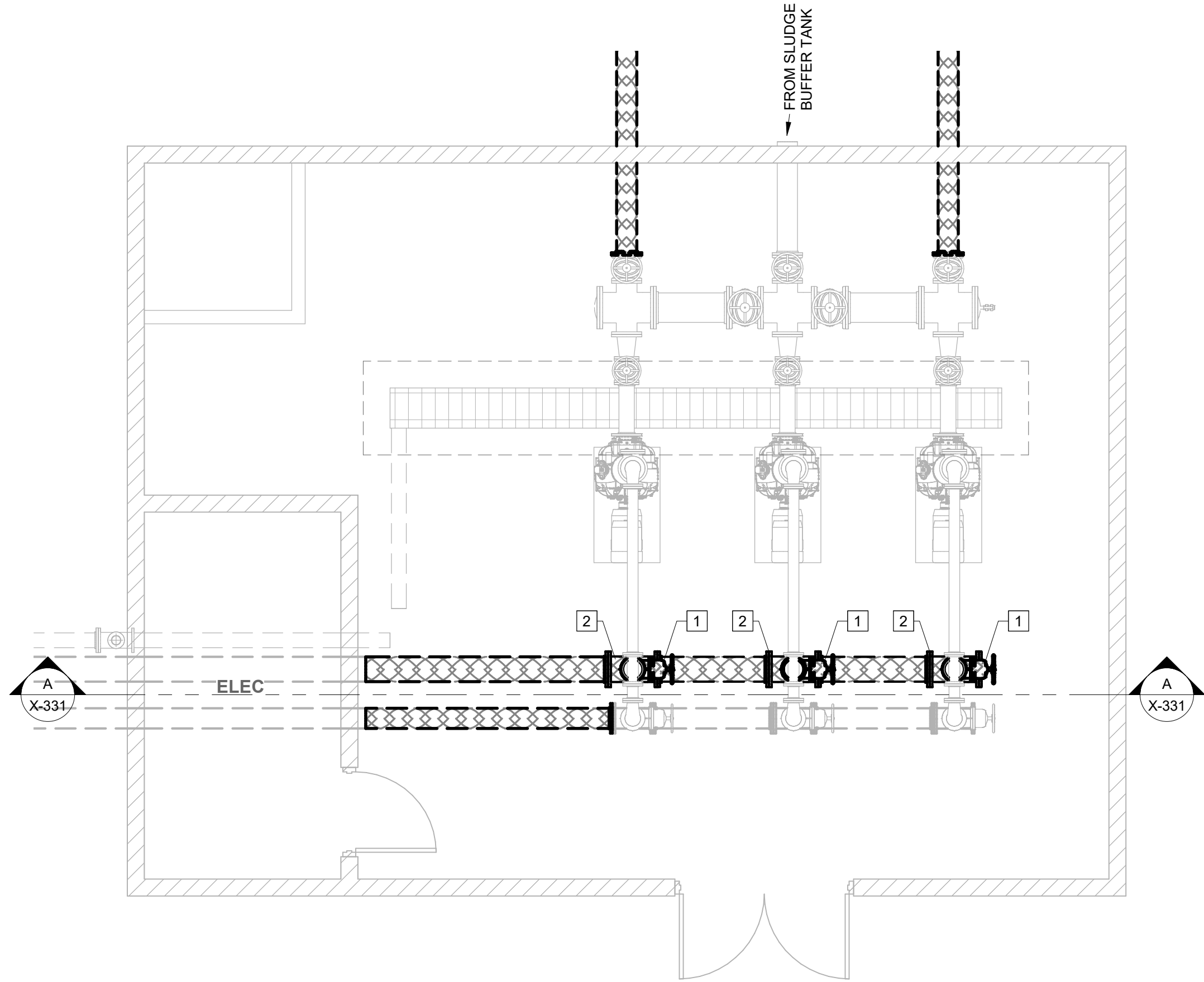


4E

PLAN

X-331

SCALE: 1/4" = 1'-0"



A

SECTION

E-441

SCALE: 1/4" = 1'-0"

KEY NOTES: #

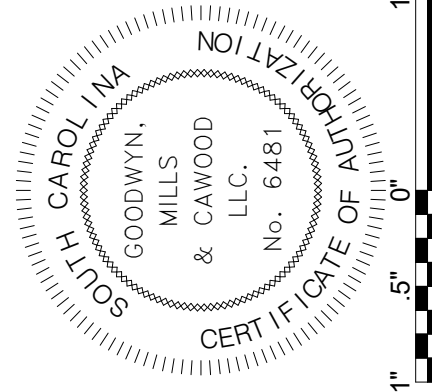
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2. REMOVE & SALVAGE: 10" X 6" TEE
3. REMOVE & SALVAGE: 4" X 6" REDUCER
4. REMOVE & SALVAGE: 10" FL BLIND

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RAS/WAS PUMP
BUILDING - PLAN &
SECTION

X-331

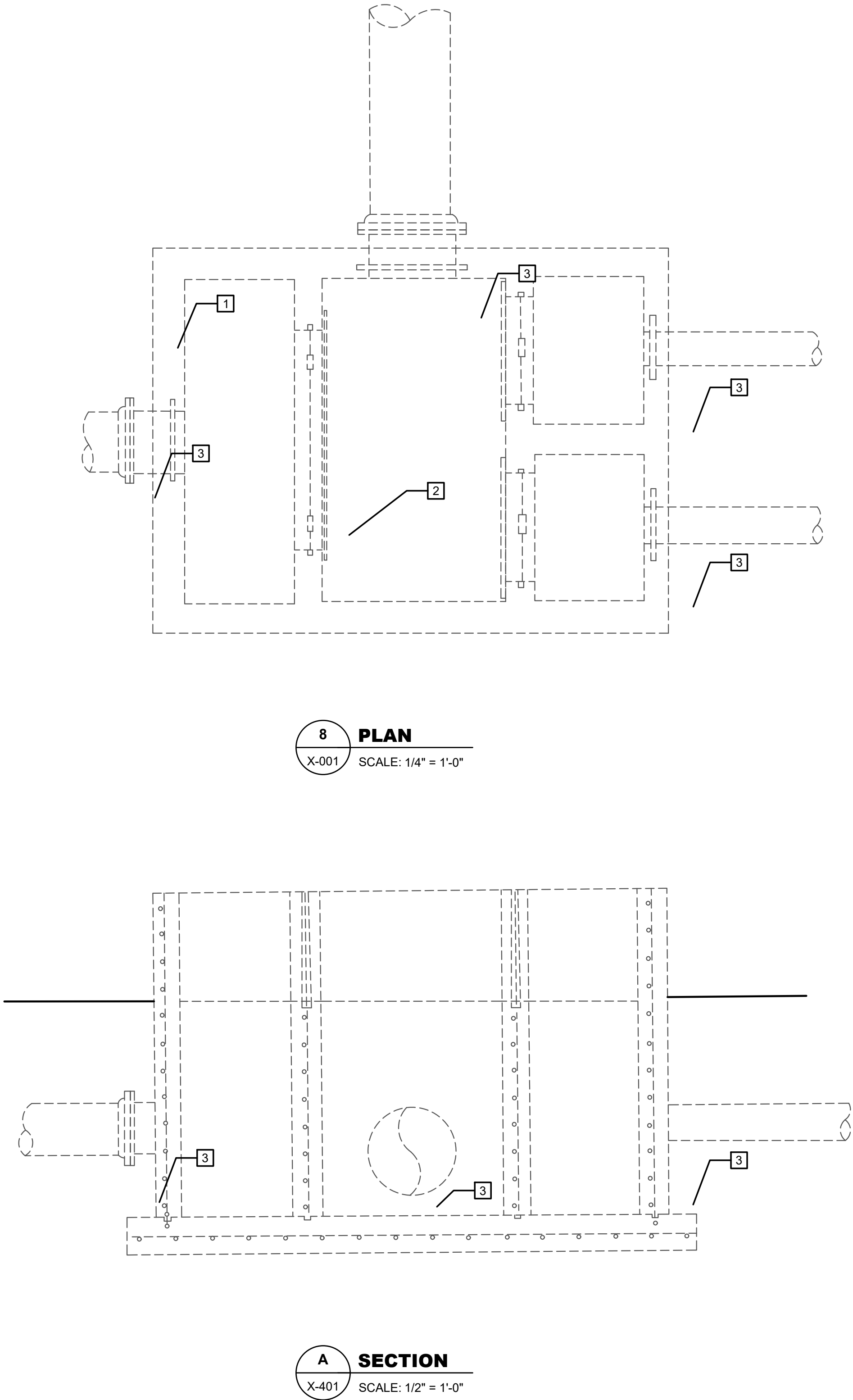


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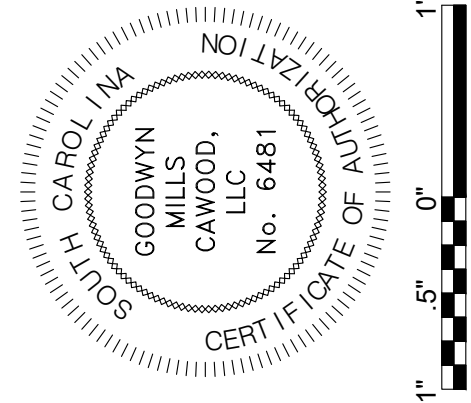
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PLOTTED: Mar 11, 2024 - 4:36pm



KEY NOTES: #

1. REMOVE: CONCRETE STRUCTURE
2. REMOVE & SALVAGE: EQUIPMENT
3. REMOVE & SALVAGE: PIPE ACCESSORIES
4. REMOVE & SALVAGE: PIPING & FITTINGS
5. REMOVE & SALVAGE: MISCELLANEOUS METALS



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Drawn By:	HKD

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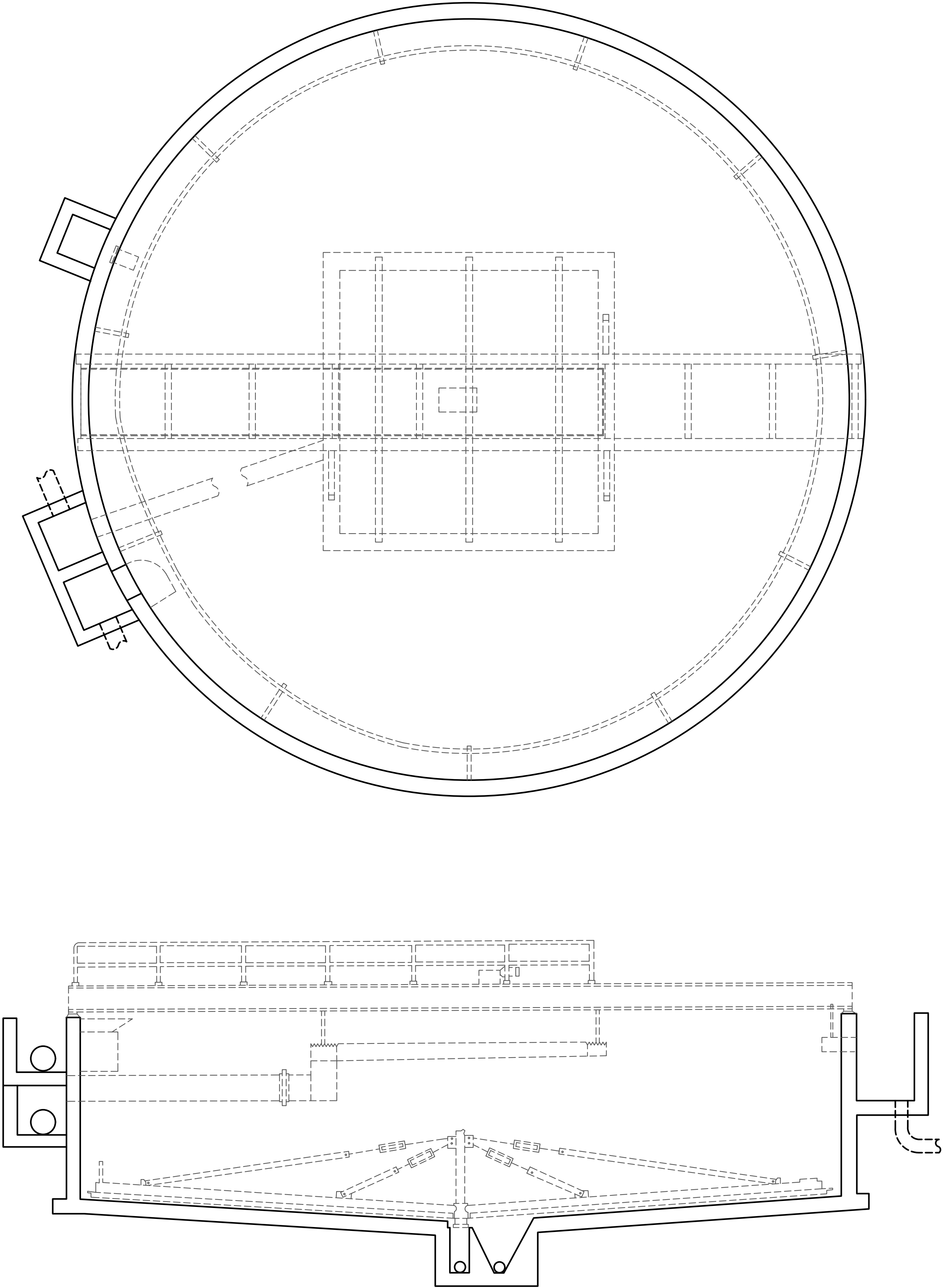
CLARIFIER
DISTRIBUTION BOX
PLAN & SECTION

X-401

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DRAWING FILE: T:\1 Projects\SC\Pendleton, Town of\CGRE220027 - Pendleton-Clemson WWTP\01.DWG+CAD\01 BID DRAWINGS\05 DEMOLITION\X-411.dwg
PLOTTED: Mar 11, 2024 - 4:36pm

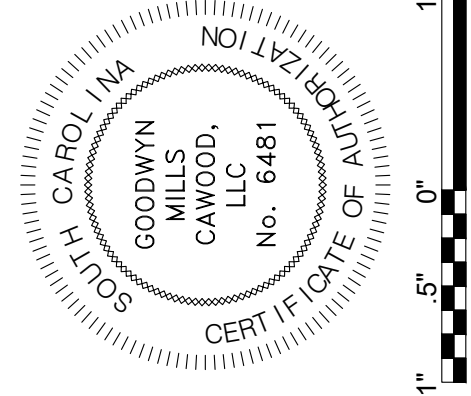
9 PLAN
X-001 SCALE: 1/4" = 1'-0"



A SECTION
X-411 SCALE: 1/4" = 1'-0"

KEY NOTES: #

1. REMOVE & SALVAGE: MECHANICAL INTERNALS
2. REMOVE & SALVAGE: WALKWAY



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Designer:	JX
Drawn By:	HKD

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CLARIFIER NO.1 AND 2
PLAN & SECTION

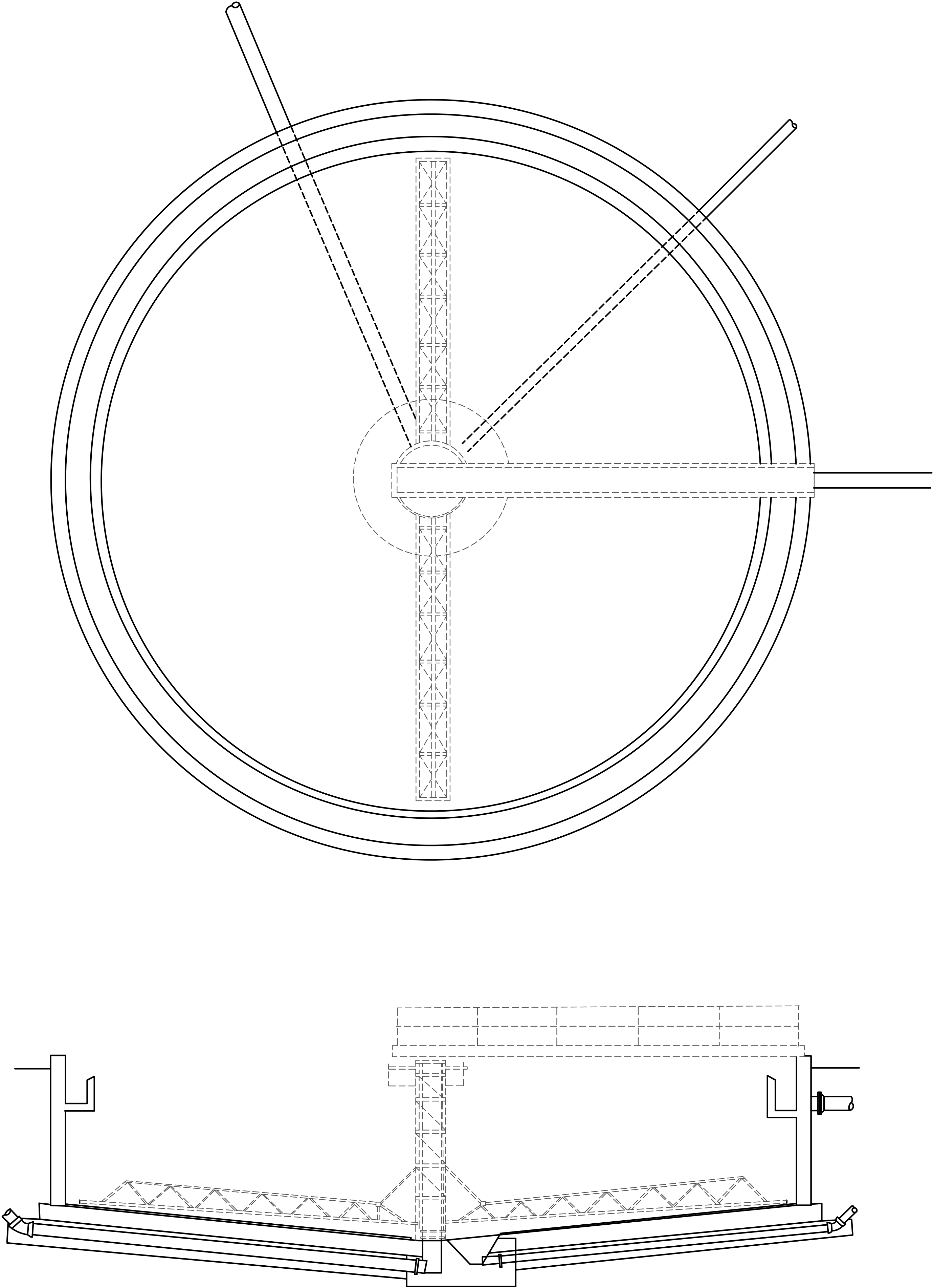
X-411

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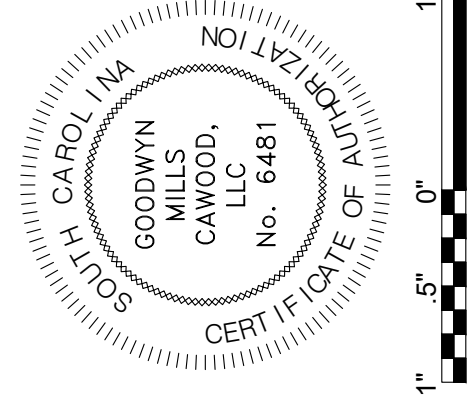
9 PLAN
X-001 SCALE: 3/16" = 1'-0"

A SECTION
X-411 SCALE: 3/16" = 1'-0"



KEY NOTES: #

1. REMOVE & SALVAGE: MECHANICAL INTERNALS
2. REMOVE & SALVAGE: WALKWAY



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Drawn By:	HKD

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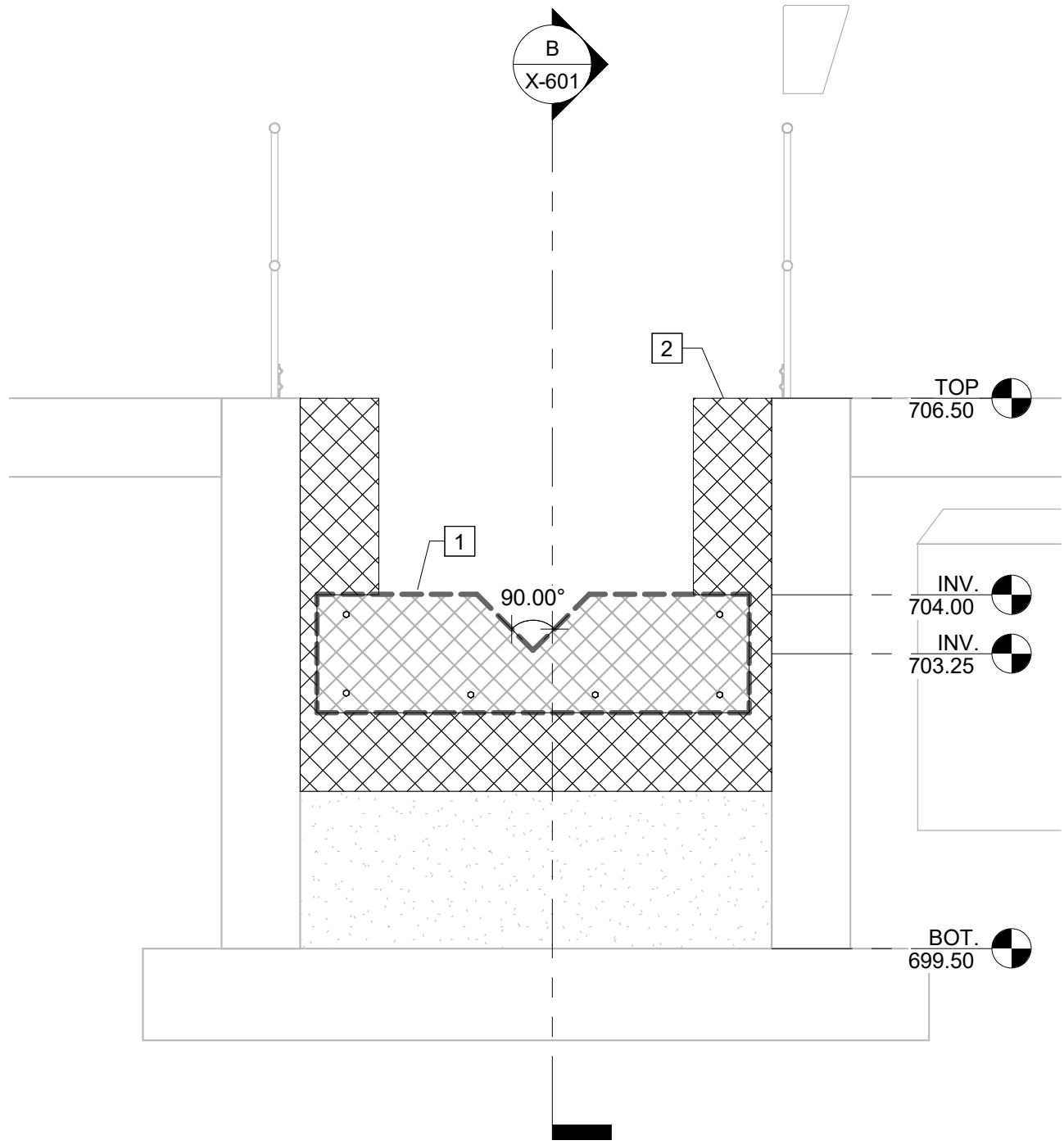
GMC PROJECT #CGRE220027

CLARIFIER NO.3
PLAN & SECTION

X-412

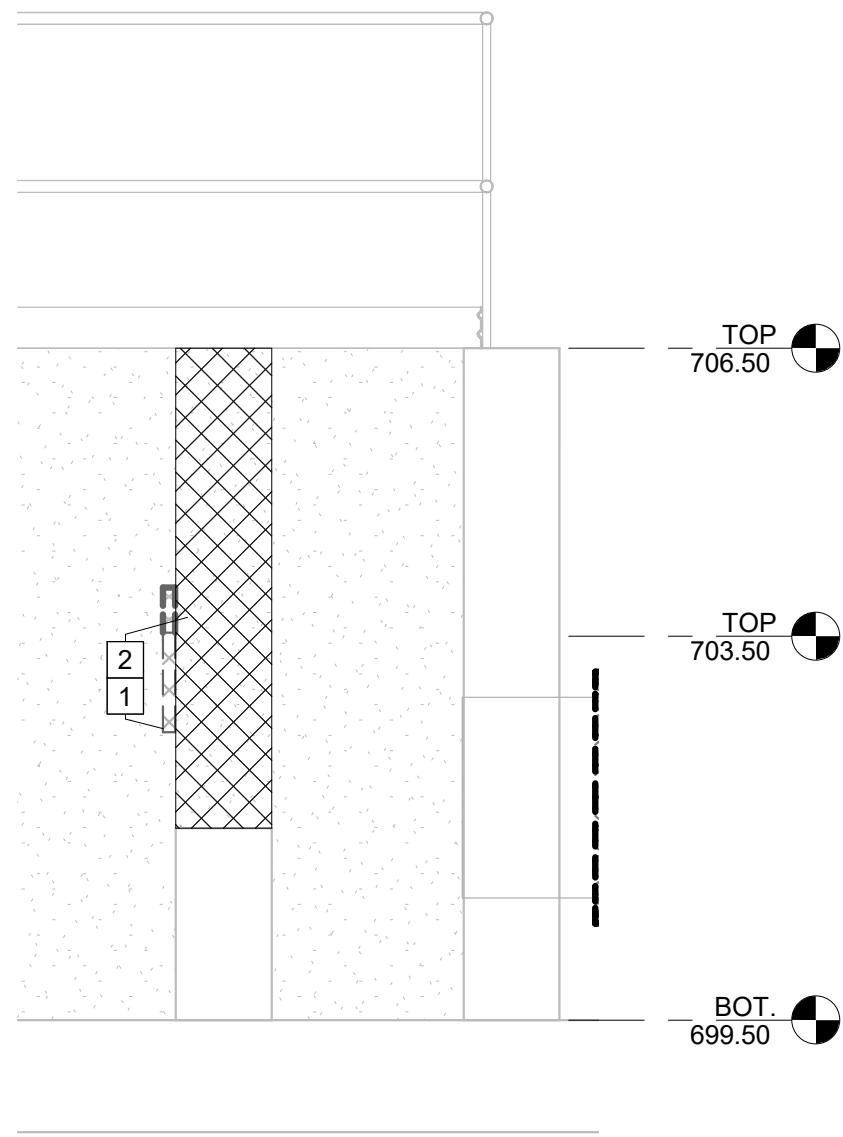
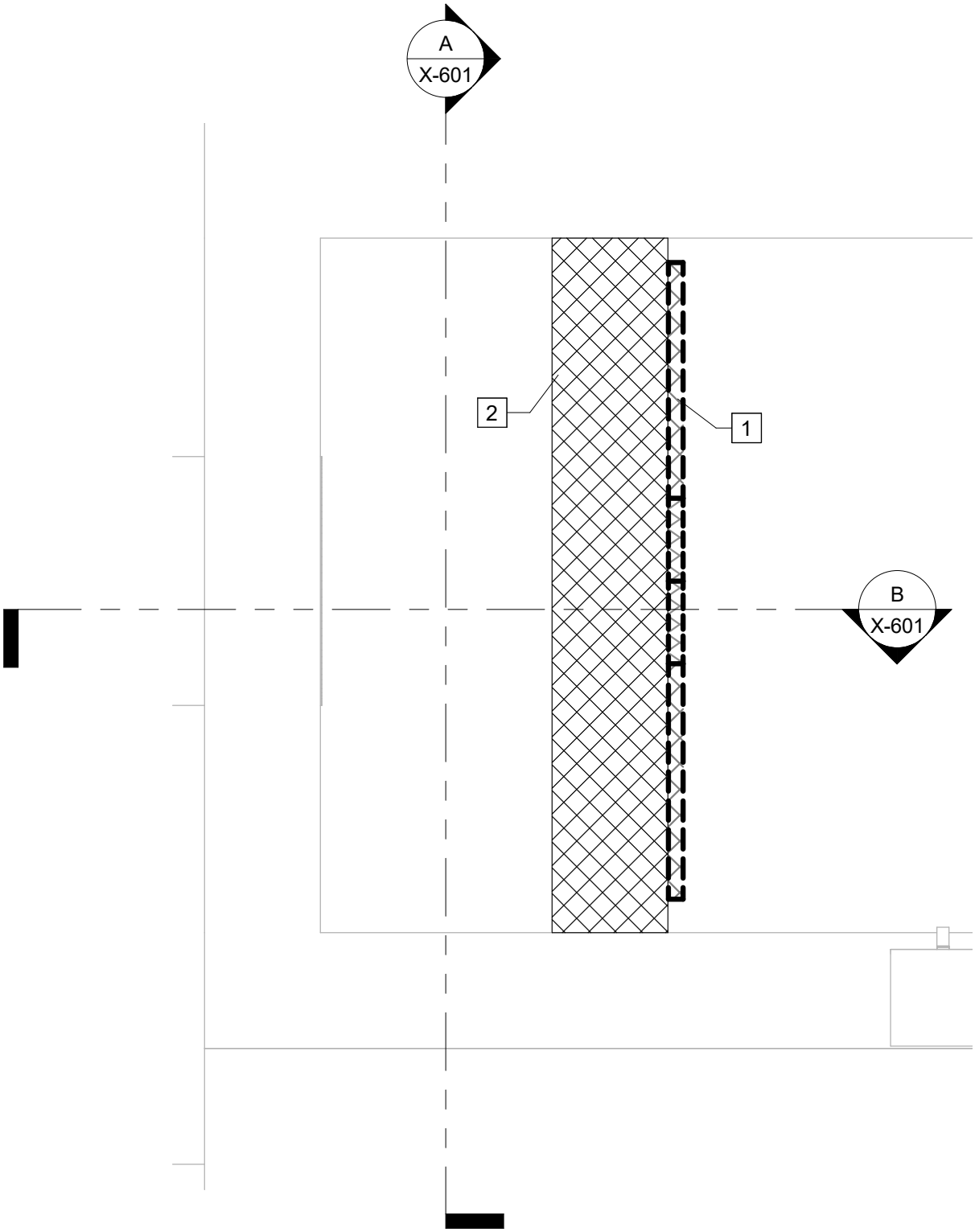
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A SECTION
X-601 SCALE: 1/2" = 1'-0"

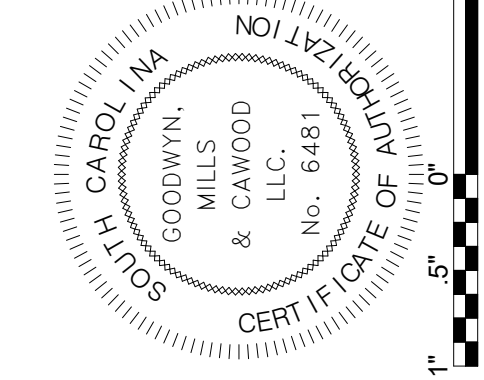
6A PLAN
X-601 SCALE: 3/4" = 1'-0"



B SECTION
X-601 SCALE: 1/2" = 1'-0"

KEY NOTES: #

1. REMOVE: 1/4" MIN. SST PLATE
2. REMOVE: CONCRETE



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**DEMOLITION WEIR
GATE**

X-601

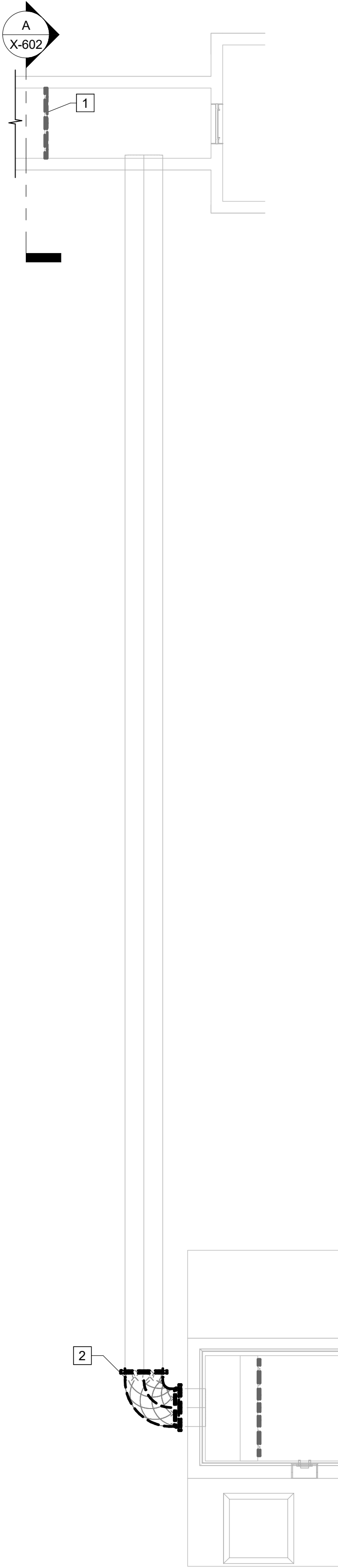
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5B

X-602

PLAN

SCALE: 3/16" = 1'-0"

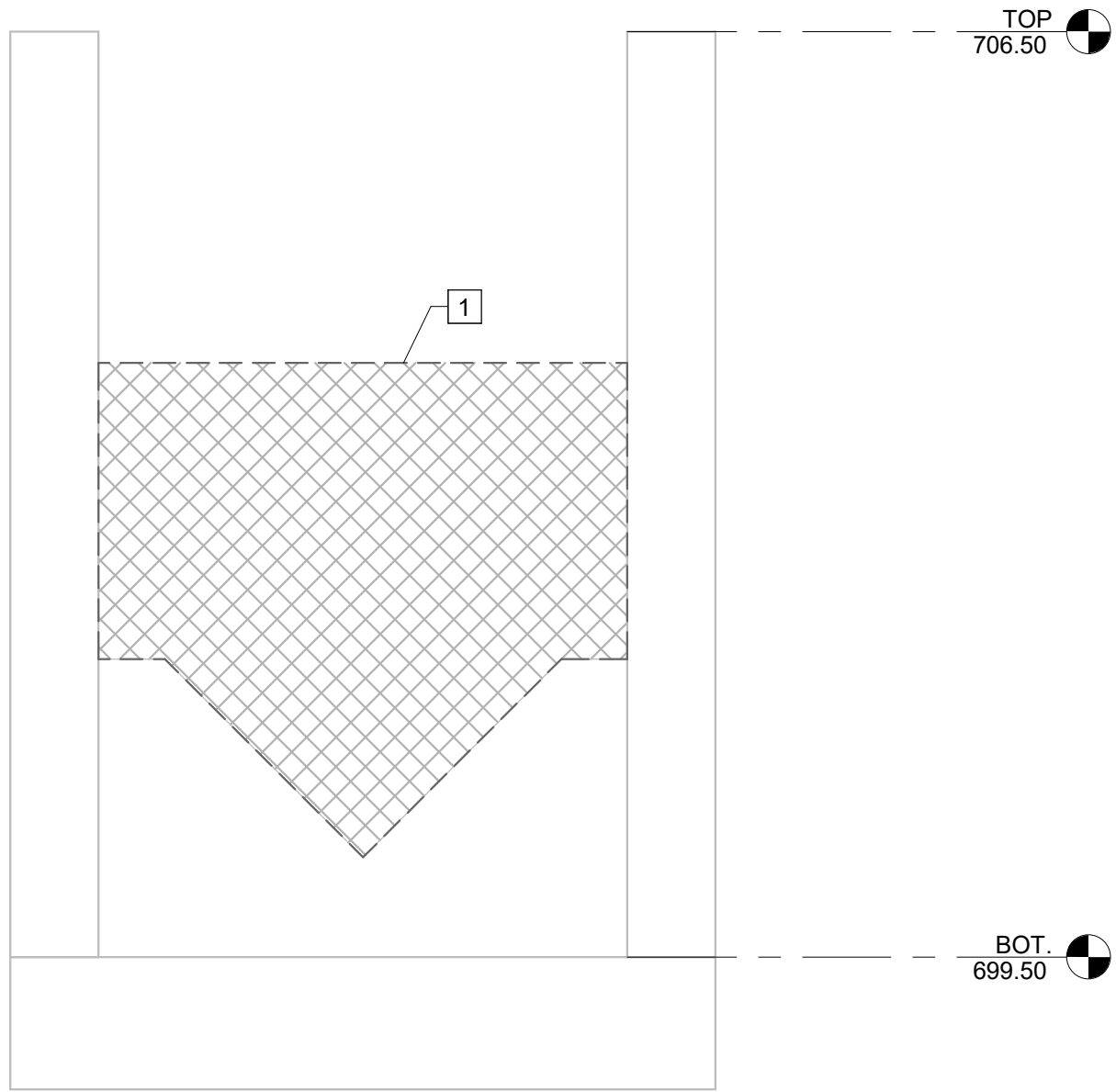


A

X-602

SECTION

SCALE: 3/4" = 1'-0"



KEY NOTES: #

1. REMOVE & REUSE: EXISTING BAFFLE WALL
2. REMOVE: PIPE FITTING

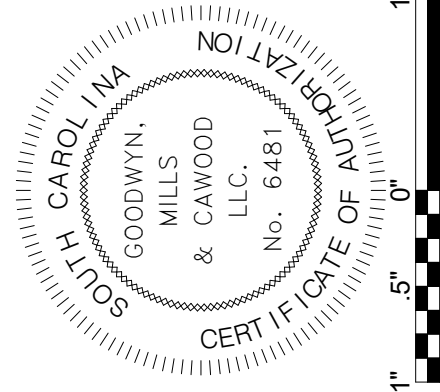
AERATION BASIN
CASCADE PLAN &
SECTION

X-602

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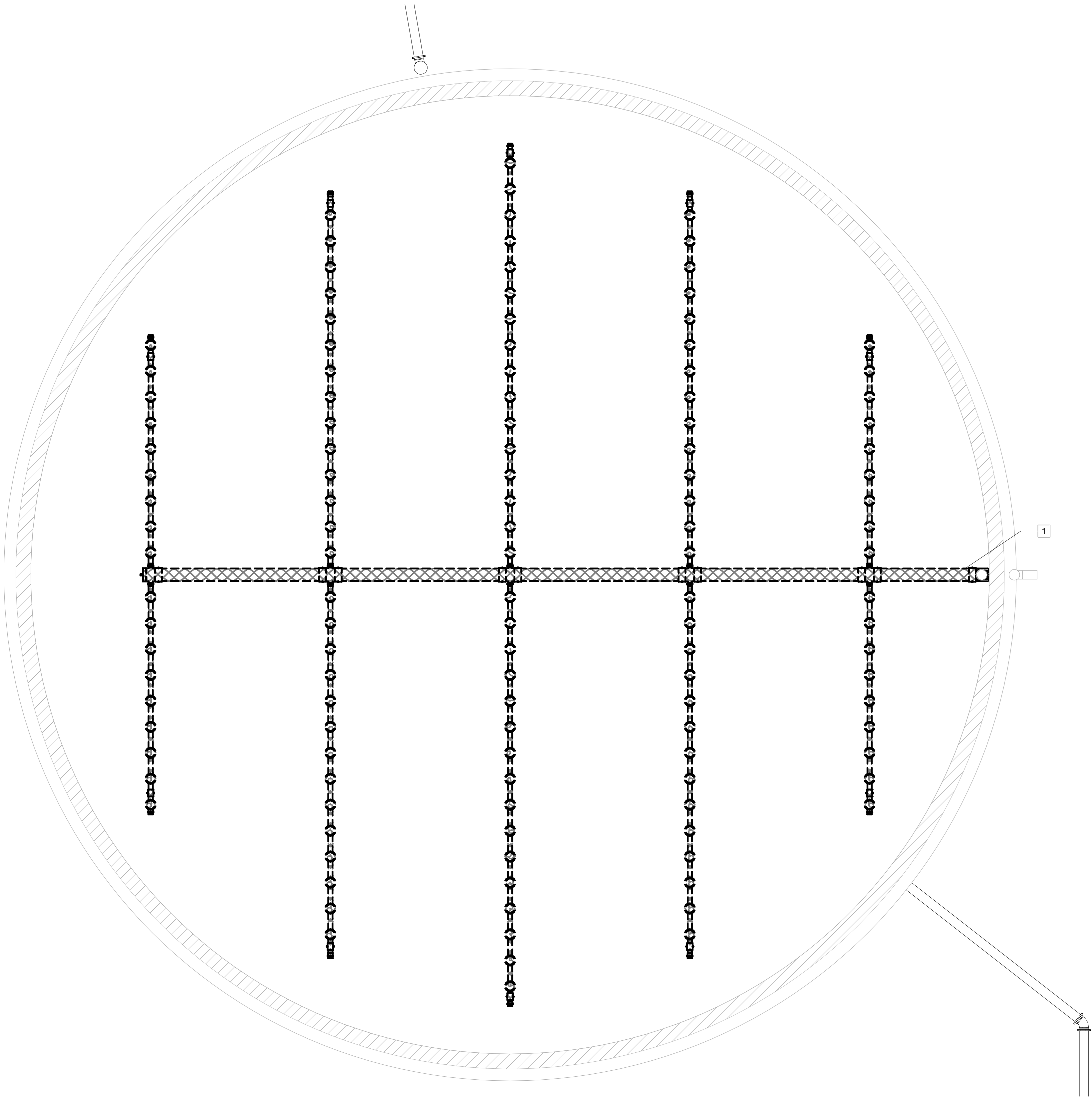
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KEY NOTES: #

1. REMOVE & SALVAGE: AIR PIPING AND DIFFUSERS

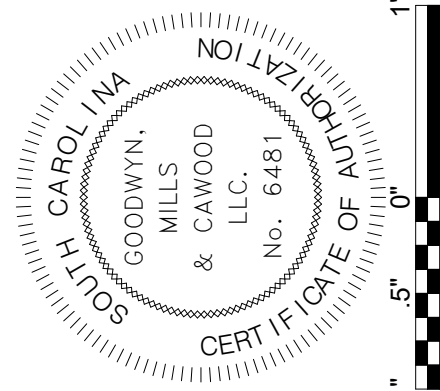
AEROBIC DIGESTER
DEMOLITION - PLAN

X-701

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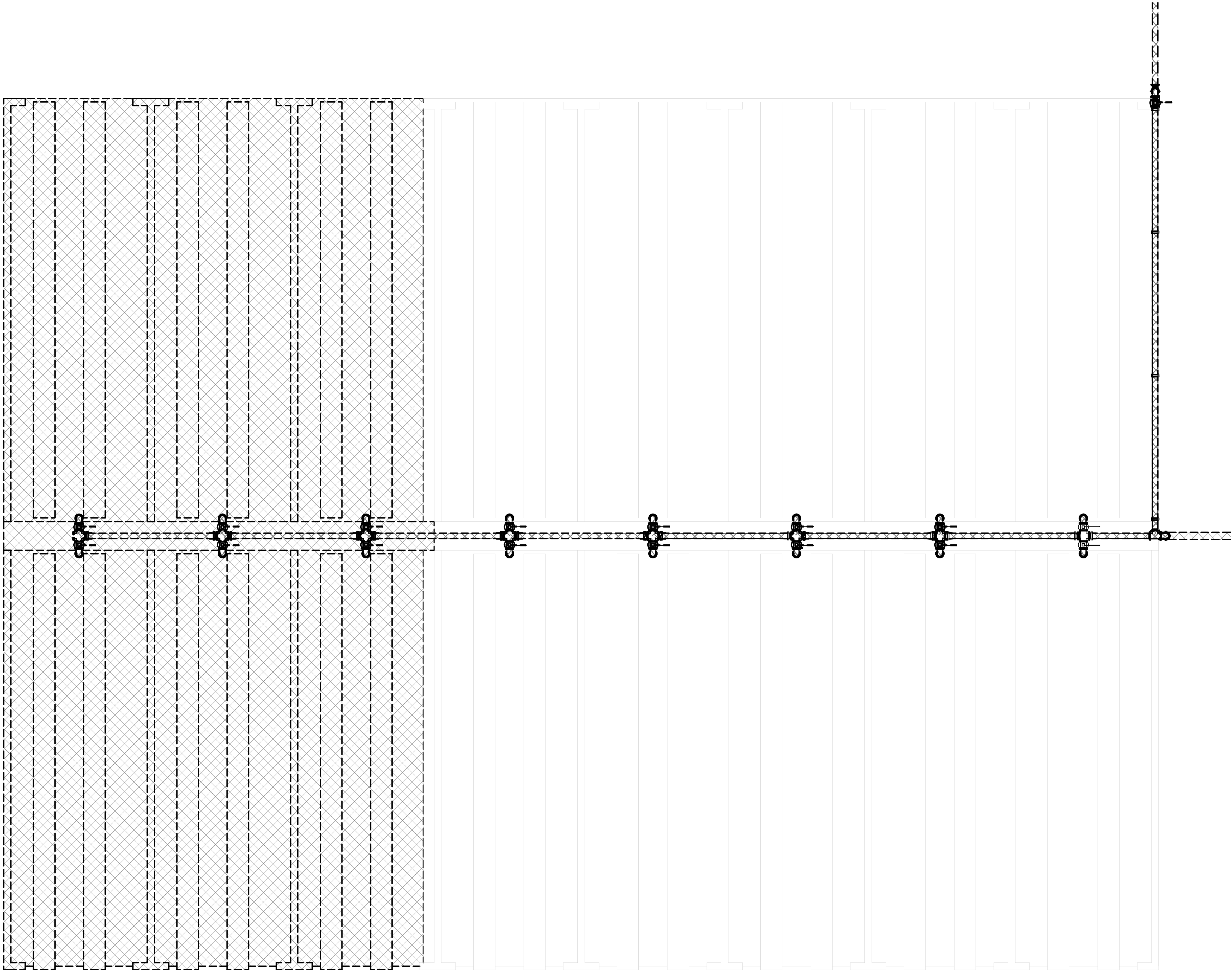


7B

PLAN

X-711

SCALE: 1/8" = 1'-0"



KEY NOTES: #

1. REMOVE & SALVAGE: PIPING ACCESSORIES
2. REMOVE & SALVAGE: PIPING & FITTINGS

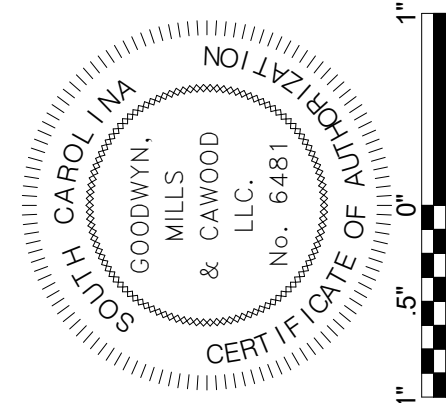
SLUDGE DRYING BED -
PLAN

X-711

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Drawn By:	HKD



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FOUNDATIONS:

1. THE FOUNDATION SUBGRADE AND SHALL BE PREPARED IN ACCORDANCE WITH THE REPORT OF SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING STUDY BY GMC, LLC. DATED SEPTEMBER 27, 2022 (GMC PROJ. NO. GGRE220008). FOR THE PURPOSE OF THESE STRUCTURAL DRAWINGS, SELECT INFORMATION HAS BEEN EXTRACTED FROM THE REFERENCED GEOTECHNICAL REPORT AND NOTED BELOW; HOWEVER, IT IS THE CONTRACTOR'S RESPONSIBILITY TO OBTAIN, READ, AND FOLLOW ALL RECOMMENDATIONS CONTAINED IN THE REFERENCED GEOTECHNICAL REPORT.
2. SHALLOW FOUNDATIONS ARE SIZED FOR A SOIL BEARING VALUE OF 2000 PSF. FOUNDATION SHALL EXTEND TO A MINIMUM OF FROST PENETRATION DEPTH, TO A DEPTH WHERE SOIL MOISTURE CONTENT DOES NOT FLUCTUATE, A MINIMUM DEPTH OF 24" INTO ORIGINAL SOIL AND A MINIMUM DEPTH TO ACHIEVE 2000 PSF BEARING CAPACITY (WHICHEVER IS GREATER). NOTIFY THE ENGINEER SHOULD ANY UNUSUAL SOIL CONDITIONS BE ENCOUNTERED.
33. STRUCTURAL FILL SHALL BE PLACED IN LIFTS NOT TO EXCEED 8" LOOSE MEASURE AND DENSIFIED TO 98% (MINIMUM) STANDARD PROCTOR DENSITY (ASTM D698).
4. BELOW GRADE WALLS ARE DESIGNED FOR AN "AT REST" EQUIVALENT FLUID DENSITY OF 90 LBS/FT³. BACKFILL SHALL CONSIST OF USC SM, SC, SP, SW, GW, OR GP. THE BACKFILL SHALL EXTEND UPWARD FROM THE TOP OF THE FOOTING ON A LINE 30 DEGREES FROM THE VERTICAL. SAMPLES OF ALL BACKFILL MATERIAL SHALL BE EVALUATED BY A THIRD-PARTY TESTING AGENCY FOR USE AS BACKFILL.

CONCRETE:

1. SUBMITTALS PER SPECIFICATIONS.
2. COMPLY WITH ASTM C 94; ACI 301 "SPECIFICATIONS FOR STRUCTURAL CONCRETE FOR BUILDINGS", ACI 350 "CODE REQUIREMENTS FOR ENVIRONMENTAL ENGINEERING CONCRETE STRUCTURES"; AND CRSI'S "MANUAL OF STANDARD PRACTICE."
3. DEFORMED REINFORCING BARS: ASTM A615, GRADE 60.
4. WELDED WIRE FABRIC: ASTM A 185, FLAT SHEETS.
5. PORTLAND CEMENT: ASTM C 150, TYPE I OR II.
6. CONCRETE SHALL HAVE THE FOLLOWING MINIMUM SPECIFIED 28 DAY COMPRESSIVE STRENGTH:
- | | |
|--|----------|
| A. SLABS ON GRADE AND PIPE ENCASEMENT | 3000 PSI |
| B. LIQUID RETAINING AND CONTAINMENT STRUCTURES | 4000 PSI |
7. UNLESS OTHERWISE NOTED, ALL DETAILING, FABRICATION, AND PLACING OF REINFORCING STEEL SHALL CONFORM IN ACCORDANCE WITH "ACI DETAILING MANUAL", PUBLICATION SP-66, ACI 318-11, AND ACI 315-99, OR LATEST EDITIONS.
8. REINFORCEMENT SHALL BE FABRICATED TO SHAPES AND DIMENSIONS SHOWN AND SHALL CONFORM TO THE REQUIREMENTS OF CRSI AND ACI 318. REINFORCEMENT SHALL BE COLD BENT UNLESS OTHERWISE AUTHORIZED. BENDING MAY BE ACCOMPLISHED IN THE FIELD OR AT THE MILL. BARS NOT TO BE BENT AFTER EMBEDDED IN CONCRETE. REINFORCEMENT SHALL BE FREE FROM LOOSE RUST AND SCALE, DIRT, OIL, OR OTHER DELETERIOUS COATING THAT COULD REDUCE BOND WITH THE CONCRETE.
9. ALL REINFORCING BAR SPlice LENGTHS AND LOCATIONS, EMBEDMENT LENGTHS, HOOKS, ETC. SHALL BE MADE AS SHOWN ON THE DRAWINGS, DEVIATIONS SHALL NOT BE MADE UNLESS OTHERWISE AUTHORIZED.
10. PROVIDE CLASS B LAP SPLICES IN ACCORDANCE WITH ACI 318 UNLESS NOTED OTHERWISE. PROVIDE ACCESSORIES NECESSARY TO PROPERLY SUPPORT REINFORCING AT POSITIONS SHOWN ON THE PLANS.
- TENSION AND COMPRESSION REINFORCEMENT SPLICES SHALL BE MADE AS FOLLOWS:
- | >12" FRESH CONCRETE BELOW | OTHER BARS |
|---------------------------|------------|
| #4 BARS | 32 INCHES |
| #5 BARS | 40 INCHES |
| #6 BARS | 48 INCHES |
| #7 BARS | 70 INCHES |
| #8 BARS | 80 INCHES |
| #9 BARS | 91 INCHES |
| #10 BARS | 103 INCHES |
11. MINIMUM CONCRETE REINFORCING COVER REQUIREMENTS:
- | | |
|--|--------|
| CONCRETE CAST AGAINST EARTH | 3" |
| FORMED CONCRETE EXPOSED TO EARTH OR WEATHER: | |
| #6 BARS AND LARGER | 2" |
| #5 BARS AND SMALLER | 1 1/2" |
12. CONCRETE SLABS ON GRADE SHALL BE REINFORCED AS NOTED ON PLANS.
13. ALL REINFORCING STEEL AND EMBEDDED ITEMS SUCH AS ANCHOR BOLTS AND WELD PLATES SHALL BE ACCURATELY PLACED IN THE POSITIONS SHOWN AND ADEQUATELY TIED AND SUPPORTED BEFORE CONCRETE IS PLACED TO PREVENT DISPLACEMENT BEYOND PERMITTED TOLERANCES.
14. REFER TO DRAWINGS OF OTHER TRADES FOR PENETRATIONS IN CONCRETE FLOORS, REQUIRING SLEEVES OR OTHER EMBEDDED ITEMS NOT SHOWN.
15. CONSTRUCTION JOINTS FOR CONTINUOUS WALLS / FOOTINGS SHALL CONSIST OF BULK-HEAD FORM WITH FOOTING REINFORCING PROJECTING THROUGH FORM 3 FEET OR CLASS B LAP SPlice FOR LONGITUDINAL BARS, WHICHEVER IS GREATER.
16. CROSS REFERENCE ALL CONSTRUCTION DOCUMENTS FOR DIMENSIONS AND LOCATIONS NOT SPECIFICALLY SHOWN. INFORM THE COTR IN WRITING OF MISSING INFORMATION OR CONFLICTS.
17. DO NOT ADD WATER TO CONCRETE DURING DELIVERY, AT PROJECT SITE OR DURING PLACEMENT UNLESS APPROVED BY THE ENGINEER.
18. PROTECT CONCRETE FROM PHYSICAL DAMAGE OR REDUCED STRENGTH DUE TO WEATHER EXTREMES DURING MIXING, PLACING AND CURING.
19. FORM 1/8" WIDE CONTRACTION JOINTS WITH POWER SAWS WHEN CUTTING ACTION WILL NOT TEAR, ABRABE, OR OTHERWISE DAMAGE CONCRETE SURFACE AND BEFORE CONCRETE DEVELOPS RANDOM CONTRACTION JOINTS. SEE DETAILS FOR ADDITIONAL INFORMATION.
20. BEGIN CURING UNFORMED CONCRETE AFTER FINISHING. KEEP LIQUID RETAINING CONCRETE CONTINUOUSLY MOIST FOR AT LEAST 7 DAYS. MEMBRANE FORMING CURING COMPOUND MAY BE USED ON NON-LIQUID RETAINING CONCRETE. CONTRACTOR SHALL VERIFY COMPOUND IS COMPATIBLE WITH ALL FLOOR COVERINGS AND COATINGS.
21. PROTECT CONCRETE FROM DAMAGE. REPAIR CONCRETE SURFACE DEFECTS WITH METHODS AND MATERIALS APPROVED BY COTR.
22. ANCHORING ADHESIVE SHALL BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS. SUBMIT PRODUCT DATA FOR EACH APPLICATION FOR REVIEW. USE ONE OF THE FOLLOWING PRODUCTS:
- A. HILTI HY 150 INJECTION MAX ADHESIVE ANCHORING SYSTEM
- B. RAMSET / RED HEAD EPON CERAMIC 6 EPOXY ANCHORING SYSTEM
- C. SIMPSON STRONG TIE "AT" OR "SET" DEPENDING ON APPLICATION
- D. ADDITIONALLY, PROVIDE SCREEN TUBE ANCHORS IN HOLLOW CORE MASONRY

STRUCTURAL STEEL

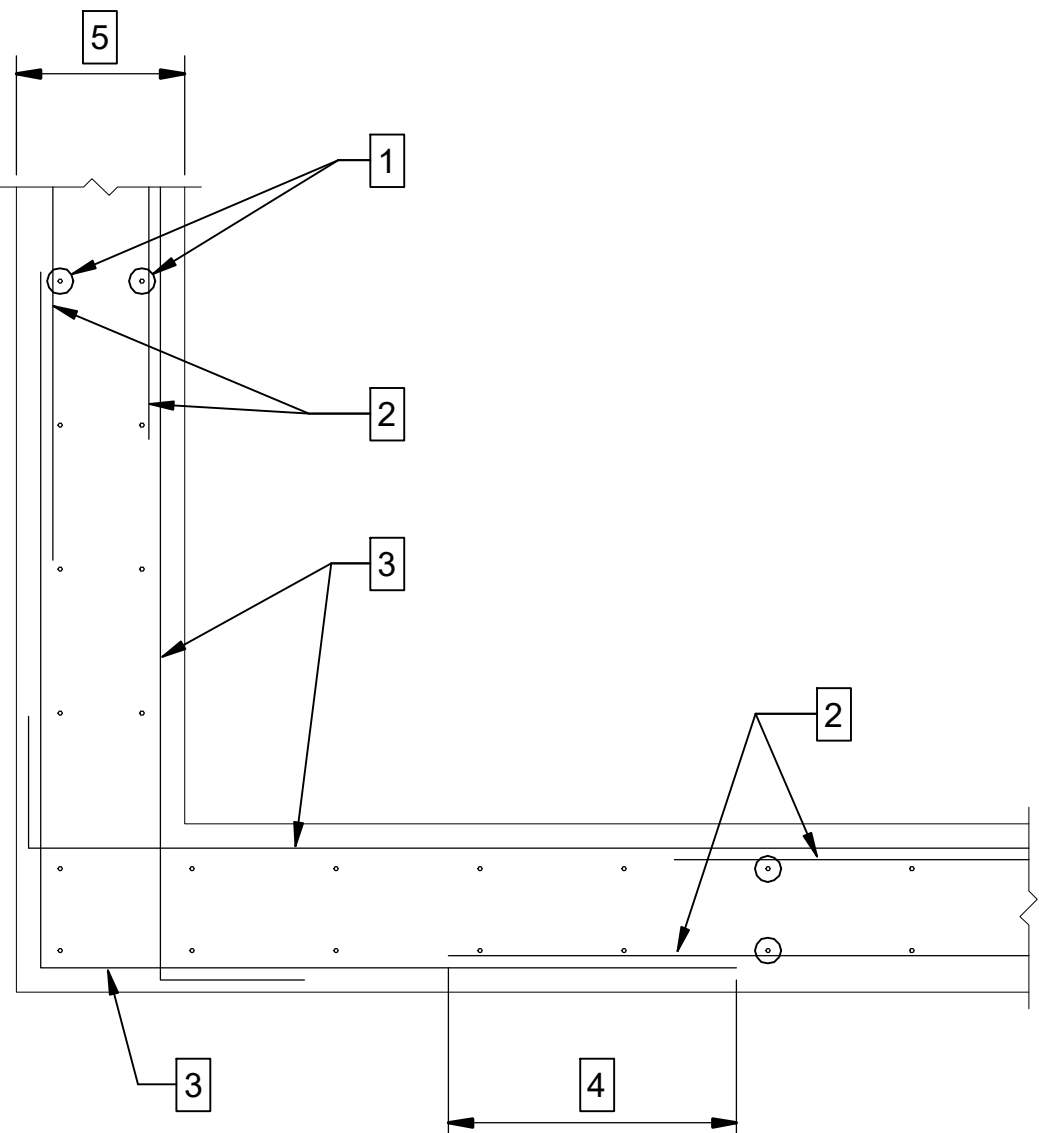
1. STRUCTURAL W-SECTION SHAPES SHALL CONFORM TO ASTM A992.
2. STRUCTURAL RECTANGULAR HSS SHALL CONFORM TO ASTM A500 GR. C.
3. STRUCTURAL ROUND HSS SHALL CONFORM TO ASTM A500 GR. C.
4. STRUCTURAL AND MISCELLANEOUS STEEL ITEMS SHALL CONFORM TO ASTM A36.
5. STRUCTURAL BOLTS SHALL BE ASTM A-325X WITH NUTS AND WASHERS.
6. DETAIL, FABRICATION, AND ERECTION OF ALL STRUCTURAL STEEL SHALL BE IN ACCORDANCE WITH LATEST AISC STANDARDS AND SPECIFICATIONS.
7. ALL WELDING SHALL BE IN ACCORDANCE WITH AWS D1.1 (LATEST EDITION)
8. ELECTRODES SHALL BE E70XX
9. UNLESS OTHERWISE NOTED OR DETAILED, ALL SHEAR CONNECTIONS SHALL BE DESIGNED USING THE APPROPRIATE DATA FROM PART 10 "DESIGN OF SIMPLE SHEAR CONNECTIONS" FROM THE AISC MANUAL OF STEEL CONSTRUCTION, LATEST EDITION. DESIGN END REACTION IS 60% OF TOTAL ALLOWABLE LOAD (60% x W_c) FROM THE ALLOWABLE LOAD OF BEAM TABLE FROM PART 9 "DESIGN OF CONNECTING ELEMENTS" OF THE AISC MANUAL OF STEEL CONSTRUCTION, LATEST EDITION.
10. ALL STEEL ITEMS SHALL BE HOT DIPPED GALVANIZED PER ASTM A123.

DESIGN LOADS:

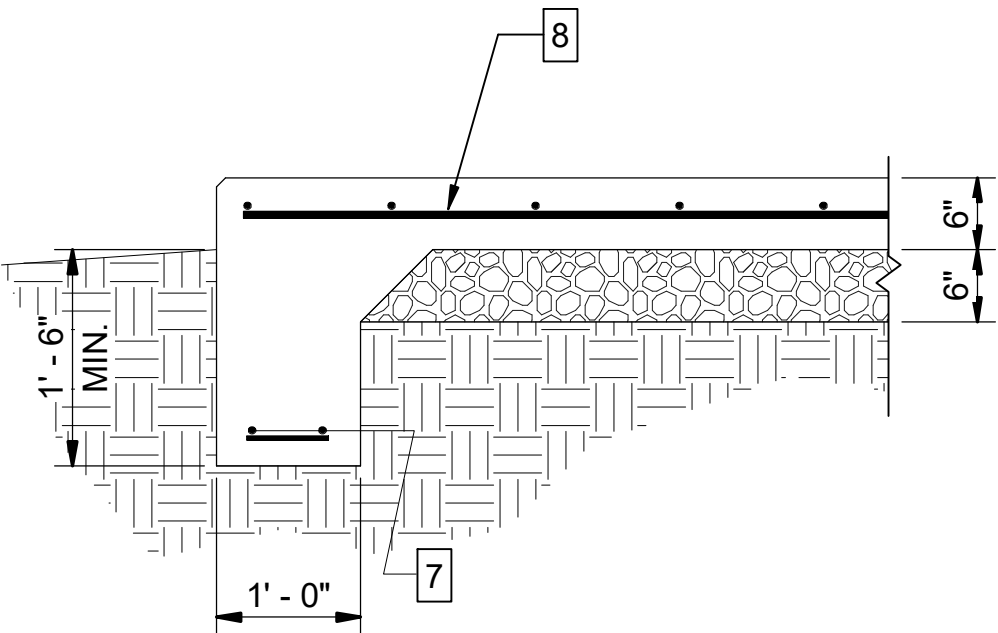
LIVE LOADS:	
ELEVATED WALKWAYS	150 PSF
WIND LOADS:	
BASIC WIND VELOCITY	119 MPH (ULT., 3-SEC. GUST)
OCCUPANCY CATEGORY	IV
WIND EXPOSURE	C
INTERNAL PRESSURE COEFFICIENTS	+/- 0.18
SEISMIC LOADS:	
SEISMIC USE GROUP	IV
SEISMIC IMPORTANCE FACTOR (I _e)	1.00
MAPPED SPECTRAL RESPONSE ACCELERATION:	
S _s	0.362
S ₁	0.100
SITE CLASS	D
SPECTRAL RESPONSE COEFFICIENTS:	
S _{ds}	0.365
S _{d1}	0.161
SEISMIC DESIGN CATEGORY	D

APPLICABLE CODES AND SPECIFICATIONS:

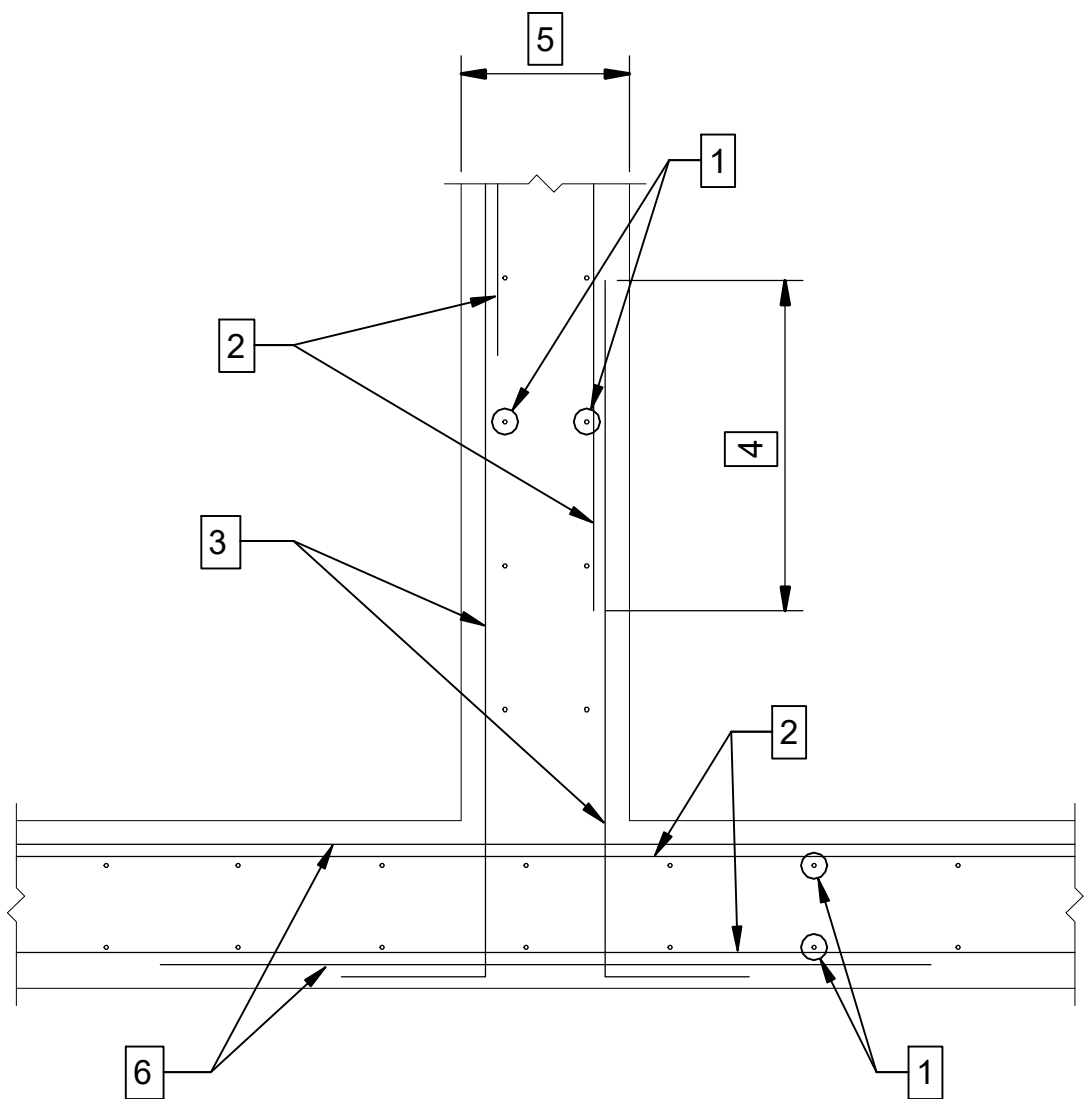
INTERNATIONAL BUILDING CODE 2021 w/ SOUTH CAROLINA AMENDMENTS
AMERICAN CONCRETE INSTITUTE - ACI 350
CONCRETE REINFORCING STEEL INSTITUTE
AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AMERICAN IRON AND STEEL INSTITUTE
AMERICAN SOCIETY OF TESTING AND MATERIALS
AMERICAN WELDING SOCIETY



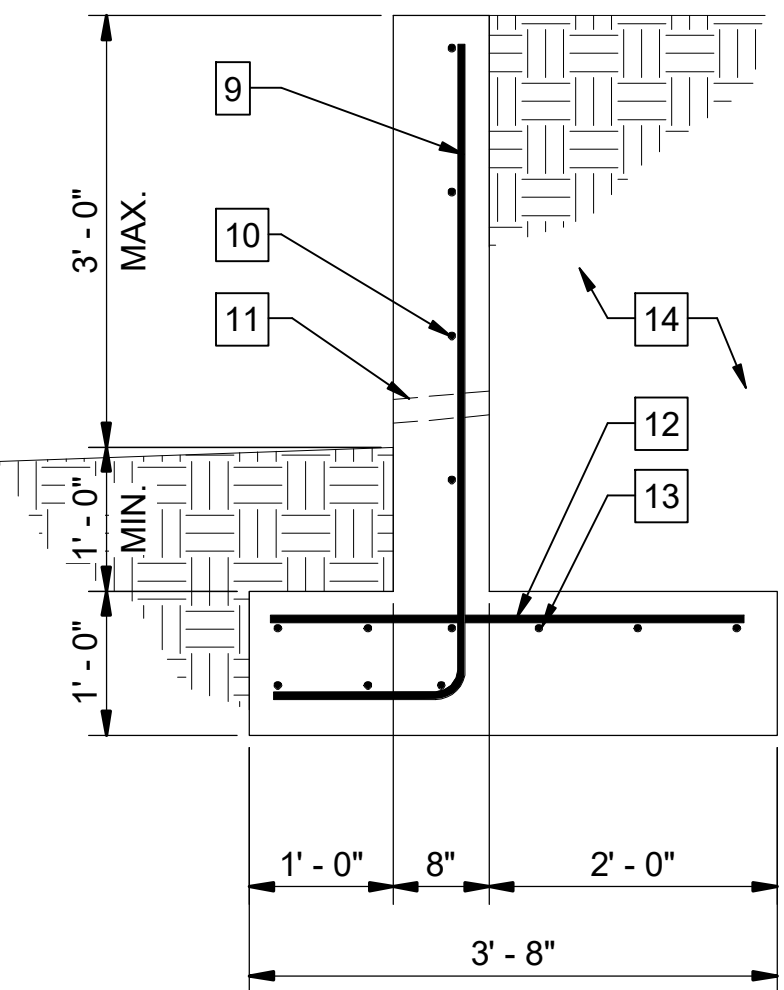
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S-001
TYPICAL CORNER REINFORCING
SCALE: 3/4" = 1'-0"



3
S-001
TYP EQUIPMENT PAD
SCALE: 3/4" = 1'-0"



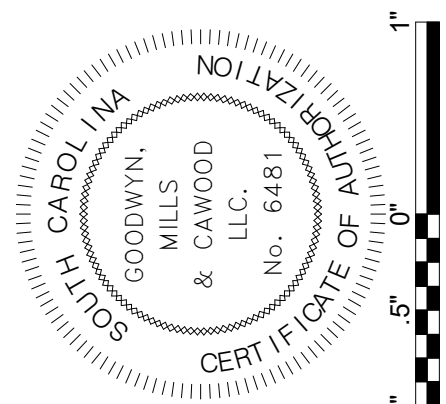
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S-001
TYPICAL INTERSECTING WALLS
SCALE: 3/4" = 1'-0"



4
S-001
TYP RETAINING WALL
SCALE: 3/4" = 1'-0"

REQUIRED NOTES: #

1. TYPICAL VERTICAL WALL REINFORCING
2. TYPICAL HORIZONTAL WALL REINFORCING
3. CORNER REINFORCING. SEE PLANS FOR SIZE AND SPACING (TYPICAL)
4. CLASS B TENSION LAP SPlice (TYP.)
5. WALL THICKNESS
6. ADDITIONAL HORIZONTAL REINFORCING. SEE PLAN FOR SIZE AND SPACING (TYP.)
7. 2-#5 CONT. w/ #3 TIES @ 36" O.C.
8. #6 @ 12" O.C. (TYPICAL)
9. #5 DOWELS @ 12" O.C.
10. #5 HORIZONTAL @ 12" O.C.
11. 2" DIAMETER WEEPS @ 4'-0" MAX. O.C.
12. #5 TRANSVERSE @ 12" O.C.
13. #5 CONTINUOUS @ 8" MAX. O.C.
14. COMPACTED GRANULAR FILL



ISSUE	DATE
30% Submittal	01/18/2023
60% Submittal	08/07/2023
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Designer:	TS
Drawn By:	JD

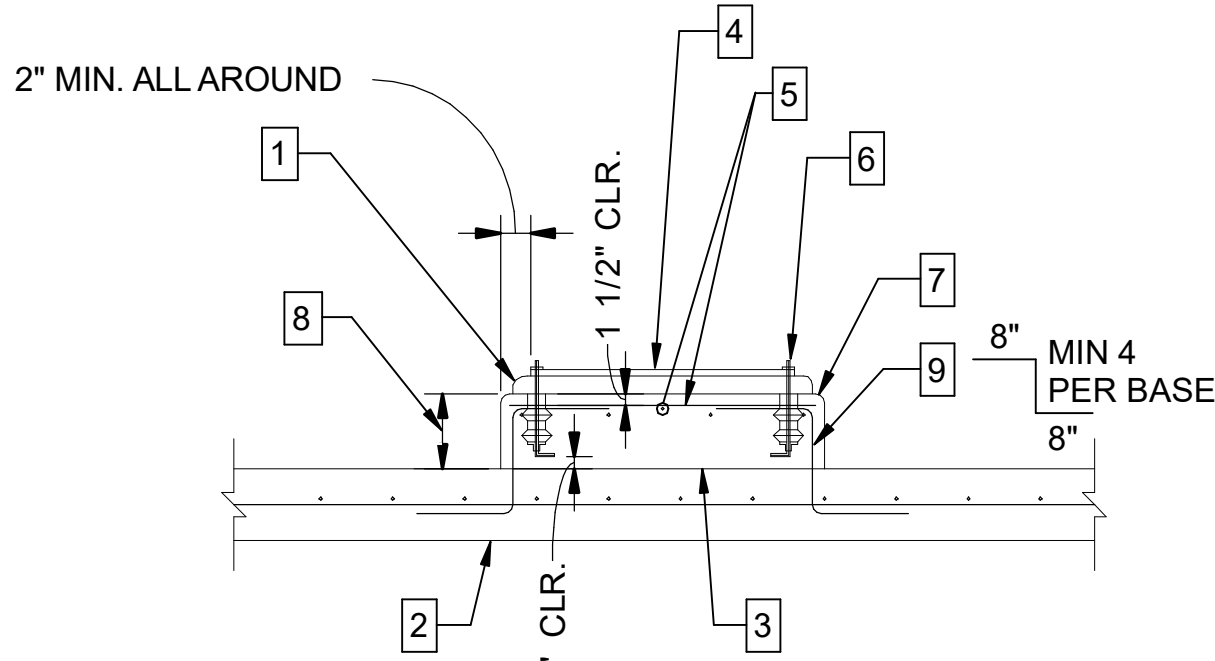
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PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

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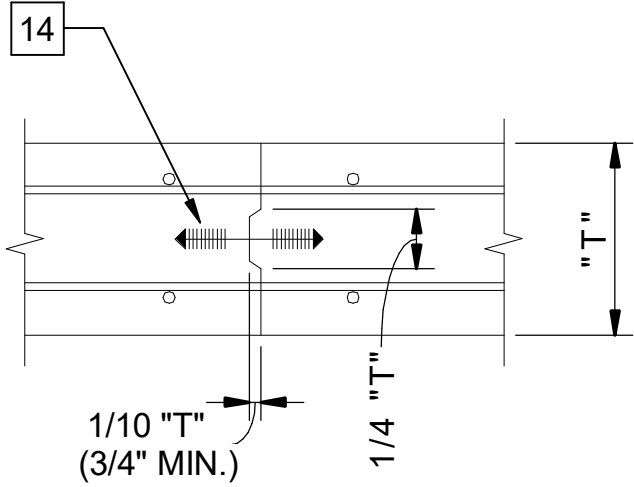
STRUCTURAL NOTES
& TYPICAL DETAILS

S-001

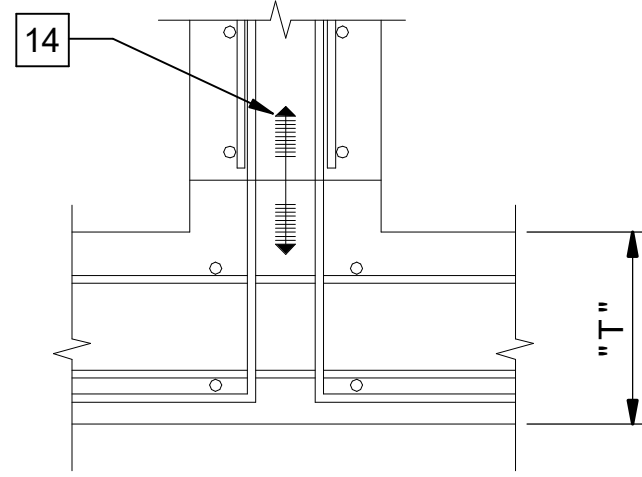
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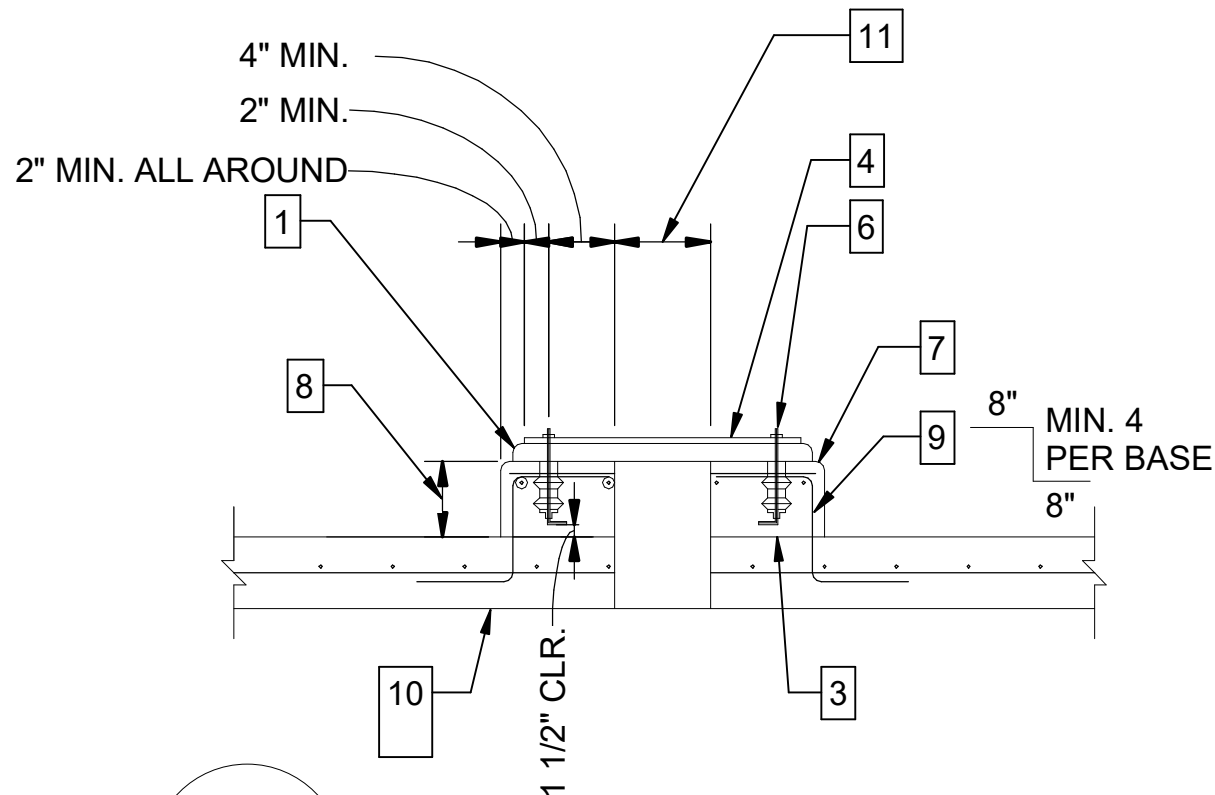
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S-002
EQUIPMENT PAD TYPE A
SCALE: 3/4" = 1'-0"



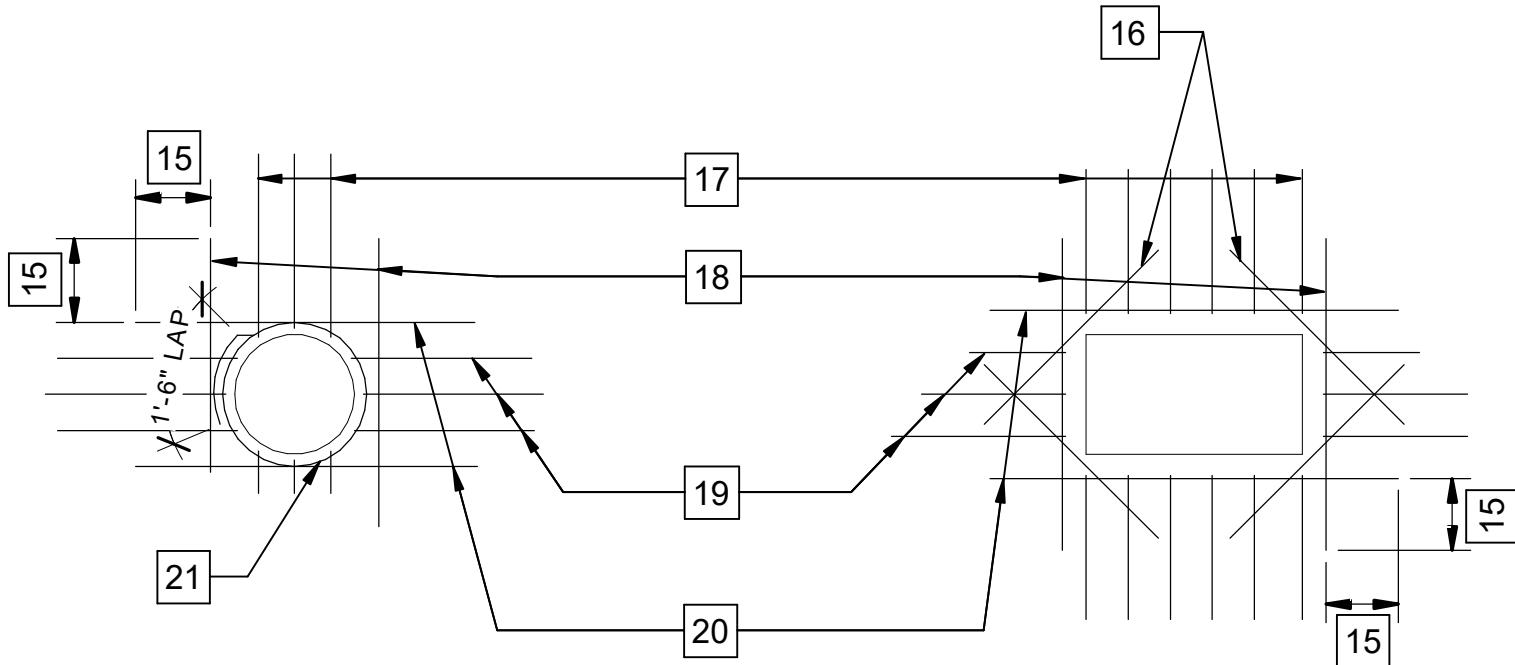
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S-002
CONSTRUCTION JOINT
SCALE: 3/4" = 1'-0"



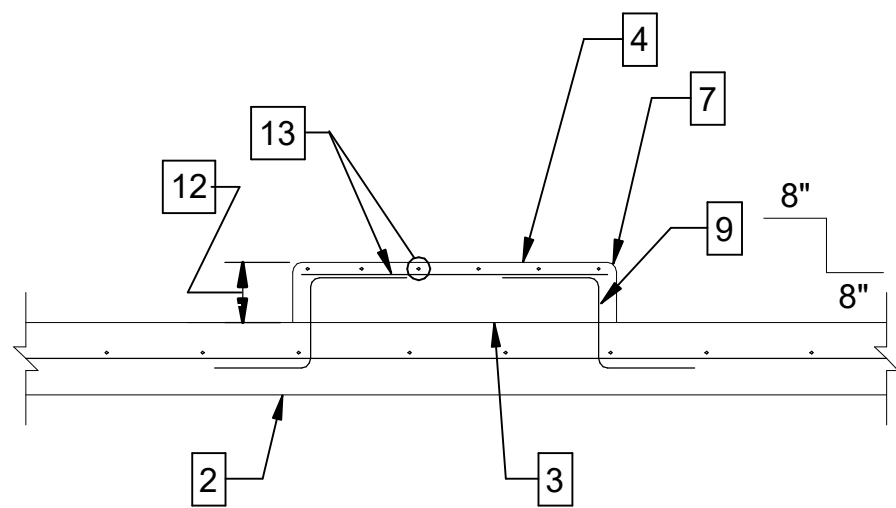
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S-002
CONSTRUCTION JOINT
SCALE: 3/4" = 1'-0"



2
S-002
EQUIPMENT PAD TYPE C
SCALE: 3/4" = 1'-0"



6
S-002
OPENING REINFORCEMENT
SCALE: 3/4" = 1'-0"



3
S-002
EQUIPMENT PAD TYPE F
SCALE: 3/4" = 1'-0"

REQUIRED NOTES: #

- 1 1 1/2" FLOWABLE NON-SHRINK GROUT (TYP.)
- SUSPENDED SLAB OR SLAB ON GRADE, FOR THICKNESS, SEE PLANS
- CONSTRUCTION JOINT. LEAVE ROUGH & CLEAN
- EQUIPMENT BASE
- #4 @ 12" O.C. EACH WAY
- MINIMUM ANCHOR BOLT DIMENSIONS, SEE NOTES AND ANCHOR BOLT DETAILS
- TOOLED EDGES (3/4")
- AS REQUIRED FOR EQUIPMENT, BOLTS AND PIPING (5 1/2" MINIMUM)
- #4 @ 12" O.C.
- SUSPENDED SLAB ONLY, SEE PLANS
- OPENING SIZE, VERIFY w/ PLANS & EQUIPMENT MFR. FORM TO RETAIN GROUT
- PAD HEIGHT AS REQ'D, 5" MAX.
- #3 @ 12" O.C. EA. WAY, 1" CLR.
- WATERSTOP (SEE SECTIONS FOR SIZE AND TYPE)
- PROVIDE MIN LAP AS NOTED OR SHOWN ON PLANS (TYP.)
- ADD 1-#5x4'-0" DIAG AT EA CORNER FOR EA LAYER OF REINF.
- STEEL REINF. CUT BAND "B"
- AREA OF BARS EQUAL BAND "B" BARS CUT
- STEEL REINF. CUT BAND "A"
- AREA OF BARS EQUAL BAND "A" BARS CUT
- 1-#5 HOOP DIA OF OPNG +8", IN EA LAYER OF REINF FOR OPNGS LARGER THAN 8"

EQUIPMENT PAD NOTES:

- PAD SIZE SHALL BE MINIMUM INDICATED OR AS SHOWN ON THE PLANS OR AS INDICATED BY THE MANUFACTURER AND APPROVED BY THE ENGINEER.
- THE SIZE, NUMBER, TYPE, LOCATION AND THREAD PROJECTION OF THE ANCHOR BOLTS SHALL BE DETERMINED BY THE EQUIPMENT MANUFACTURER, AND SHALL BE AS APPROVED BY THE ENGINEER. ANCHOR BOLTS SHALL BE HELD IN POSITION WITH A TEMPLATE WHILE PAD IS BEING POURED.
- ANCHOR BOLT SLEEVES SHALL BE USED TO PROVIDE THE ANCHOR BOLT A MINIMUM MOVEMENT OF 1/2" IN ALL DIRECTIONS. THE MINIMUM SLEEVE LENGTH SHALL BE 8 TIMES THE BOLT DIAMETER. SLEEVES SHALL BE FILLED WITH NON-SHRINK GROUT.
- ANCHOR BOLT SLEEVES SHALL HAVE A MINIMUM INTERNAL DIAMETER 1" GREATER THAN BOLT DIAMETER AND A MAXIMUM INTERNAL DIAMETER 3" GREATER THAN ANCHOR BOLT DIAMETER. SLEEVES SHALL BE FILLED WITH NON-SHRINK GROUT.
- EQUIPMENT BASES SHALL BE INSTALLED LEVEL UNLESS SPECIFIED OTHERWISE.
- WEDGES OR SHIMS SHALL BE USED TO SUPPORT THE BASE WHILE THE NON-SHRINK GROUT IS PLACED. TEMPORARY LEVELING NUTS SHALL BE BACKED OFF. IF LEFT IN, THE WEDGES OR SHIMS SHALL NOT BE EXPOSED TO VIEW.

TYPICAL DETAILS

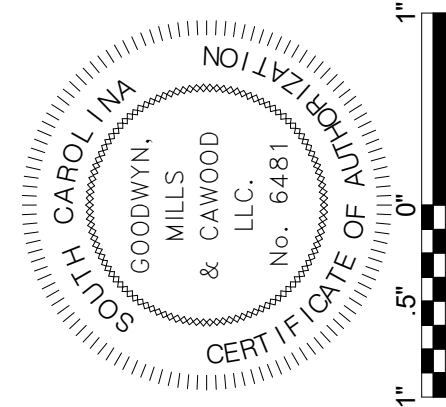
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Town of Pendleton
City of Clemson
Anderson County

S-002

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ISSUE	DATE
30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
Bid Set	
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Project Manager:	WN
Engineer:	JD
Designer:	TS
Drawn By:	JD

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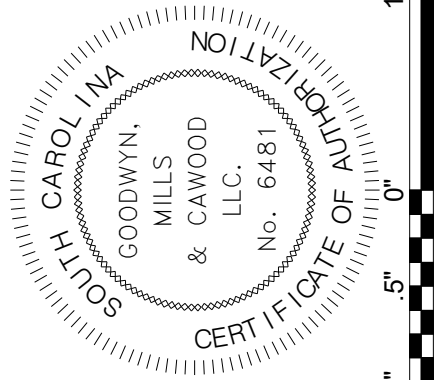
SCHEDULE OF
STRUCTURAL SPECIAL
INSPECTIONS

S-003

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
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ISSUE	DATE
30% Submittal	01.18.2023
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Engineer:	JD
Designer:	TS
Drawn By:	JD



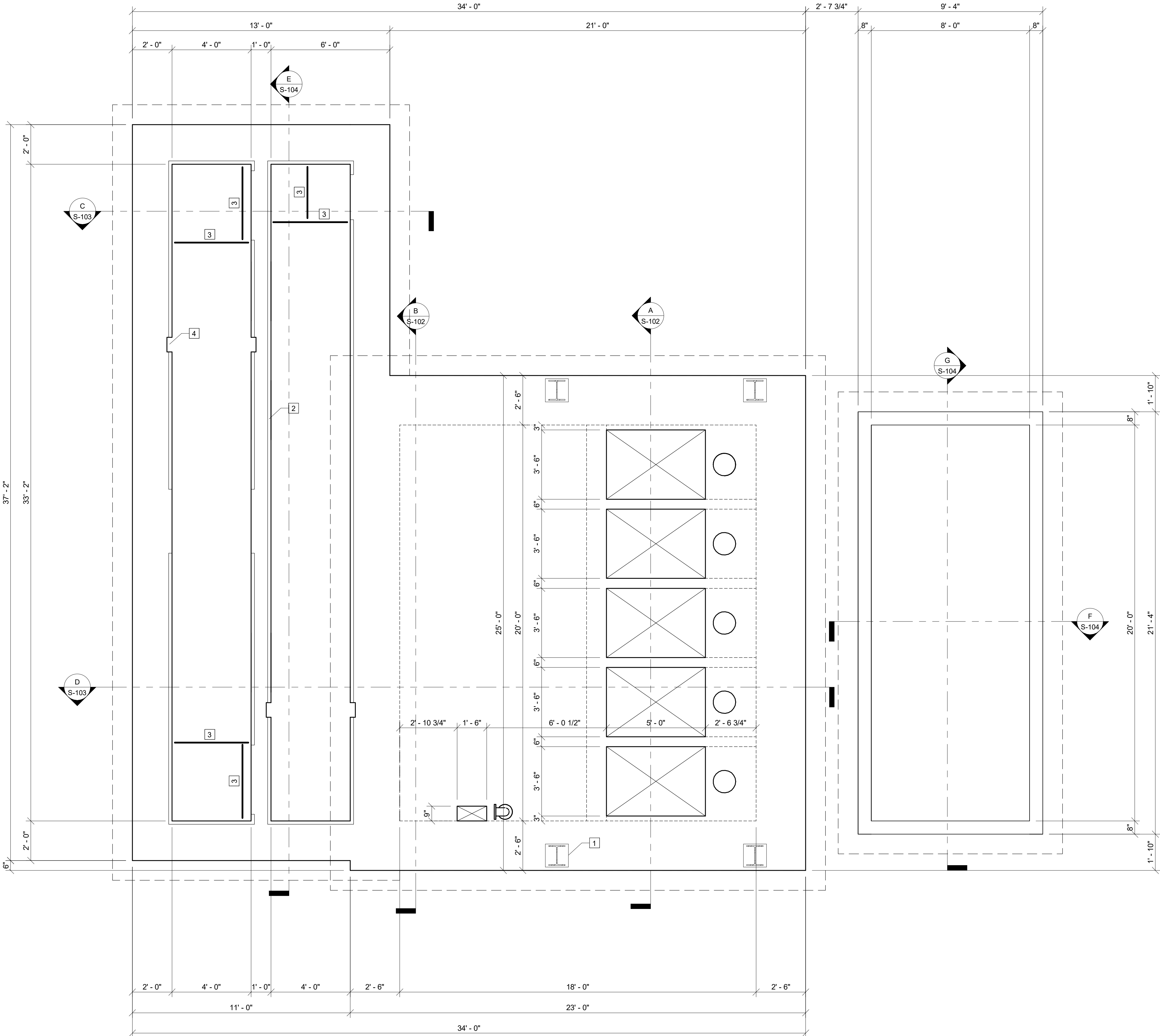
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1
S-101

PLAN

SCALE: 3/8" = 1'-0"



KEY NOTES: #

1. PREFABRICATED HOIST FRAME BY OTHERS
2. PREFABRICATED GRATING SUPPORT EMBED
3. 316SS L6x4x3/8 GRATING SUPPORT ANGLE
4. NOTCH FOR SLIDE GATE - SEE S-001 FOR DETAILS

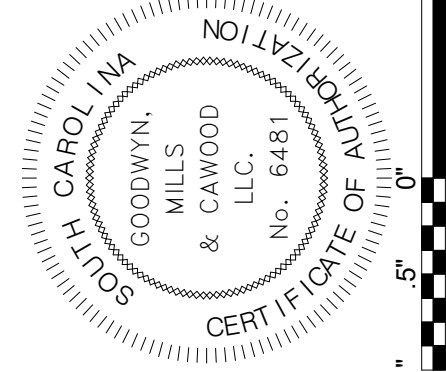
PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

S-101

INFLUENT PUMP
STATION - PLAN

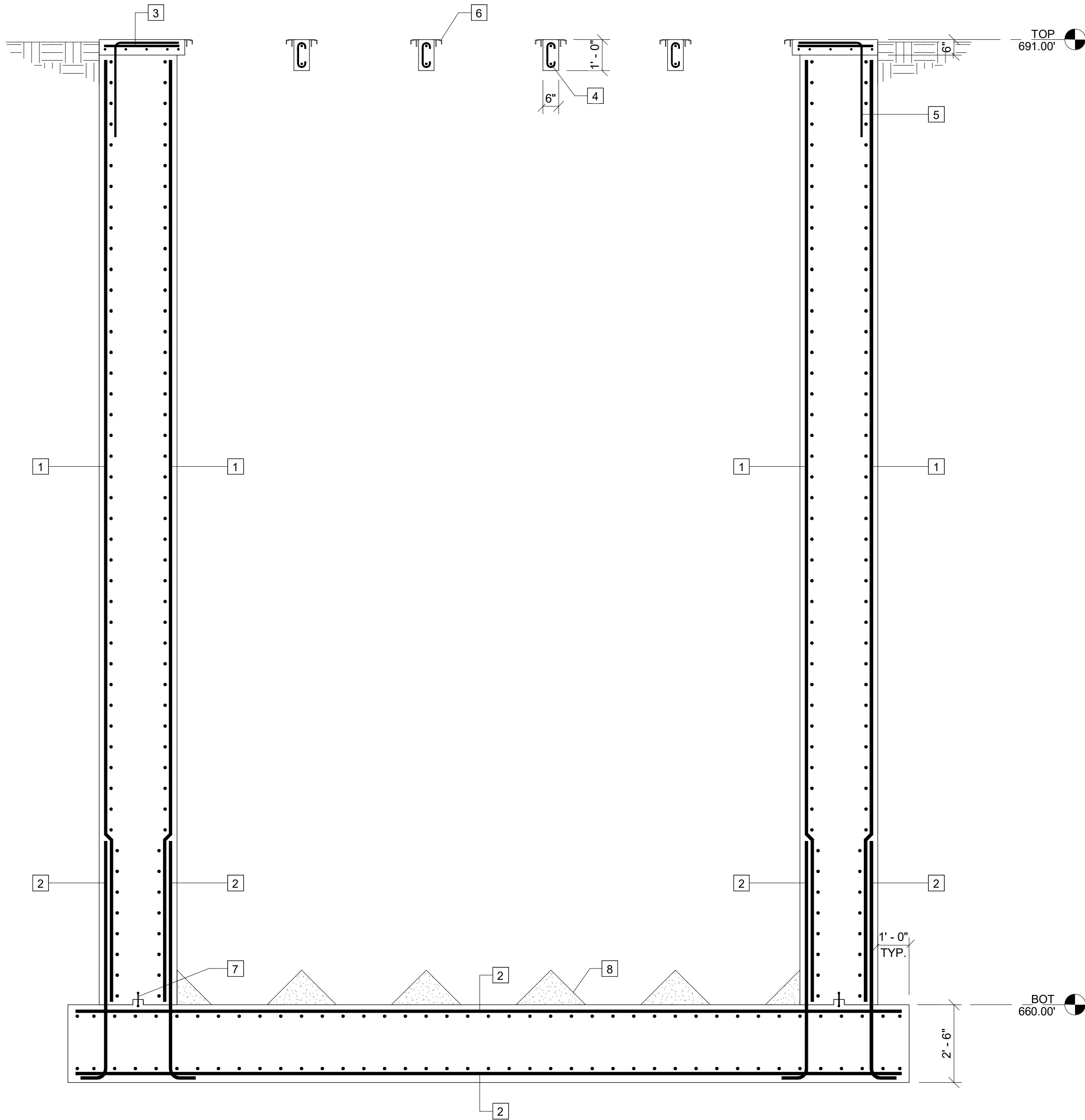
GMC PROJECT #CGRE220027

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Engineer:	JD
Designer:	TS
Drawn By:	JD

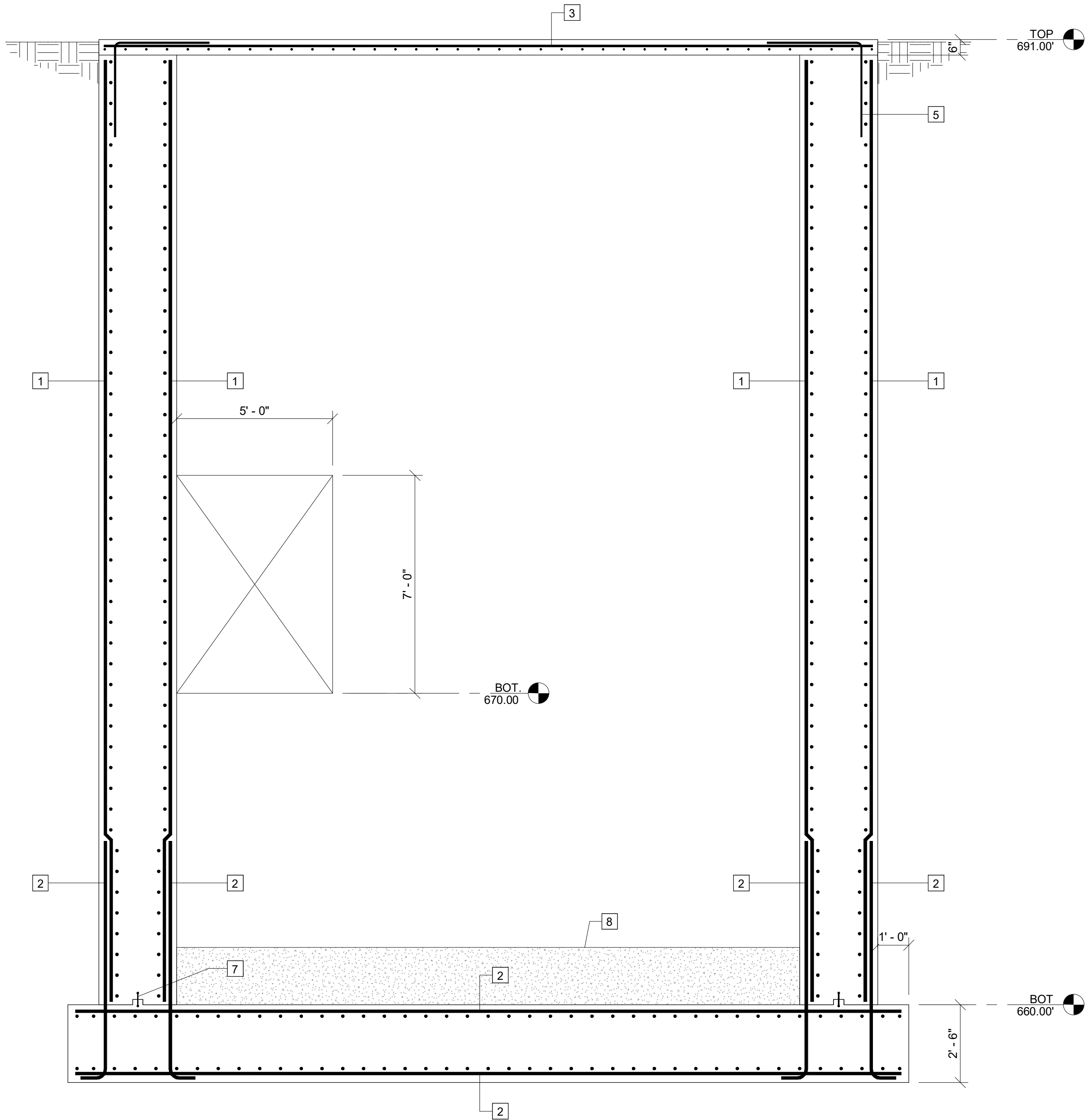


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A SECTION
S-101 SCALE: 3/8" = 1'-0"



B SECTION
S-101 SCALE: 3/8" = 1'-0"

KEY NOTES: #

1. #8 @ 8" O.C. EACH WAY
2. #8 VERTICAL DOWELS @ 8" O.C.
3. #5 @ 8" O.C. EACH WAY (CENTERED IN SLAB)
4. (1) #5 TOP & BOTTOM w/ #3 TIES @ 4" MAX. O.C.
5. #4 BENT BAR (3'-0" x 3'-0") @ 24" MAX. O.C. - TRIM @ OPENINGS
6. PREFABRICATED HATCH COVER - SEE PROCESS
7. 6" PVC WATERSTOP - TYPICAL
8. GROUT FILL - SEE PROCESS

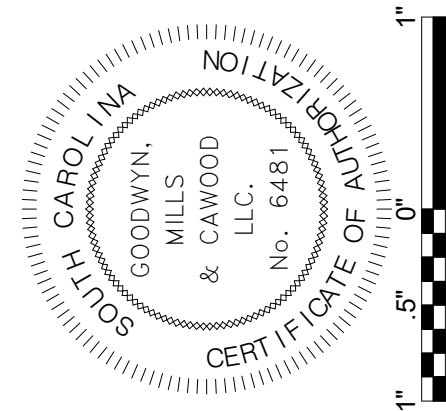
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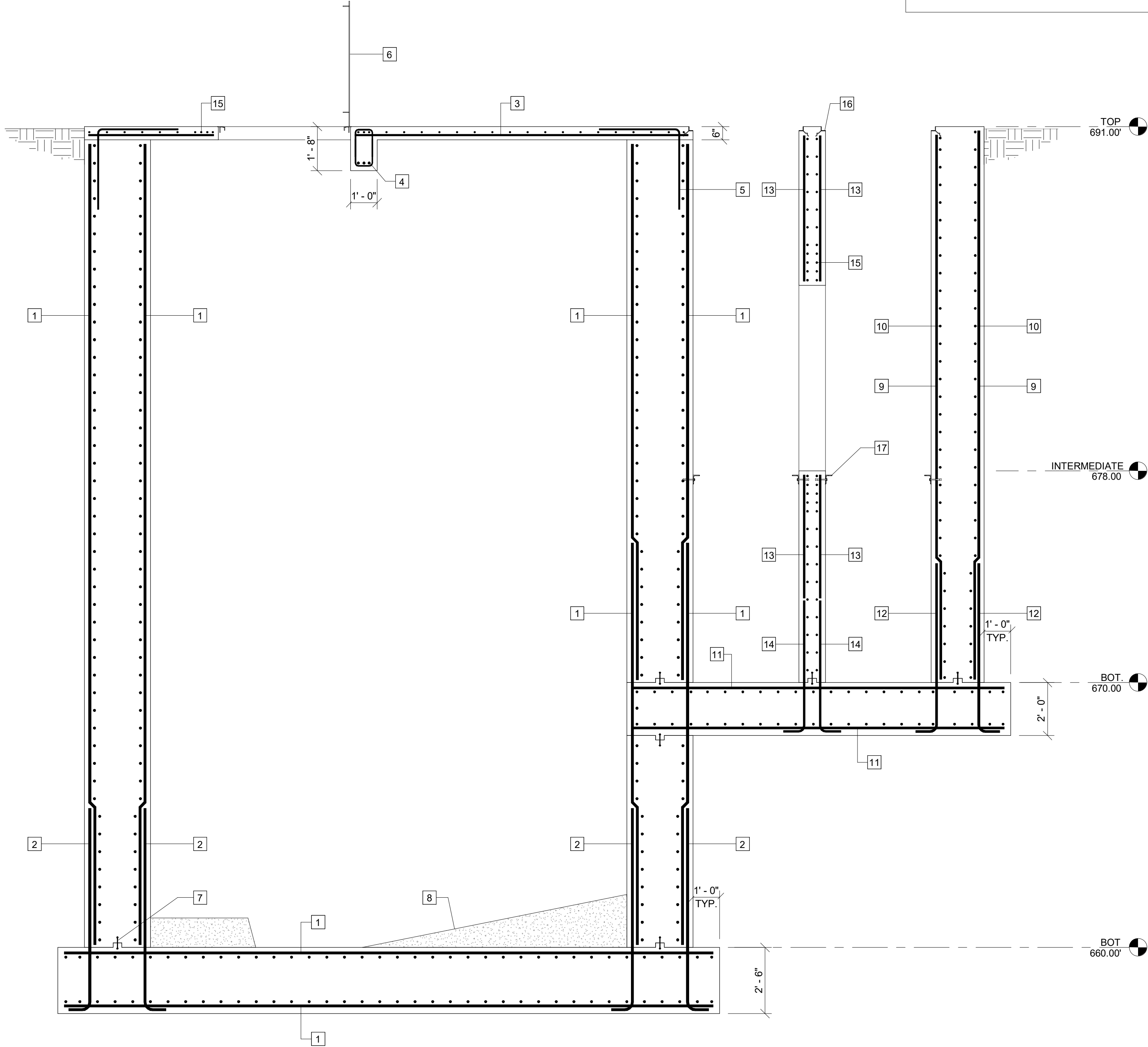
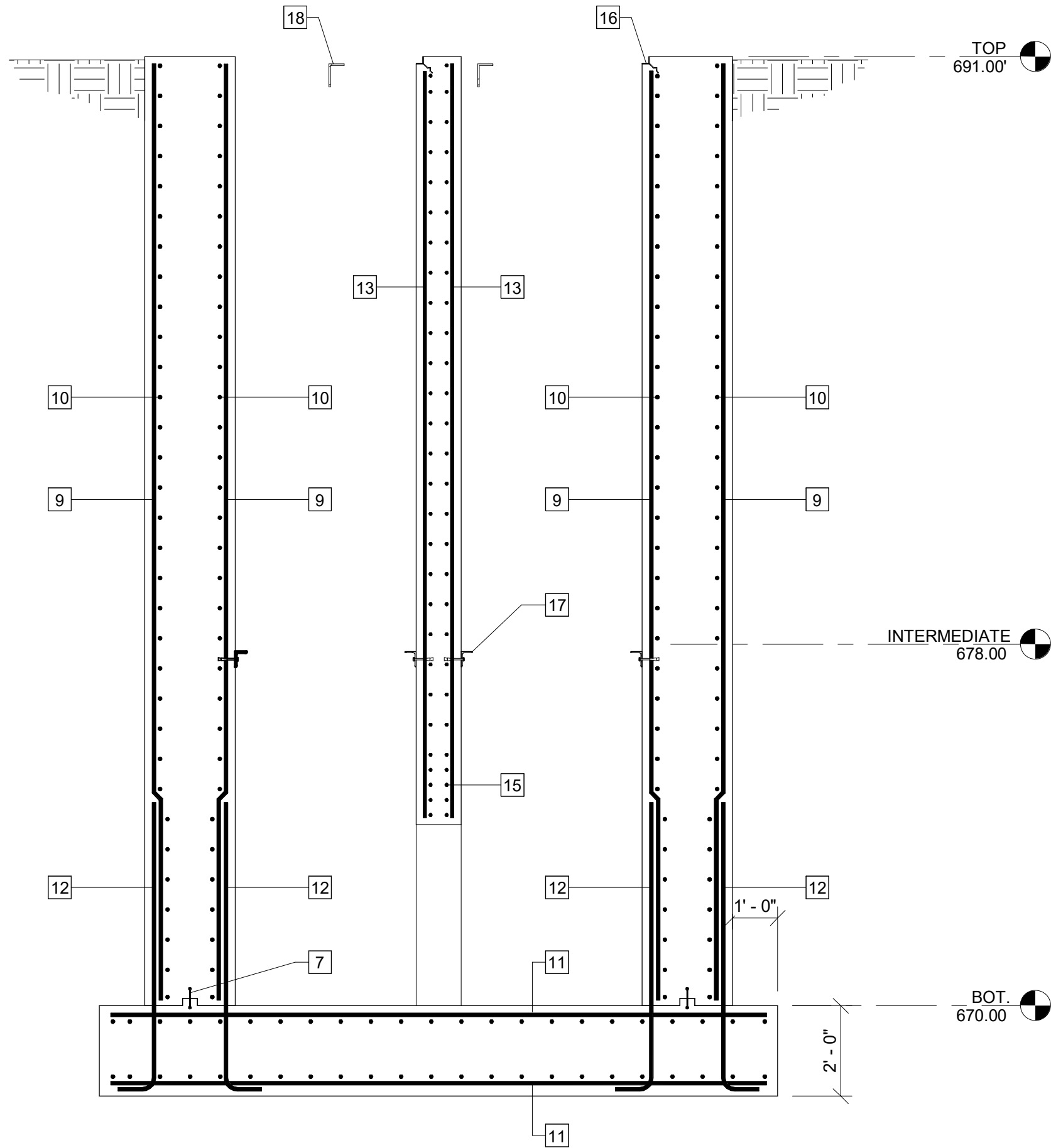
INFLUENT PUMP
STATION - SECTIONS

S-102



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KEY NOTES: #

- #8 @ 8" O.C. EACH WAY
- #8 VERTICAL DOWELS @ 8" O.C.
- #5 @ 8" O.C. EACH WAY (CENTERED IN SLAB)
- (3) #8 TOP & (3) #8 BOTTOM w/ #3 TIES @ 8" MAX. O.C.
- #4 BENT BAR (3'-0" x 3'-0") @ 24" MAX. O.C. - TRIM @ OPENINGS
- PREFABRICATED HATCH COVER - SEE PROCESS
- 6" PVC WATERSTOP - TYPICAL
- GROUT FILL - SEE PROCESS
- #7 VERTICAL @ 8" O.C.
- #7 HORIZONTAL @ 8" O.C. (#8 OUTSIDE CORNER BARS)
- #7 @ 8" O.C. EACH WAY
- #7 VERTICAL DOWELS @ 8" O.C.
- #6 @ 12" O.C. EACH WAY
- #6 VERTICAL DOWELS @ 12" O.C.
- ADDITIONAL REINFORCING AT OPENINGS - SEE S-002
- PREFABRICATED GRATING SEAT EMBED
- 316 SS L4x3x5/16 GRATING SUPPORT w/ 1/2" x 5" SS EXPANSION ANCHORS @ 24" MAX. O.C.
- 316 SS L6x4x3/8 GRATING SUPPORT BEAM (TYPICAL)

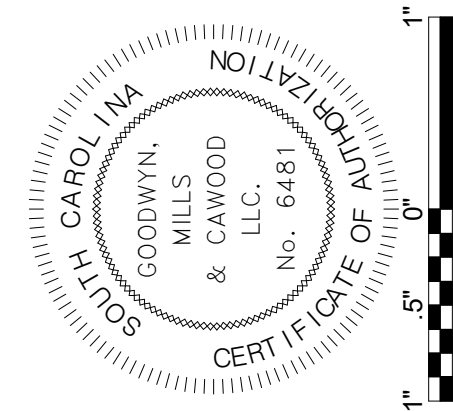
INFLUENT PUMP
STATION - SECTIONS

S-103

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
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City of Clemson
Anderson County

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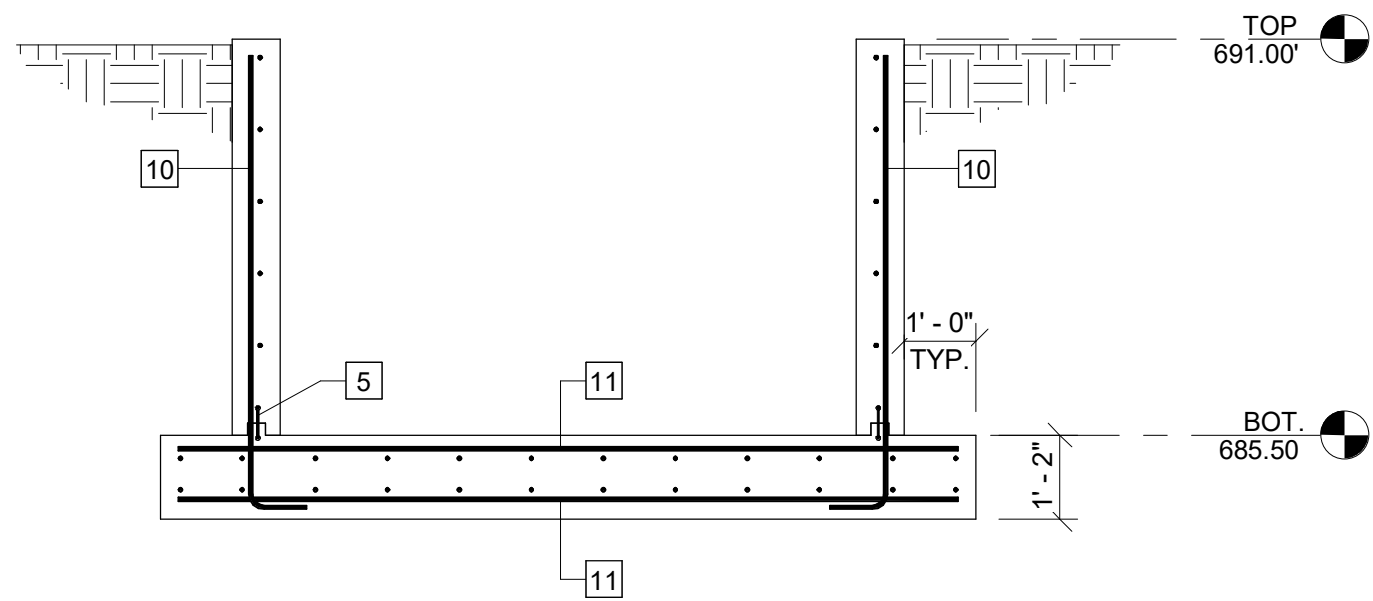
ISSUE	DATE
30% Submittal	01/18/2023
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90% Submittal	12/04/2023
Bid Set	
Conformed Set	
Project Manager:	WN
Engineer:	JD
Designer:	TS
Drawn By:	JD



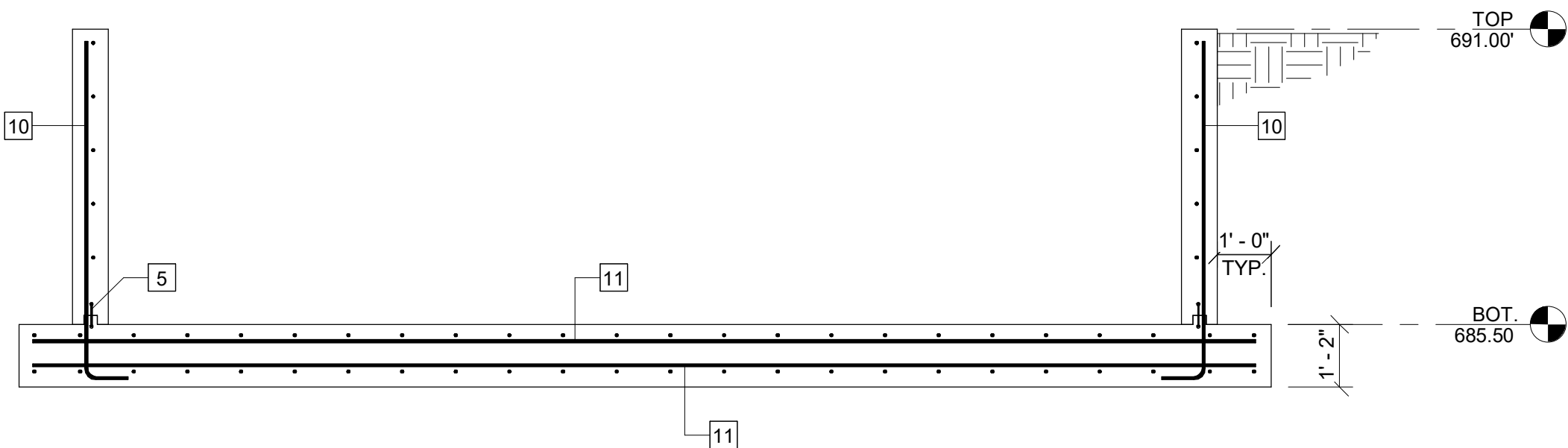
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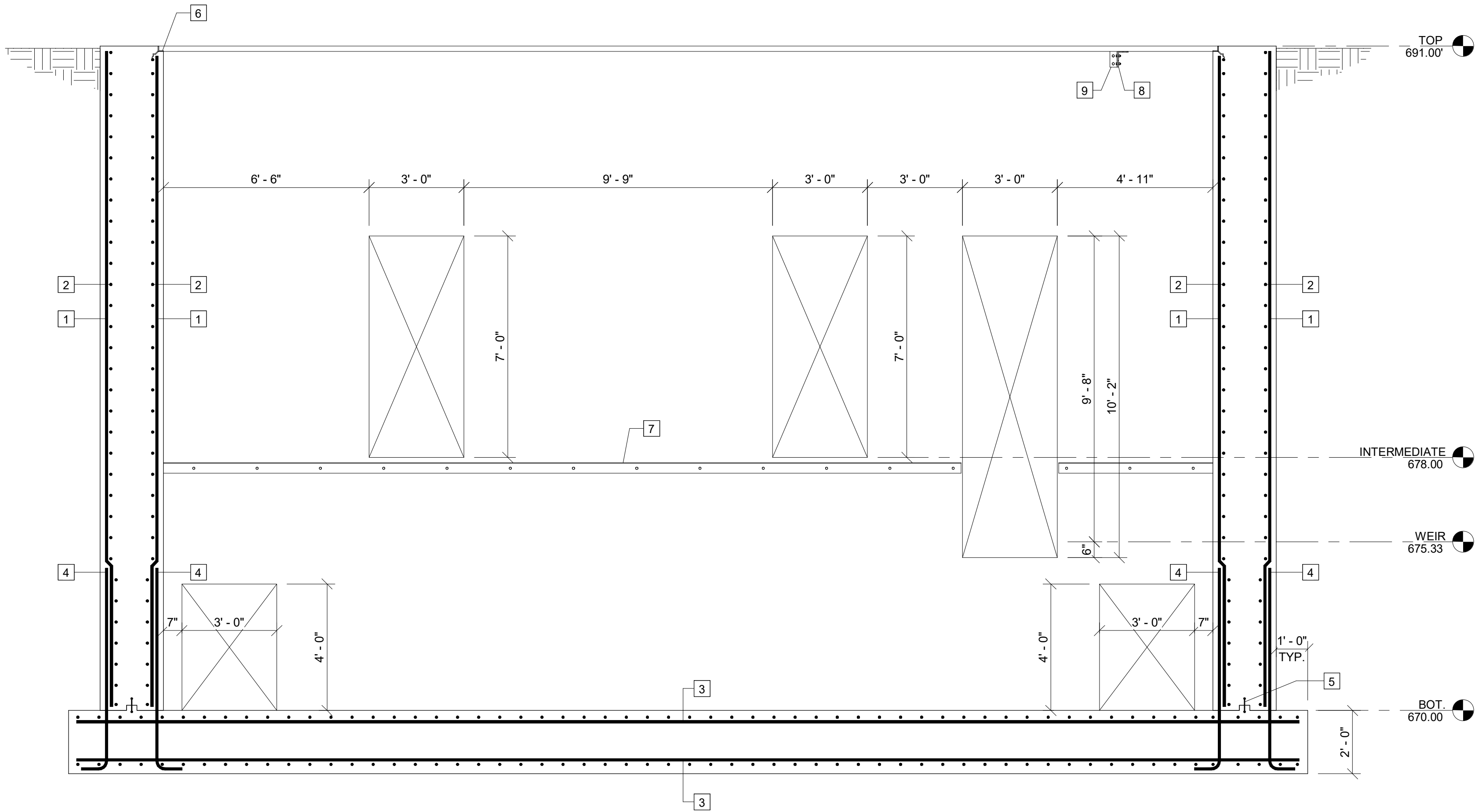
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F SECTION
S-101 SCALE: 3/8" = 1'-0"



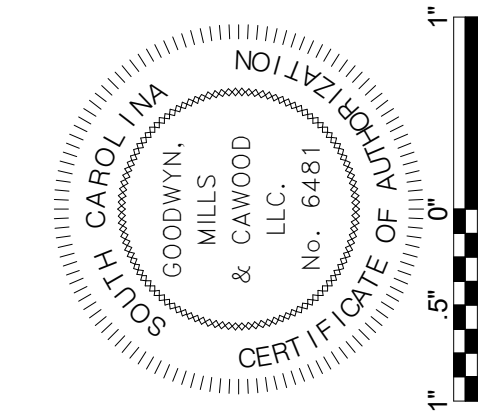
G SECTION
S-101 SCALE: 3/8" = 1'-0"



E SECTION
S-101 SCALE: 3/8" = 1'-0"

KEY NOTES: #

- #7 VERTICAL @ 8" O.C.
- #7 HORIZONTAL @ 8" O.C. (#8 OUTSIDE CORNER BARS)
- #7 @ 8" O.C. EACH WAY
- #7 VERTICAL DOWELS @ 8" O.C.
- 6" PVC WATERSTOP - TYPICAL
- PREFABRICATED GRATING SEAT EMBED
- 316 SS L4x3x5/16 GRATING SUPPORT w/ 1/2" x 5" SS EXPANSION ANCHORS @ 24" MAX. O.C.
- 316 SS L6x4x3/8 GRATING SUPPORT BEAM (TYPICAL)
- 316 SS L4x4x5/16 x 0'-6" LONG CLIP ANGLE w/ (2) 1/2" x 4" SS EXPANSION ANCHORS & (2) 1/2" SS THRU-BOLTS
- #5 @ 12" O.C. EACH WAY - CENTERED IN WALL
- #5 @ 12" O.C. EACH WAY



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INFLUENT PUMP
STATION - SECTIONS

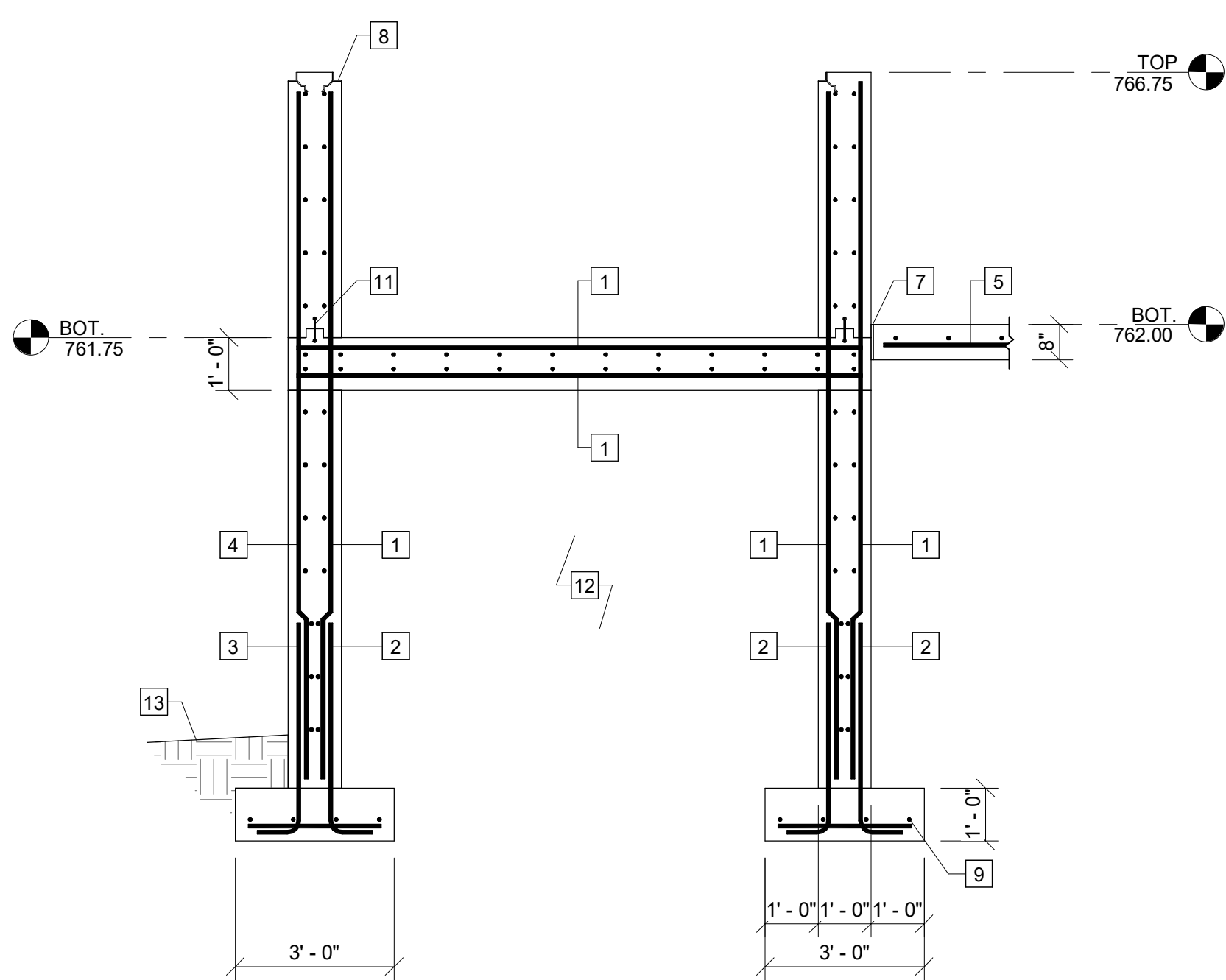
S-104

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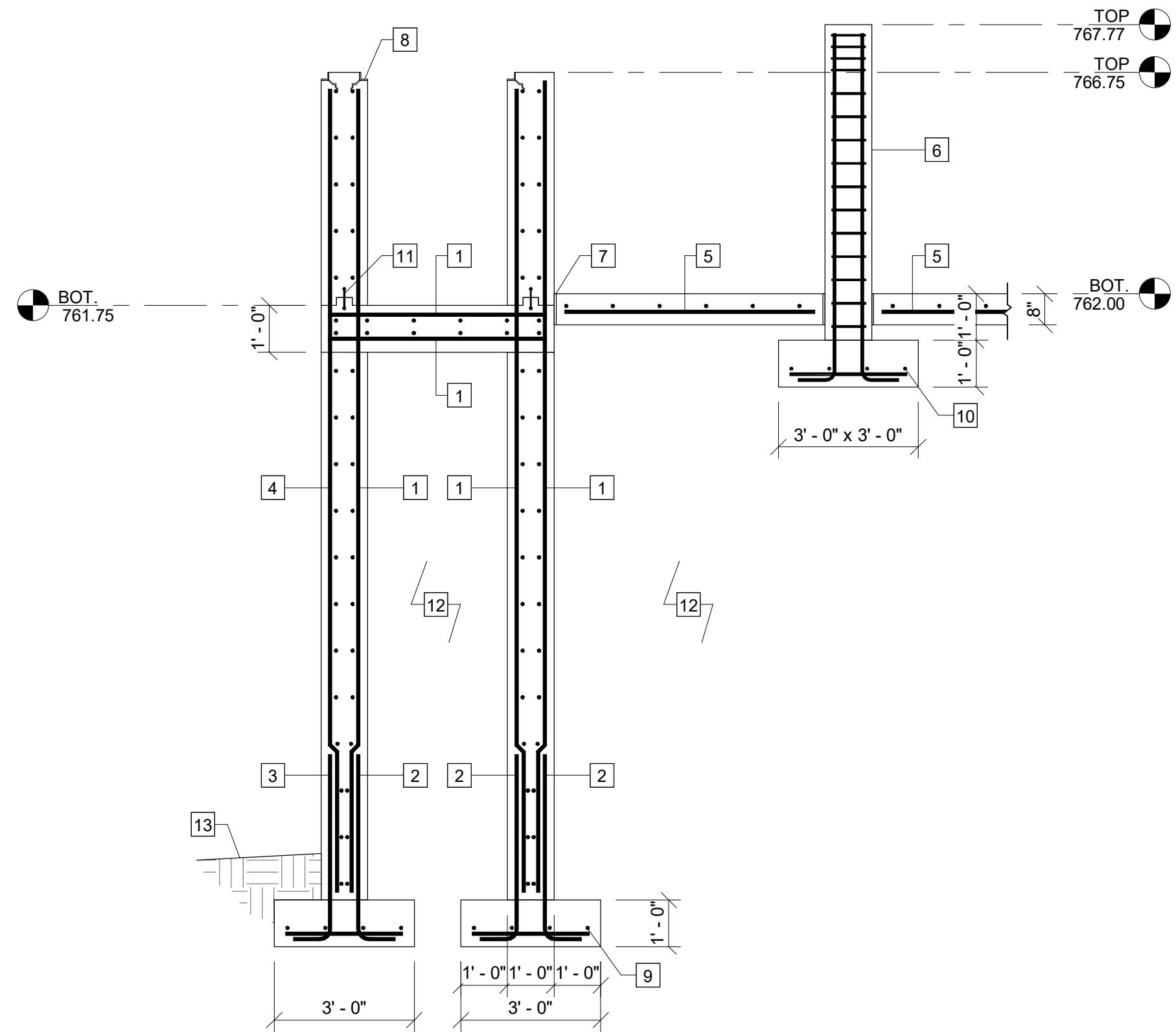
HEADWORKS - PLAN

S-1111

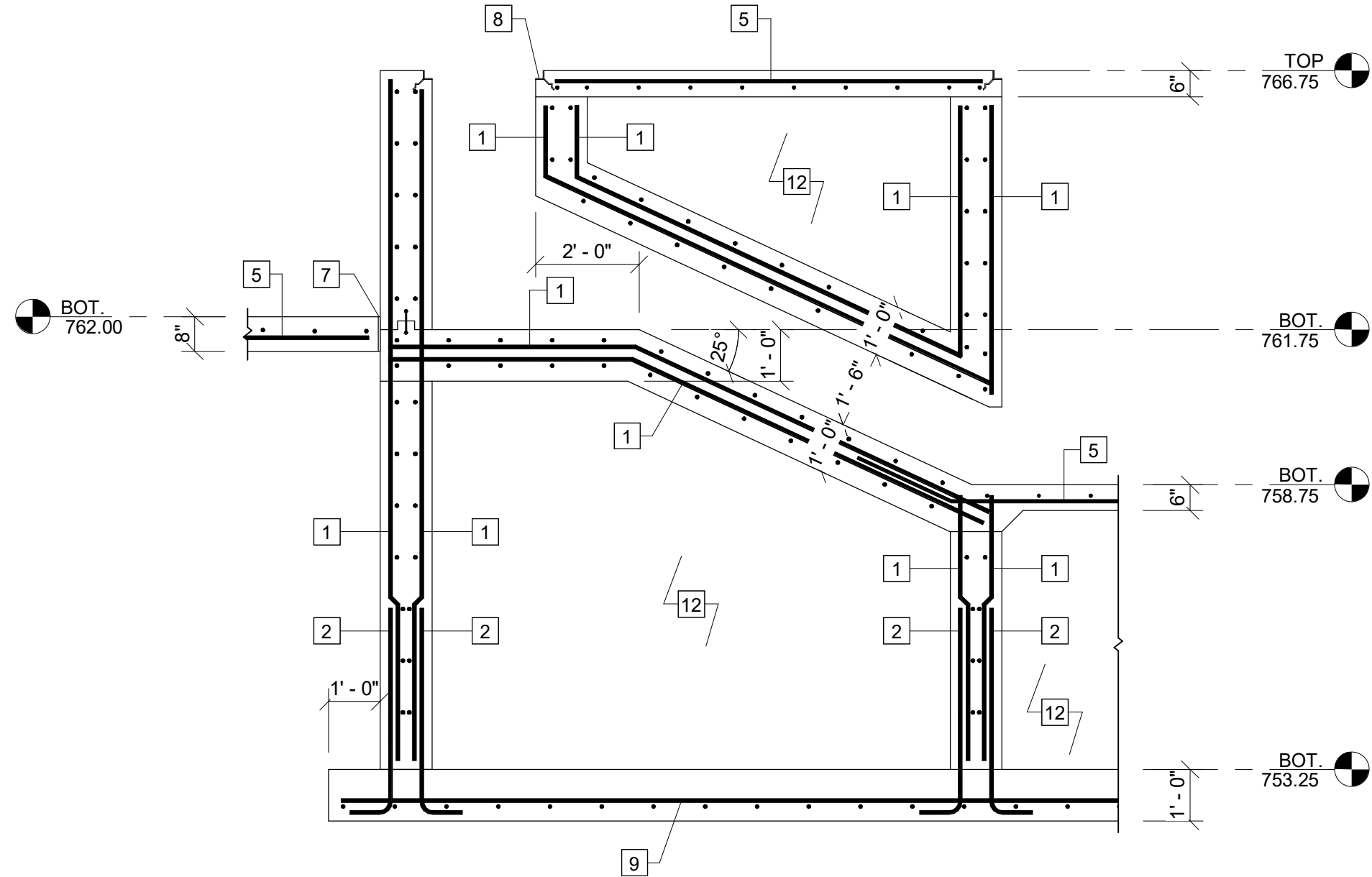
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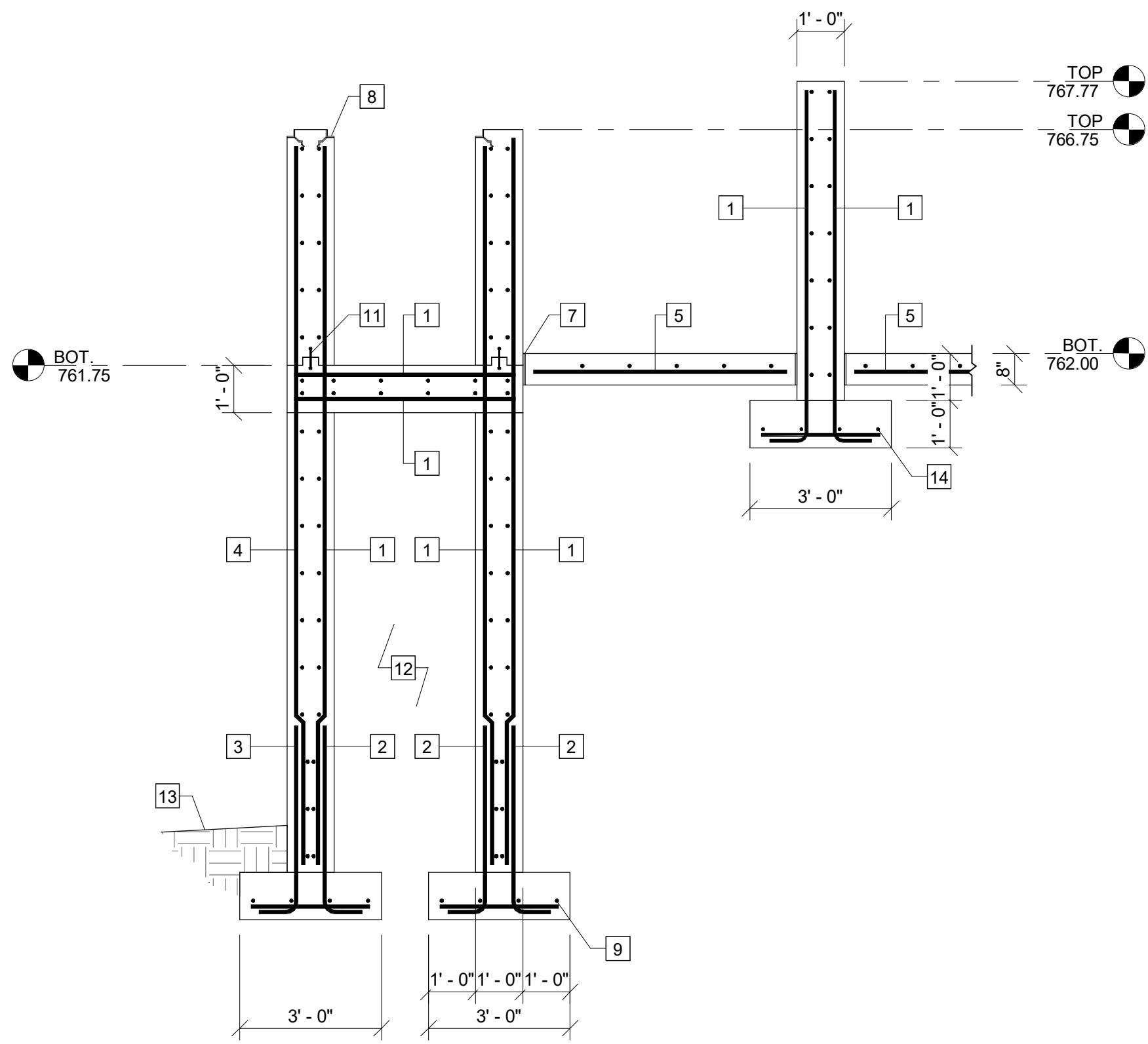
C SECTION
S-111 SCALE: 3/8" = 1'-0"



A SECTION
S-111 SCALE: 3/8" = 1'-0"



D SECTION
S-111 SCALE: 3/8" = 1'-0"



B SECTION
S-111 SCALE: 3/8" = 1'-0"

KEY NOTES: #

- #6 @ 12" O.C. EACH WAY
- #6 VERTICAL DOWELS @ 12" O.C.
- #6 VERTICAL DOWELS @ 6" O.C.
- #6 VERTICAL @ 6" O.C., #6 HORIZONTAL @ 12" O.C.
- #6 @ 12" O.C. EACH WAY (CENTERED IN SLAB)
- 12"x12" PIER w/ (4) #5 VERTICAL & #3 TIES (3 SP. @ 3" O.C., R @ 6" O.C.)
- 1/2" CONTINUOUS PREMOLDED EXPANSION JOINT
- PREFABRICATED GRATING SEAT EMBED
- (4) #6 CONTINUOUS w/ #6 TRANSVERSE @ 12" O.C.
- (4) #5 EACH WAY
- 6" PVC WATERSTOP - TYPICAL
- CLEAN COMPACTED GRANULAR FILL PER GEOTECHNICAL
- FINISH GRADE VARIES - MAINTAIN 1'-0" MINIMUM COVER
- (4) #5 CONTINUOUS w/ #5 TRANSVERSE @ 12" O.C.

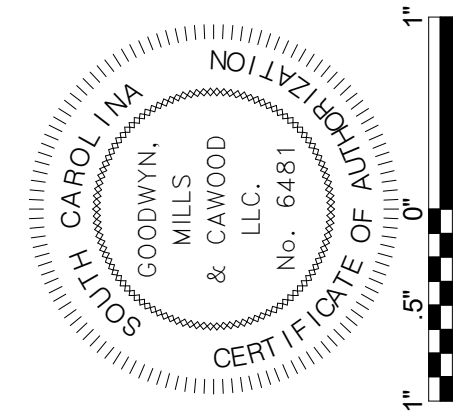
**HEADWORKS -
SECTIONS**

S-112

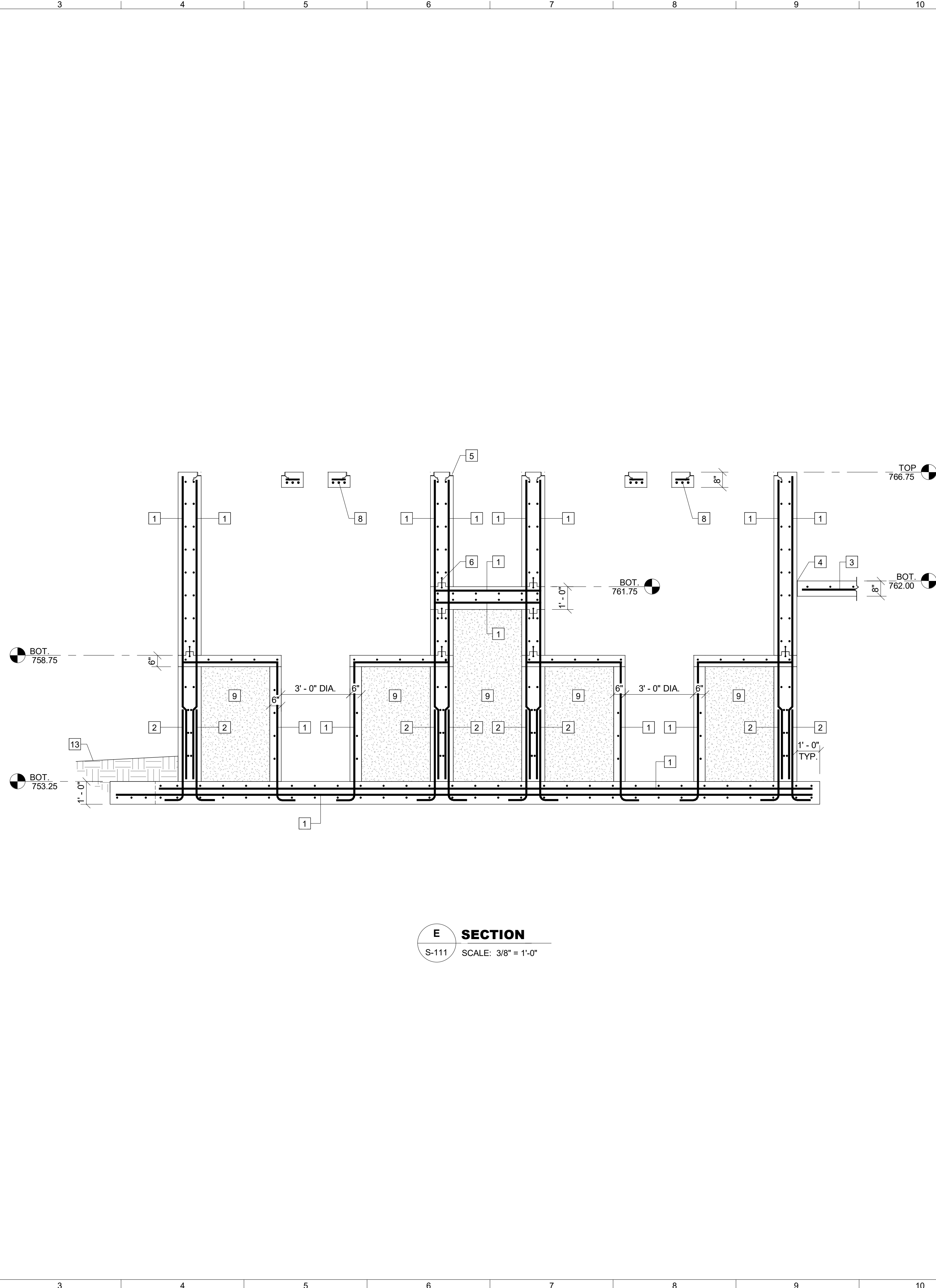
**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

ISSUE	DATE
30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
Bid Set	
Conformed Set	
Project Manager:	WN
Engineer:	JD
Designer:	TS
Drawn By:	JD



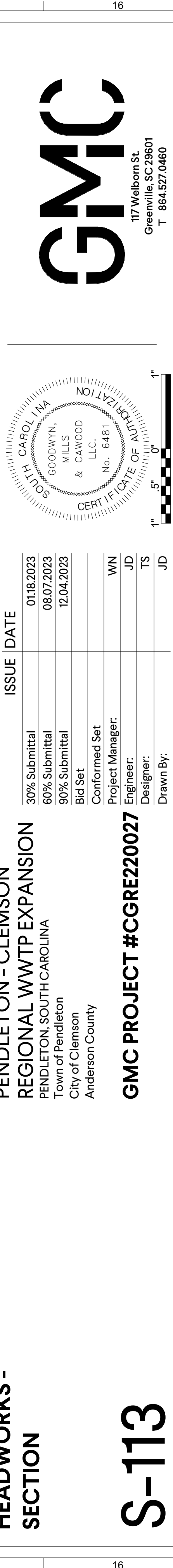
GMC
117 Welborn St.
Greenville, SC 29601
T 864.527.0460



E SECTION

S-111 SCALE: 3/8" = 1'-0"

- | | | |
|---|----|--|
| 13 | 14 | |
| KEY NOTES: # | | |
| 1. #6 @ 12" O.C. EACH WAY | | |
| 2. #6 VERTICAL DOWELS @ 12" O.C. | | |
| 3. #6 @ 12" O.C. EACH WAY (CENTERED IN SLAB) | | |
| 4. 1/2" CONTINUOUS PREMOLDED EXPANSION JOINT | | |
| 5. PREFABRICATED GRATING SEAT EMBED | | |
| 6. 6" PVC WATERSTOP - TYPICAL | | |
| 7. BITUMINOUS WATER STOP - TYPICAL | | |
| 8. (6) #8 CONTINUOUS w/ #5 TRANSVERSE @ 12" O.C. | | |
| 9. CLEAN COMPACTED GRANULAR FILL PER GEOTECHNICAL | | |
| 10. FINISH GRADE VARIES - MAINTAIN 1'-0" MINIMUM COVER | | |
| 13 | 14 | |



HEADWORKS - SECTION	
PENDLETON - CLEMSON REGIONAL WWTP EXPANSION	
PENDLETON, SOUTH CAROLINA	
Town of Pendleton	
City of Clemson	
Anderson County	
Geographical Area	
ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
Bid Set	
Construction	

S-113

GMC PROJECT #CGRE220027

Project manager: **JD**

Engineer: **JD**

Designer: **TS**

Drawn By: **JD**

1" = 5' 0"

DATE OF SUBMITTAL

117 Welborn St.
Greenville, SC 29601
T 864.527.0480


GMC PROJECT #CGRE220027
 Project manager: **WJ**
 Engineer: **JD**
 DATE OF AWARD: **11/1/2022**
 117 Welborn St.
 117 Welborn St.

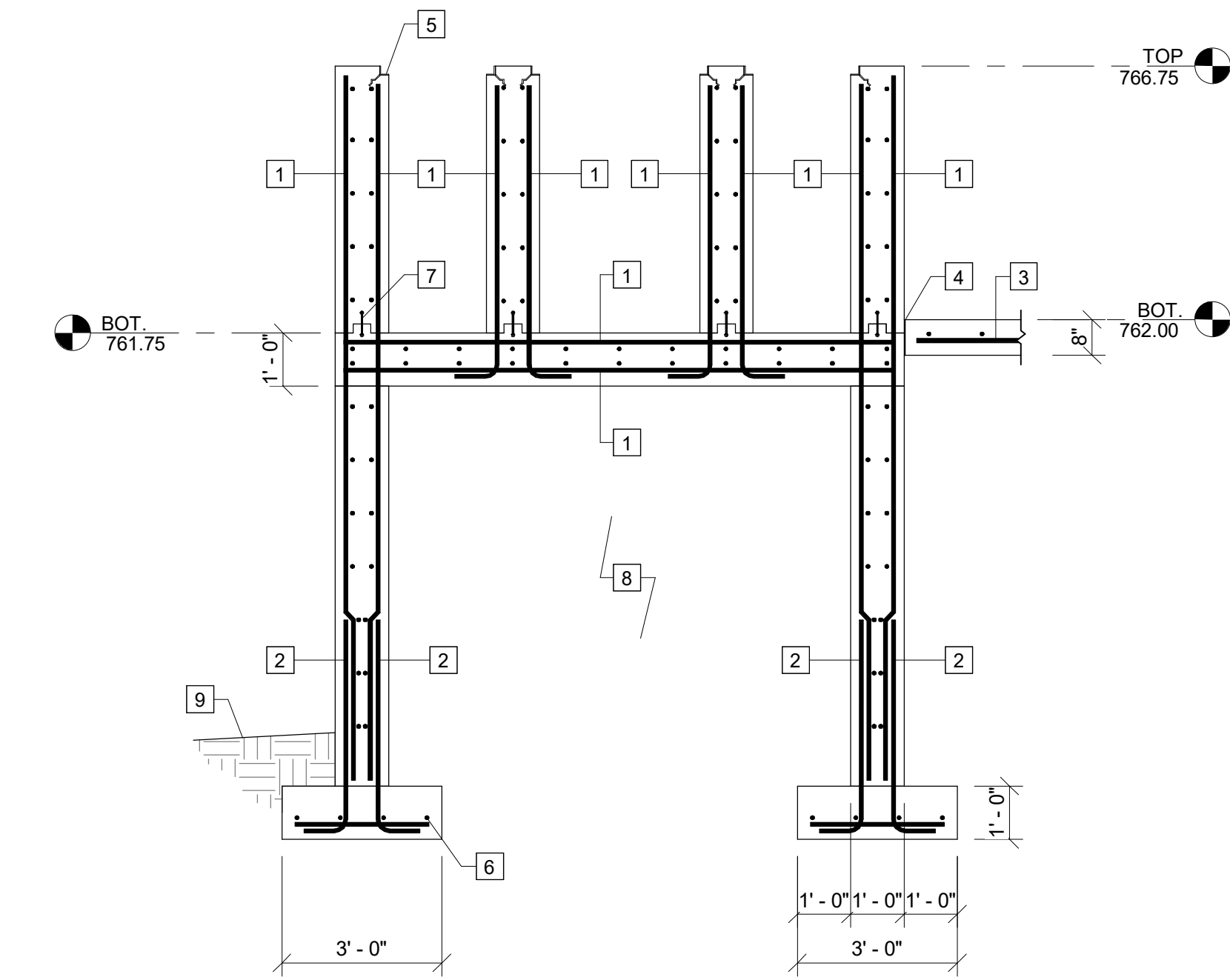
S-113

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Greenville, SC 29601
T 864.527.0460

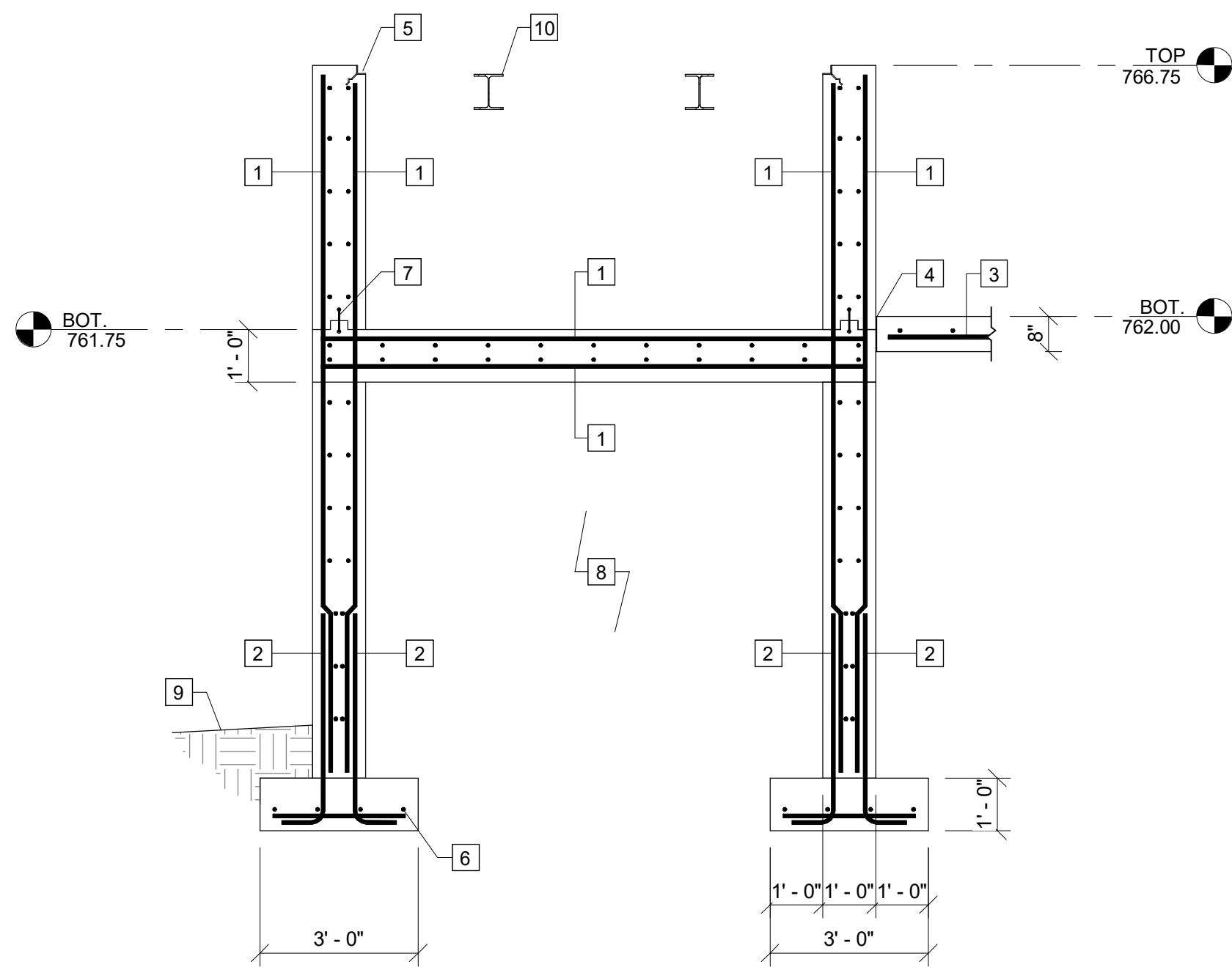
GMC PROJECT #CGRE220027

Project Manager:	WN
Engineer:	JD
Designer:	TS
Drawn By:	JD

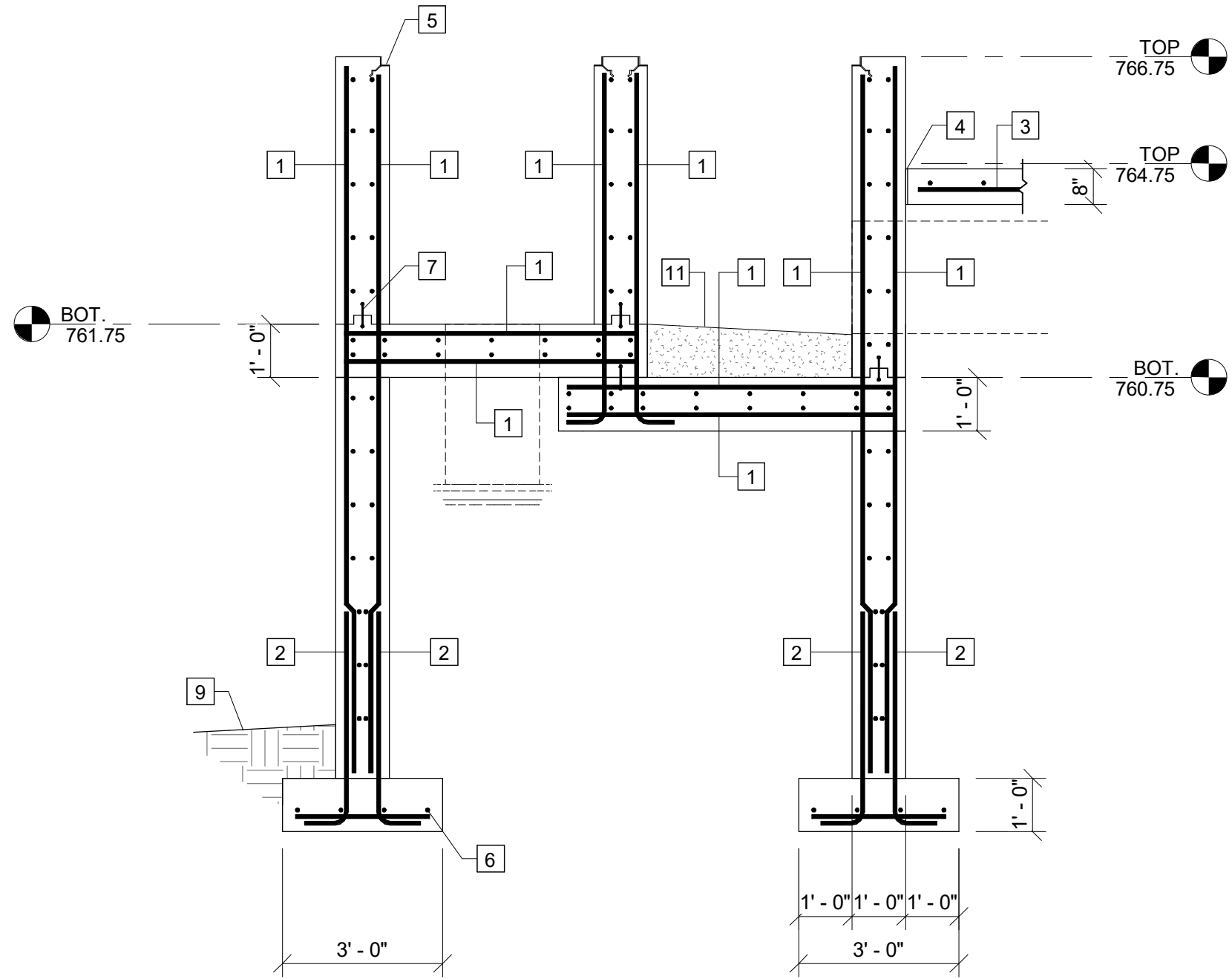
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12/8/2023 2:27:18 PM



F SECTION
S-111 SCALE: 3/8" = 1'-0"



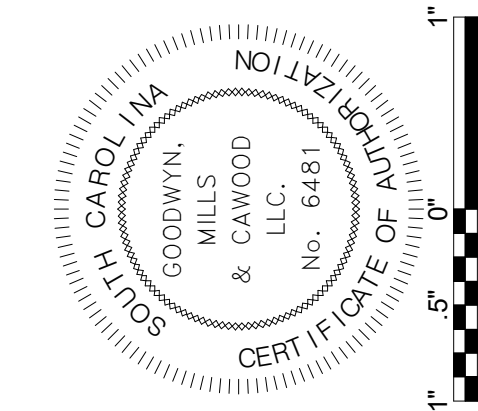
G SECTION
S-111 SCALE: 3/8" = 1'-0"



H SECTION
S-111 SCALE: 3/8" = 1'-0"

KEY NOTES: #

1. #6 @ 12" O.C. EACH WAY
2. #6 VERTICAL DOWELS @ 12" O.C.
3. #6 @ 12" O.C. EACH WAY (CENTERED IN SLAB)
4. 1/2" CONTINUOUS PREMOLDED EXPANSION JOINT
5. PREFABRICATED GRATING SEAT EMBED
6. (4) #6 CONTINUOUS w/ #6 TRANSVERSE @ 12" O.C.
7. 6" PVC WATERSTOP - TYPICAL
8. CLEAN COMPACTED GRANULAR FILL PER GEOTECHNICAL
9. FINISH GRADE VARIES - MAINTAIN 1'-0" MINIMUM COVER
10. GRATING SUPPORT BEAM - SEE PLAN
11. GROUT FILL - SEE PROCESS



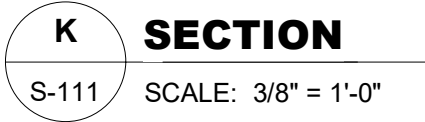
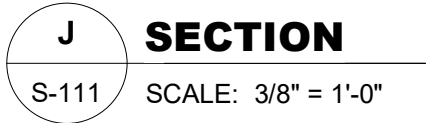
ISSUE	DATE
30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
Bid Set	
Conformed Set	
Project Manager:	WN
Engineer:	JD
Designer:	TS
Drawn By:	JD

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

**HEADWORKS -
SECTIONS**

S-114

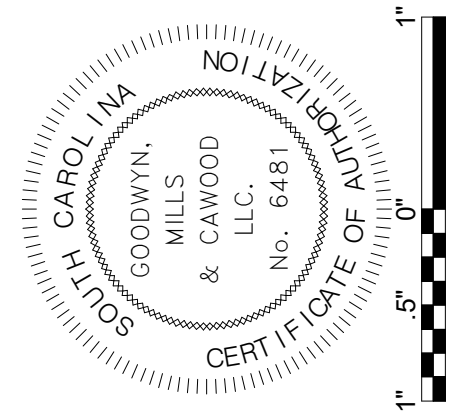


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Greenville, SC 29601
T 864.527.0460</div> </div> <div> </div> </div> | | ISSUE | DATE | 30% Submittal | | 0118.2023 | 60% Submittal | | 08.07.2023 | 90% Submittal | | 12.04.2023 | Bid Set | | | Conformed Set | | | Project Manager: | WN | | Engineer: | JD | | Designer: | TS | | Drawn By: | JD | |
|---|-------|------------|--|--|-------|------|---------------|--|-----------|---------------|--|------------|---------------|--|------------|---------|--|--|---------------|--|--|------------------|----|--|-----------|----|--|-----------|----|--|-----------|----|--|
| | ISSUE | DATE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 30% Submittal | | 0118.2023 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 60% Submittal | | 08.07.2023 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 90% Submittal | | 12.04.2023 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bid Set | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Conformed Set | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Manager: | WN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineer: | JD | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Designer: | TS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drawn By: | JD | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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S-115

GMC PROJECT #CGRE220027

ISSUE	DATE
30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
Bid Set	
Conformed Set	
Project Manager:	WN
Engineer:	JD
Designer:	TS
Drawn By:	JD



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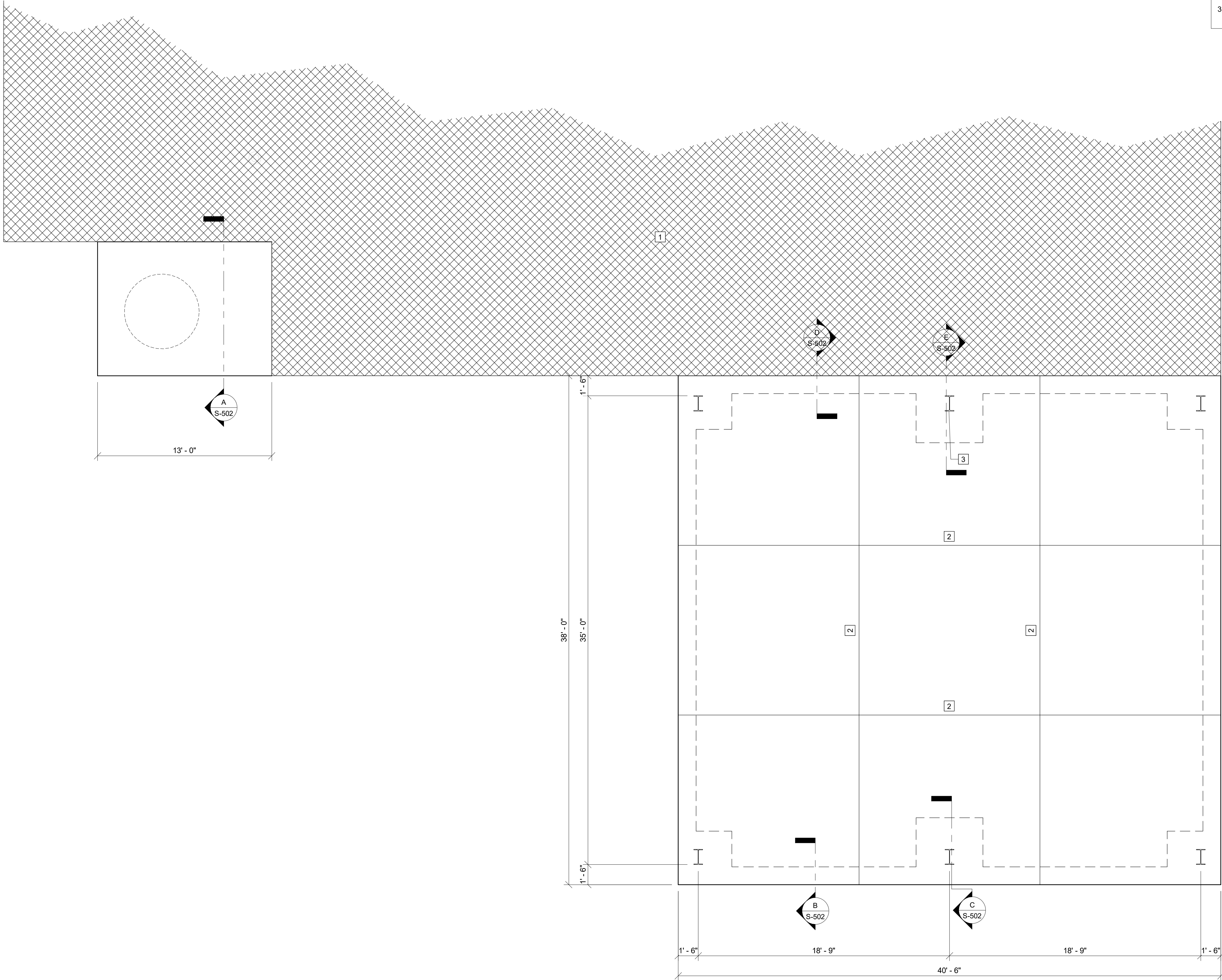


1
S-501

PLAN

SCALE: 1/4" = 1'-0"

- KEY NOTES:** #
- EXISTING BUILDING
 - CONTROL JOINT
 - PRE-ENGINEERED METAL BUILDING COLUMN - TYPICAL 6 PLACES



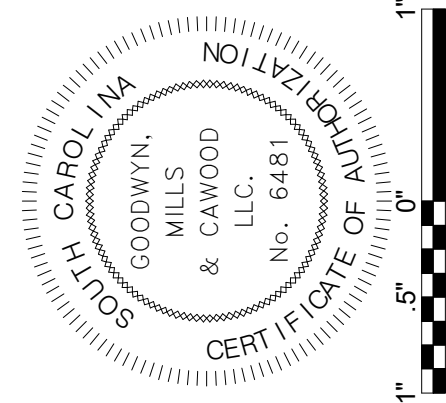
FILTERS - PLAN

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

S-501

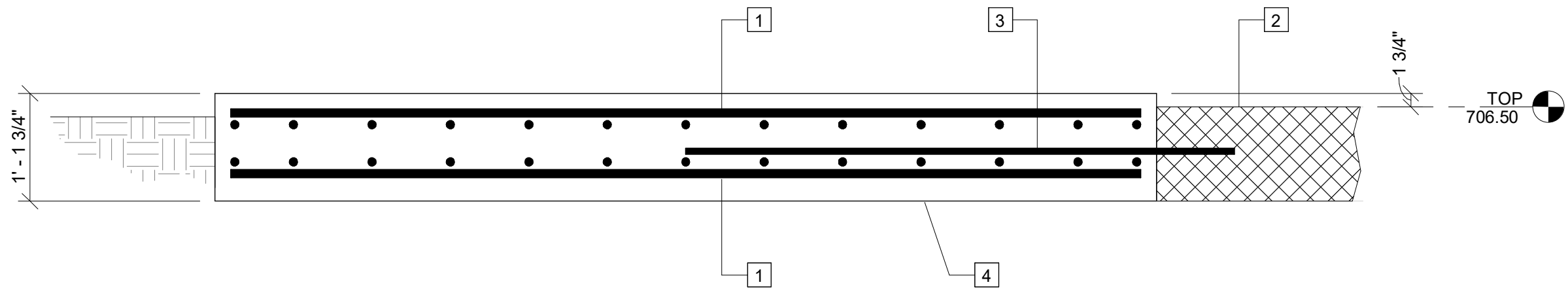
GMC PROJECT #CGRE220027

ISSUE	DATE
30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
Bid Set	
Conformed Set	
Project Manager:	WN
Engineer:	JD
Designer:	TS
Drawn By:	JD

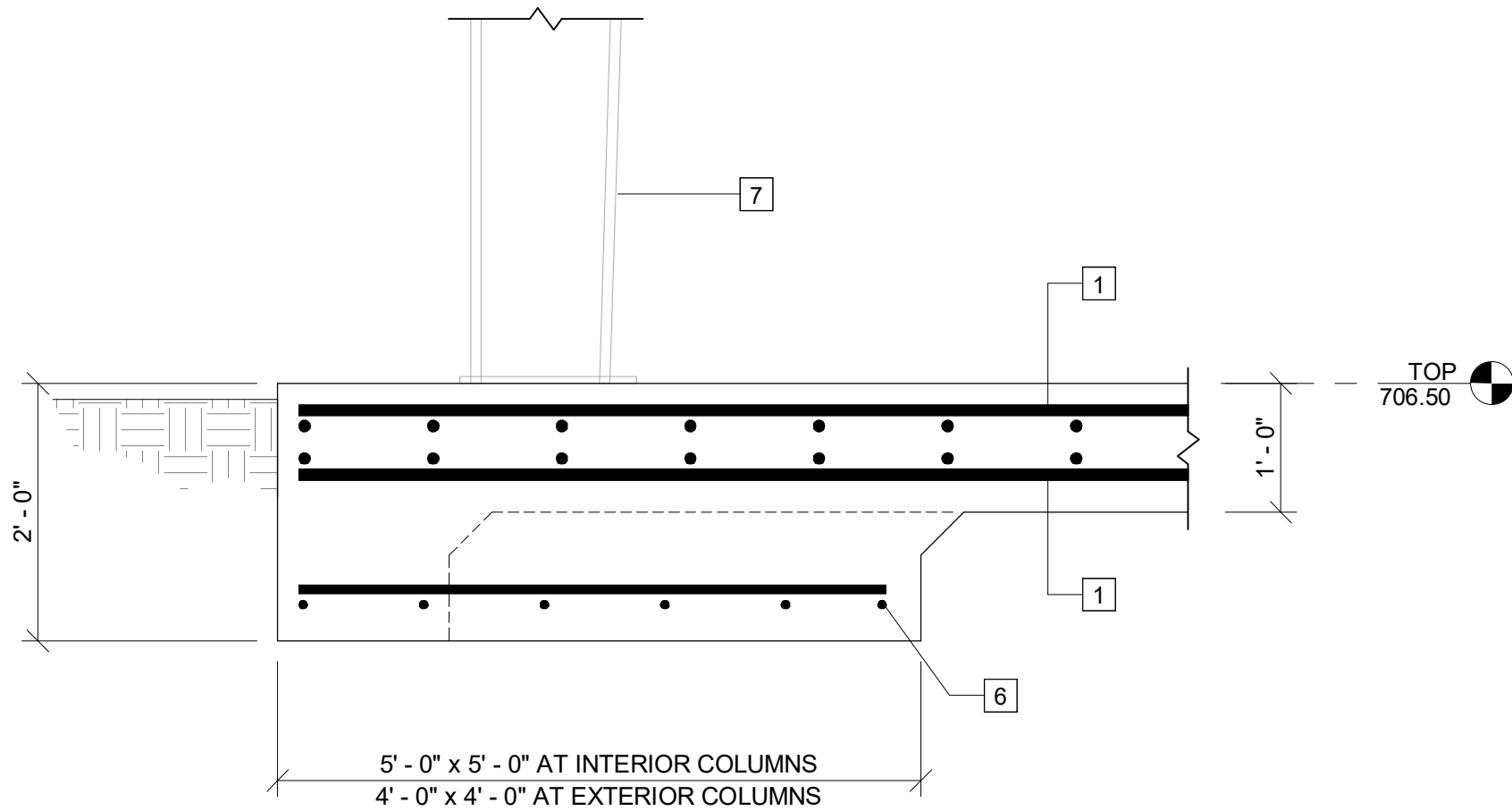


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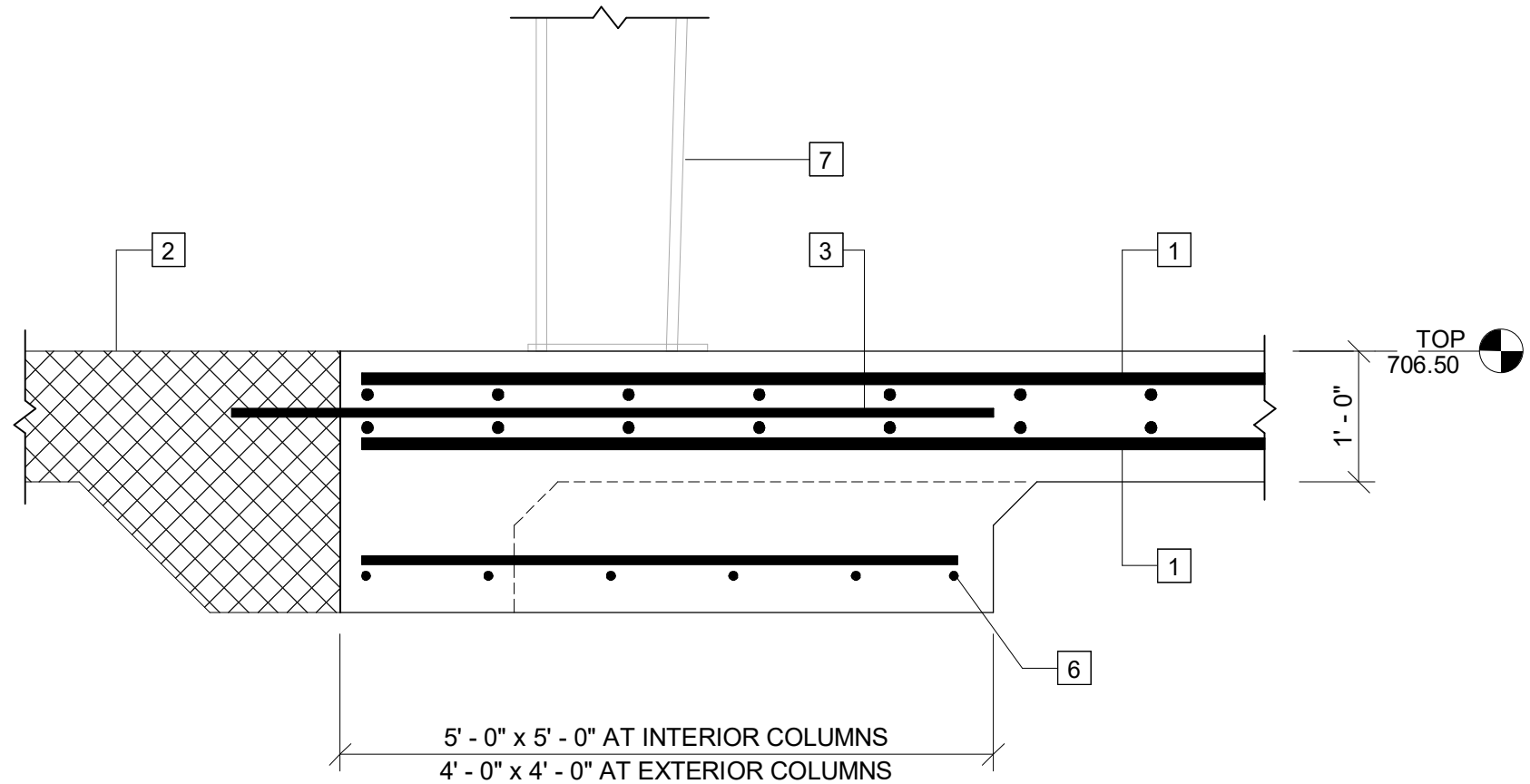
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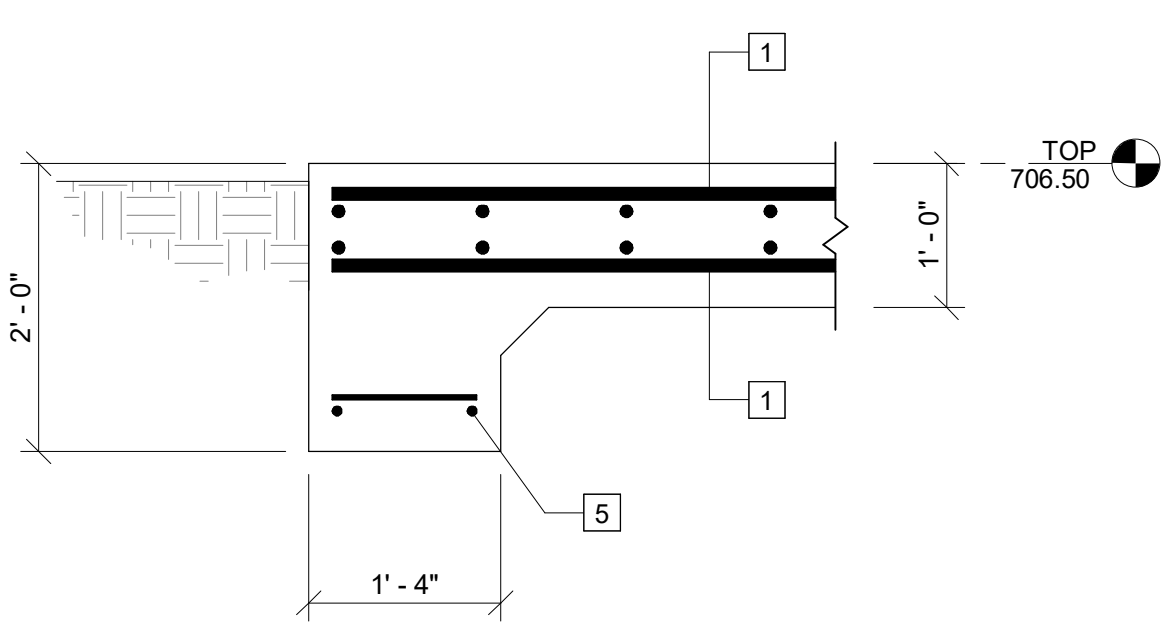
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S-501 SCALE: 3/4" = 1'-0"



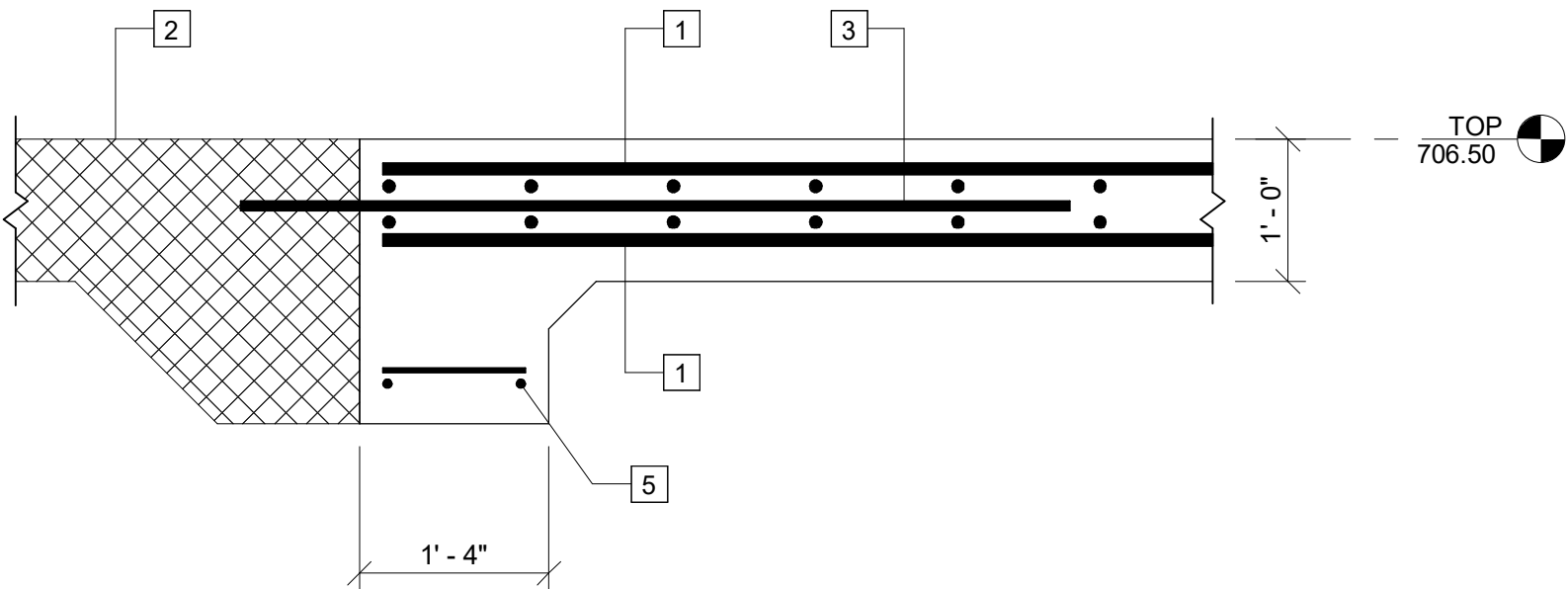
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E Section 19
S-501 SCALE: 3/4" = 1'-0"



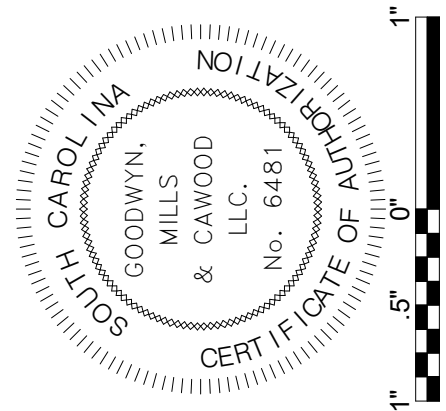
B Section 16
S-501 SCALE: 3/4" = 1'-0"



D SECTION
S-501 SCALE: 3/4" = 1'-0"

KEY NOTES: #

1. #8 @ 12" MAX. O.C. EACH WAY
2. EXISTING BUILDING SLAB
3. #6 DOWELS @ 36" MAX. O.C. (DRILL & EPOXY 10" INTO EXISTING)
4. MATCH EXISTING BOTTOM OF SLAB ELEVATION
5. (2) #6 CONTINUOUS w/ #3 TRANSVERSE @ 24" MAX. O.C.
6. (6) #6 EACH WAY AT INTERIOR COLUMNS, (5) 6 EACH WAY AT EXTERIOR COLUMNS
7. COLUMN AND ANCHORAGE BY PEMB SUPPLIER



ISSUE	DATE
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60% Submittal	08/07/2023
90% Submittal	12/04/2023
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Conformed Set	
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Engineer:	JD
Designer:	TS
Drawn By:	JD

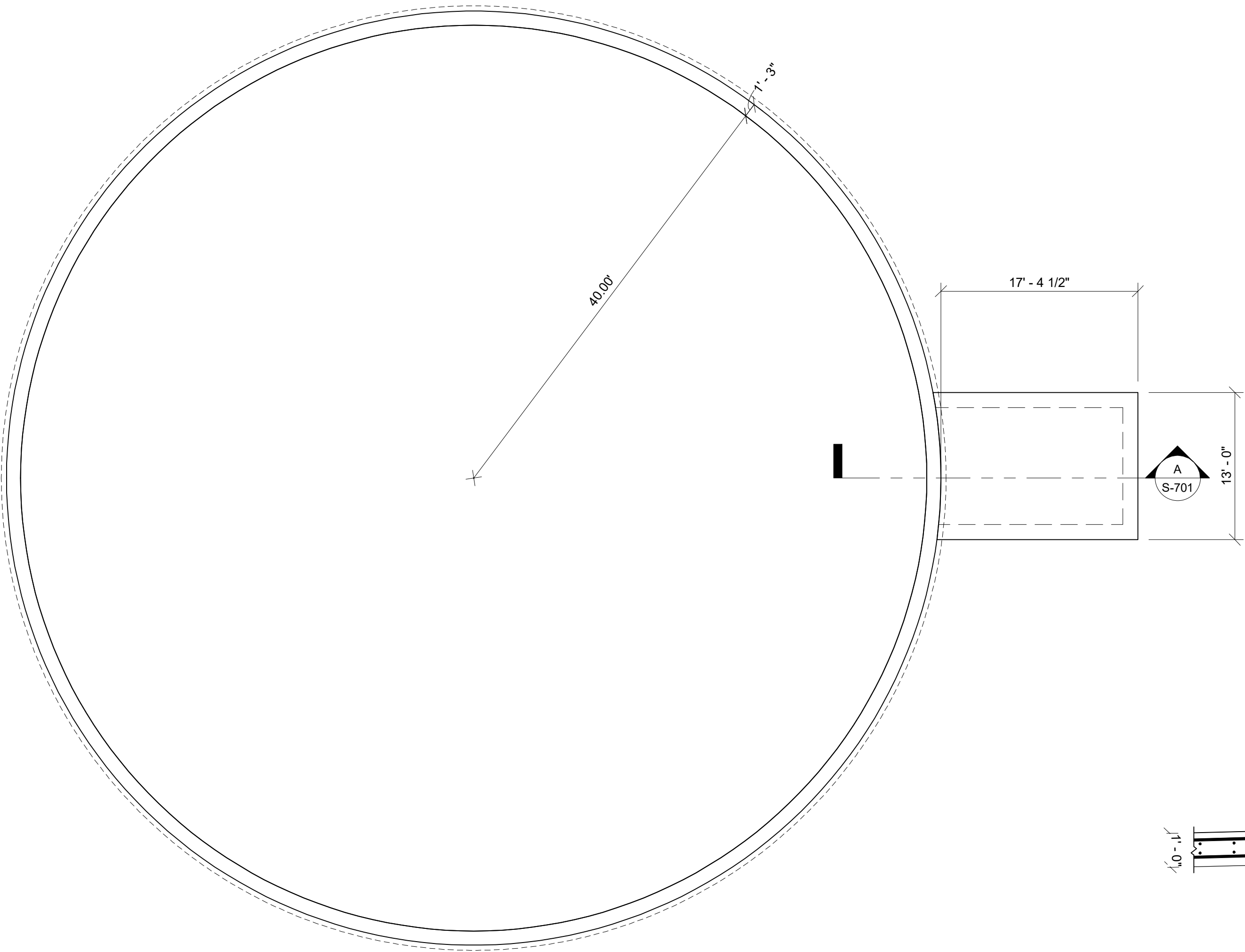
PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

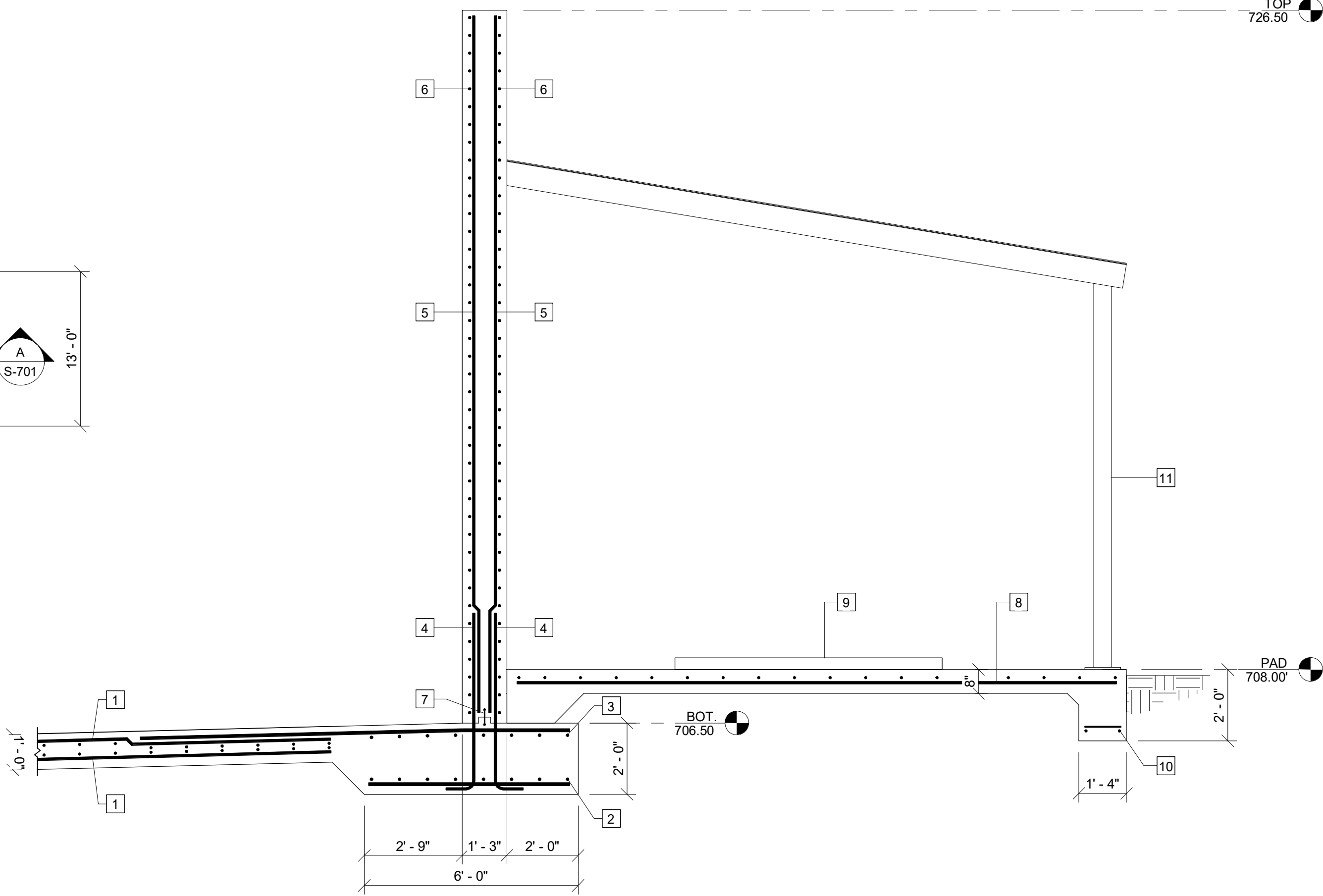
FILTERS - SECTIONS

S-502

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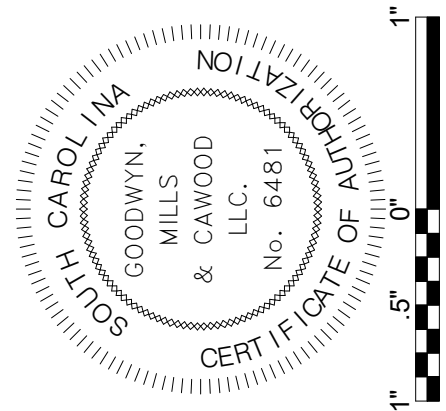
 **1 PLAN**
S-701 SCALE: 1/8" = 1'-0"



A SECTION
S-701 SCALE: 3/8" = 1'-0"

KEY NOTES: #

1. #6 @ 12" O.C. EACH WAY
2. (8) #7 CONTINUOUS RADIUS w/ #7 TRANSVERSE @ 12" MAX. O.C. RADIAL
3. (8) #7 CONTINUOUS RADIUS w/ #7 x 12'-0" TRANSVERSE @ 12" MAX. O.C. RADIAL
4. #6 VERTICAL DOWELS @ 12" O.C.
5. #6 VERTICAL @ 12" O.C.
6. #6 HORIZONTAL @ 6" O.C.
7. 6" PVC WATERSTOP - TYPICAL
8. #6 @ 12" O.C. EACH WAY - CENTERED IN SLAB
9. EQUIPMENT PAD - SEE S-002 FOR DETAILS
10. (2) #6 CONTINUOUS w/ #3 TRASNVVERSE @ 24" MAX. O.C.
11. PREFABRICATED CANOPY BY OTHERS



ISSUE	DATE
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Conformed Set	
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Engineer:	JD
Designer:	TS
Drawn By:	JD

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGCRE220027

AEROBIC DIGESTER -
PLAN

S-701

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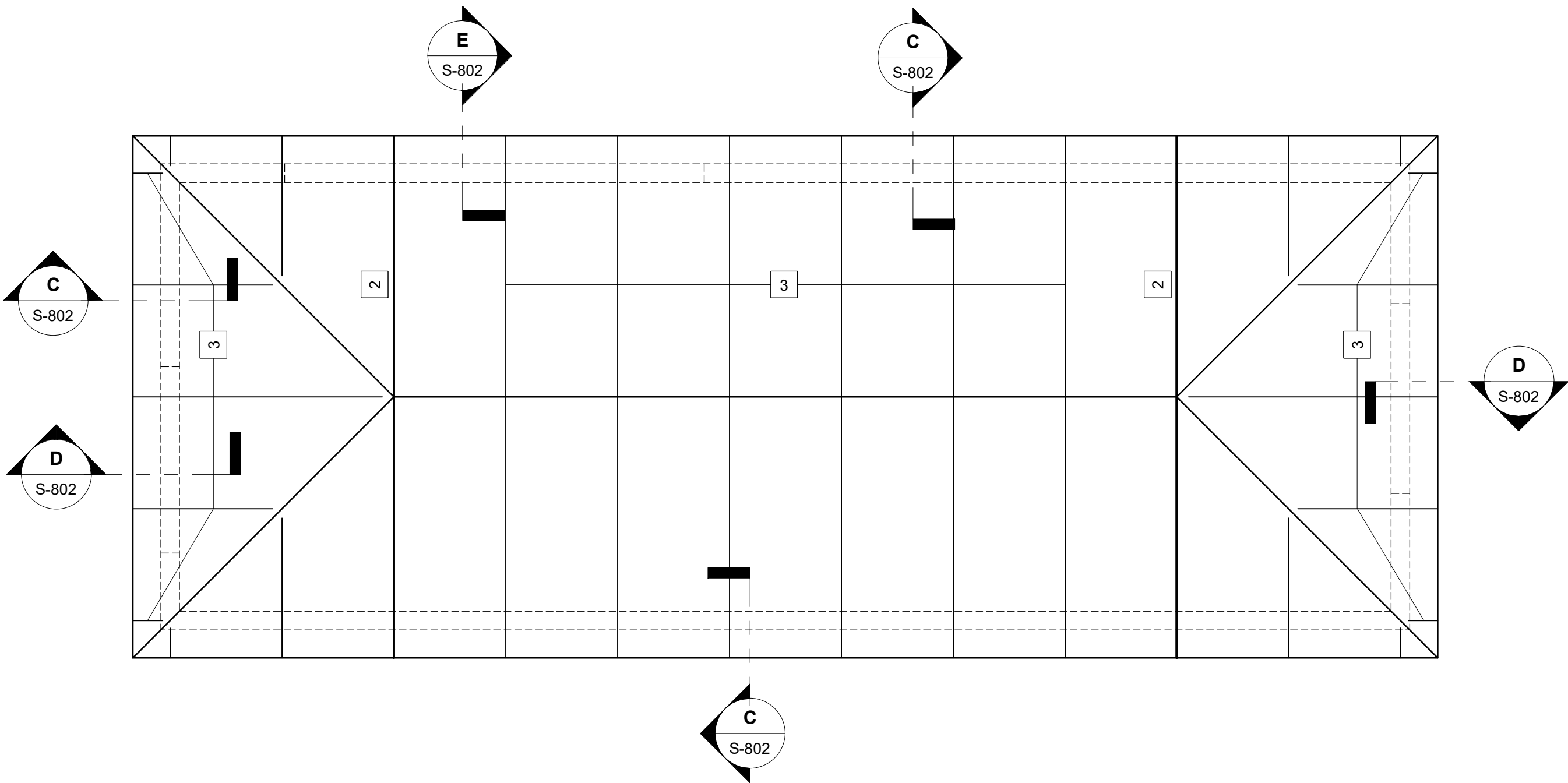


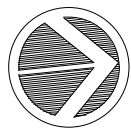
2

ROOF FRAMING PLAN

S-801

SCALE: 1/4" = 1'-0"



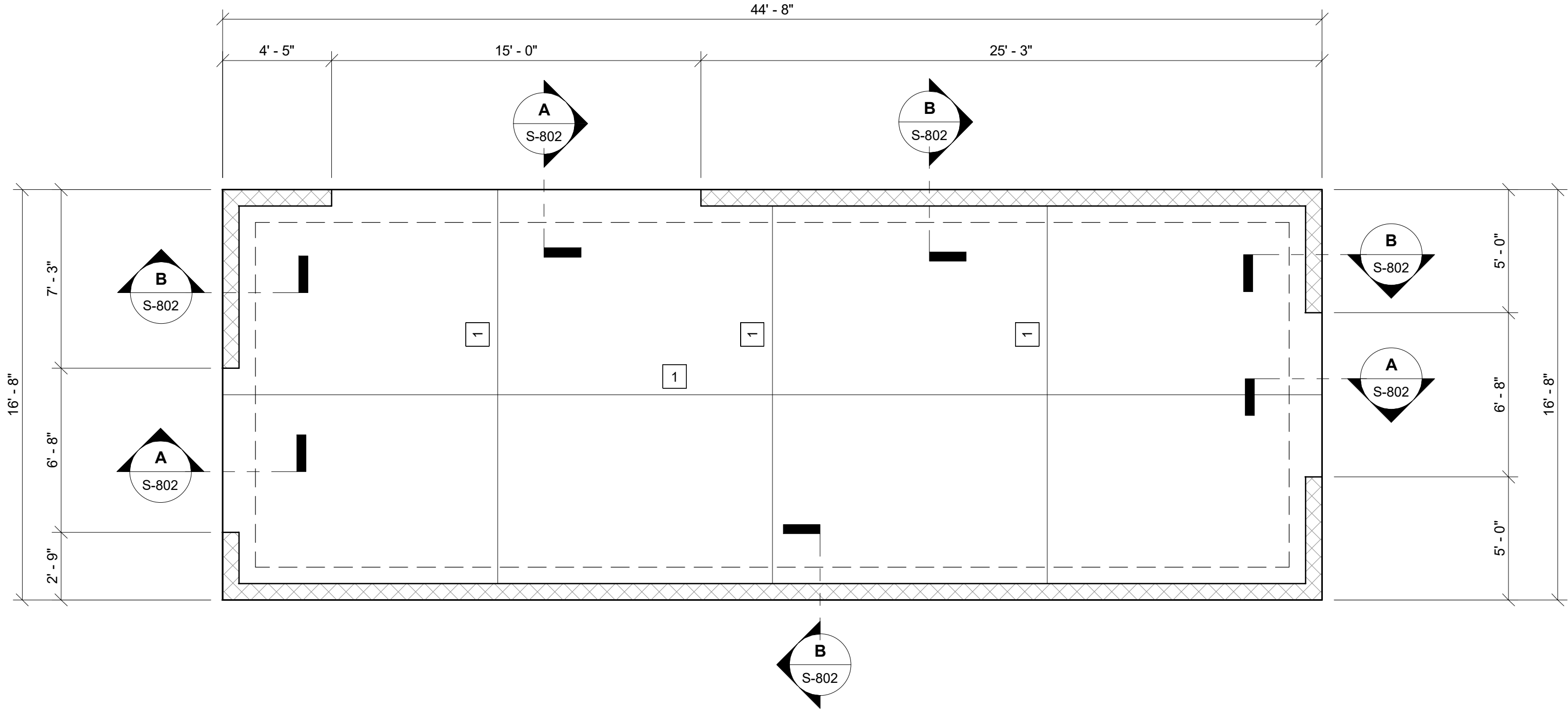


1

PLAN

S-801

SCALE: 1/4" = 1'-0"



KEY NOTES: #

1. CONTROL JOINT
2. PREFABRICATED LIGHT GAUGE STEEL GIRDER TRUSS
3. PREFABRICATED LIGHT GAUGE STEEL TRUSSES @ 4'-0" O.C.

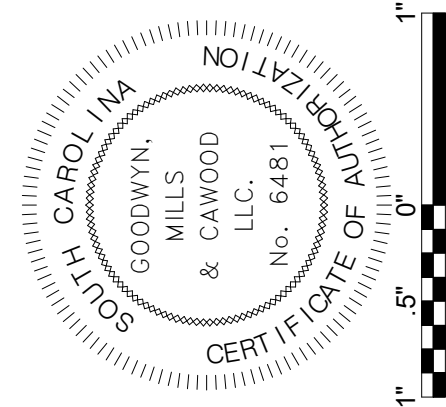
MAIN ELECTRICAL
BUILDING - PLAN

S-801

PENDLETON - CLEMSON
REGIONAL WWTTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

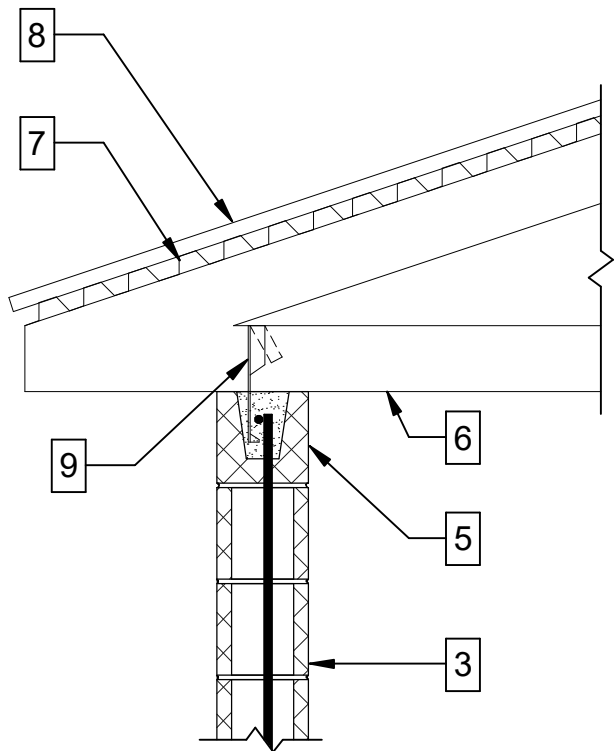
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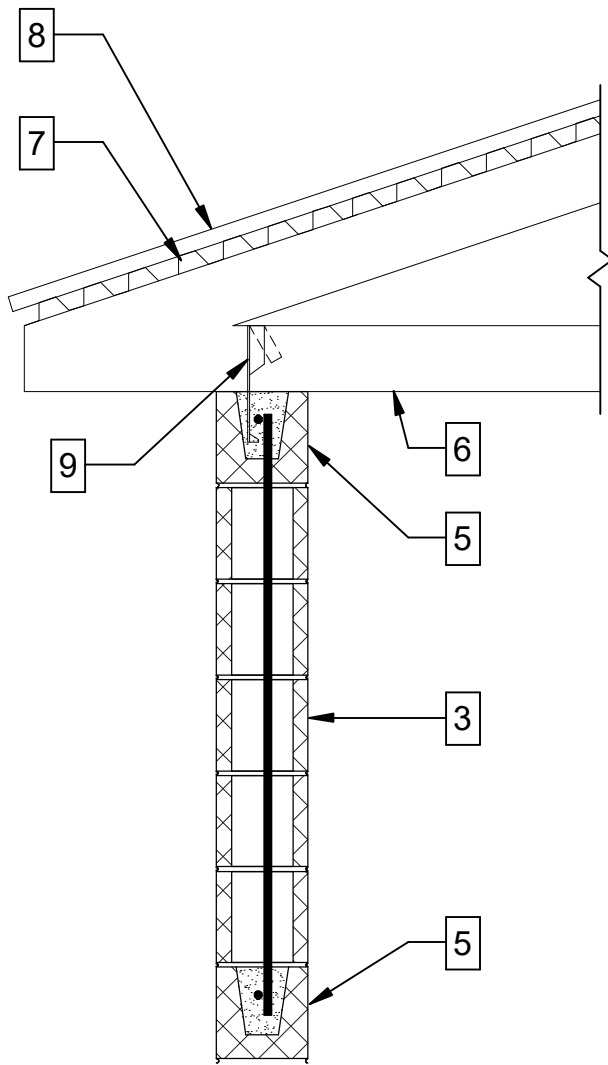


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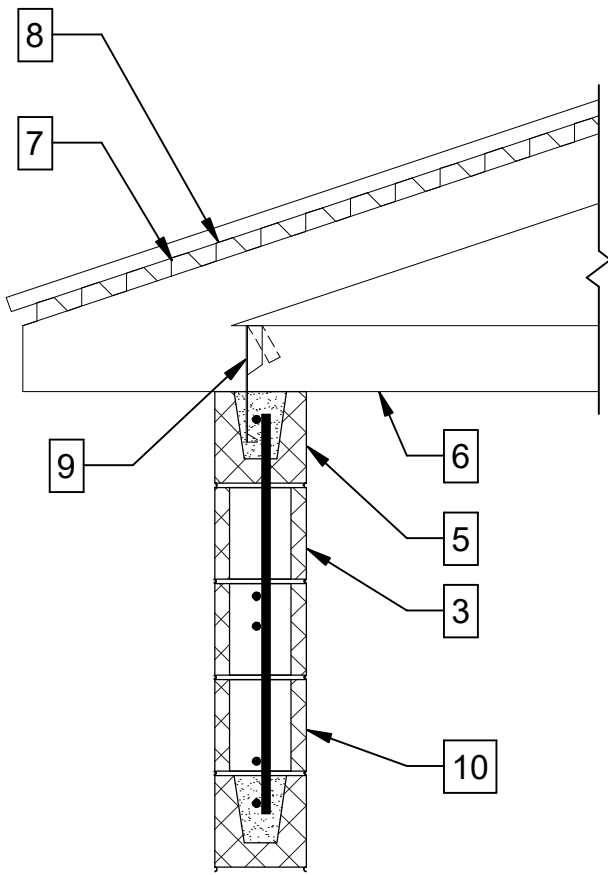
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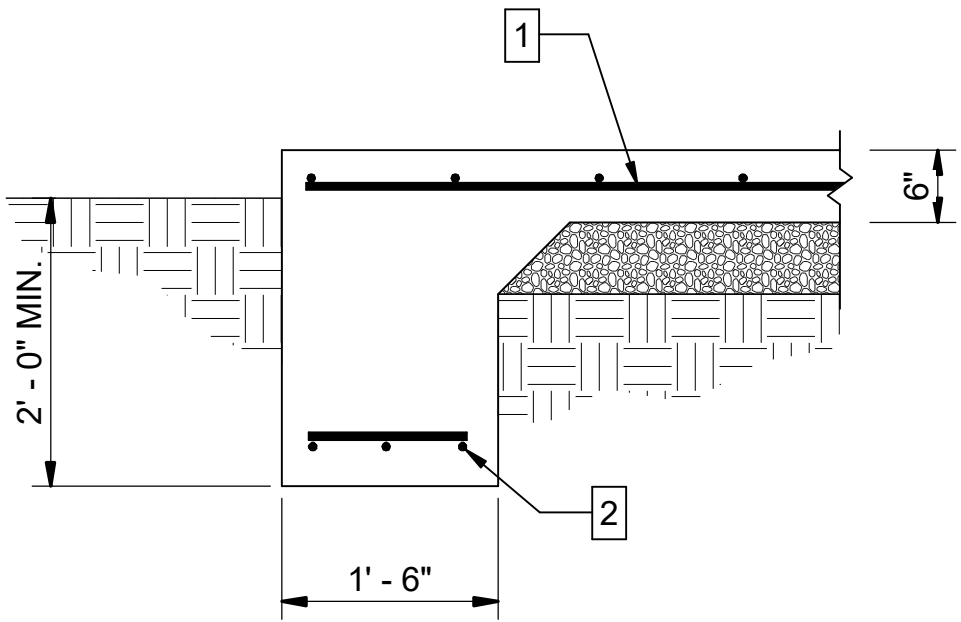
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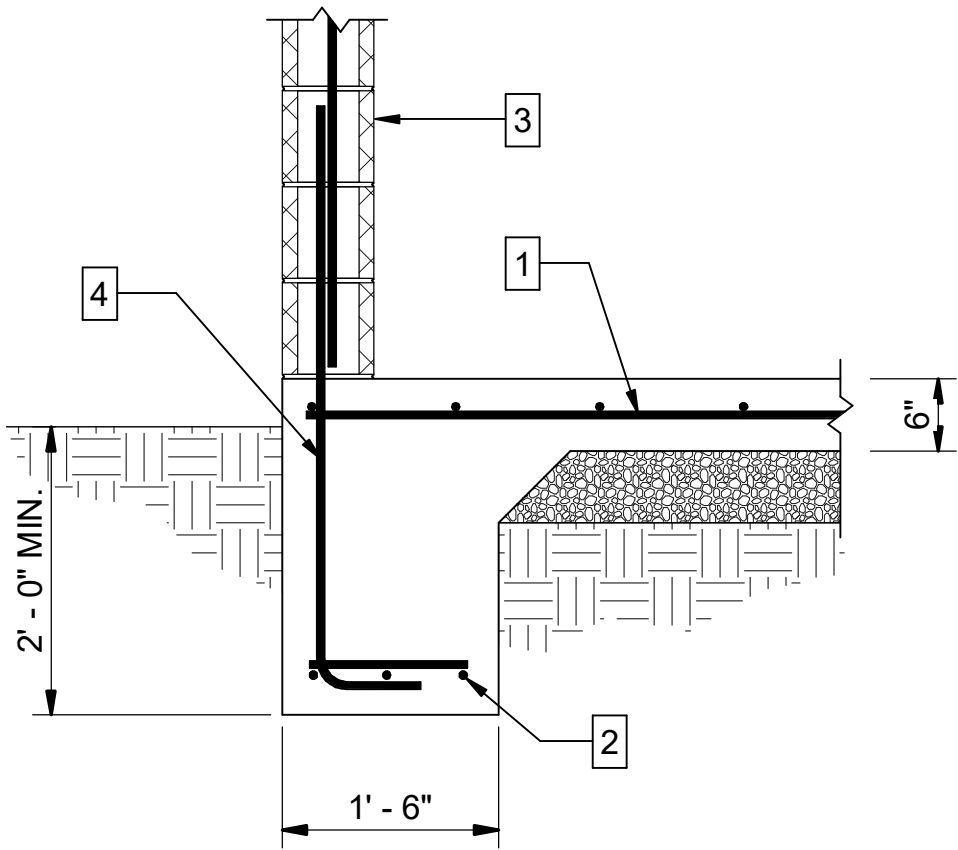
D SECTION
S-801 SCALE: 3/4" = 1'-0"



E SECTION
S-801 SCALE: 3/4" = 1'-0"



A SECTION
S-801 SCALE: 3/4" = 1'-0"



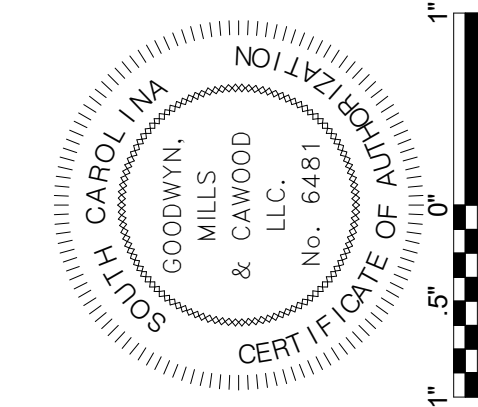
B SECTION
S-801 SCALE: 3/4" = 1'-0"

KEY NOTES: #

1. #5 @ 12" MAX. O.C. EACH WAY - CENTERED IN SLAB
2. (3) #5 CONTINUOUS w/ #3 TRANSVERSE @ 32" MAX. O.C.
3. 8" CMU WALL w/ #5 VERTICAL @ 32" O.C. - FILL REINFORCED CELLS FULL HEIGHT WITH GROUT - HORIZONTAL MASONRY REINFORCEMENT @ 16" MAX. O.C. VERTICAL
4. #5 DOWEL @ EACH VERTICAL
5. 8" BOND BEAM w/ (1) #5 CONTINUOUS
6. PREFABRICATED LIGHT GAUGE TRUSSES @ 4'-0" O.C.
7. 1.5B22 GALVANIZED ROOF DECK
8. ROOFING BY OTHERS - SEE ARCH.
9. SIMPSON META16 TRUSS TIE STRAP OR EQUIVALENT
10. 24" BOND BEAM w/ (2) #5 CONTINUOUS TOP & BOTTOM

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30% Submittal	01.18.2023
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Bid Set	
Confirmed Set	
Project Manager:	WN
Engineer:	JD
Designer:	TS
Drawn By:	JD

MAIN ELECTRICAL
BUILDING - SECTIONS

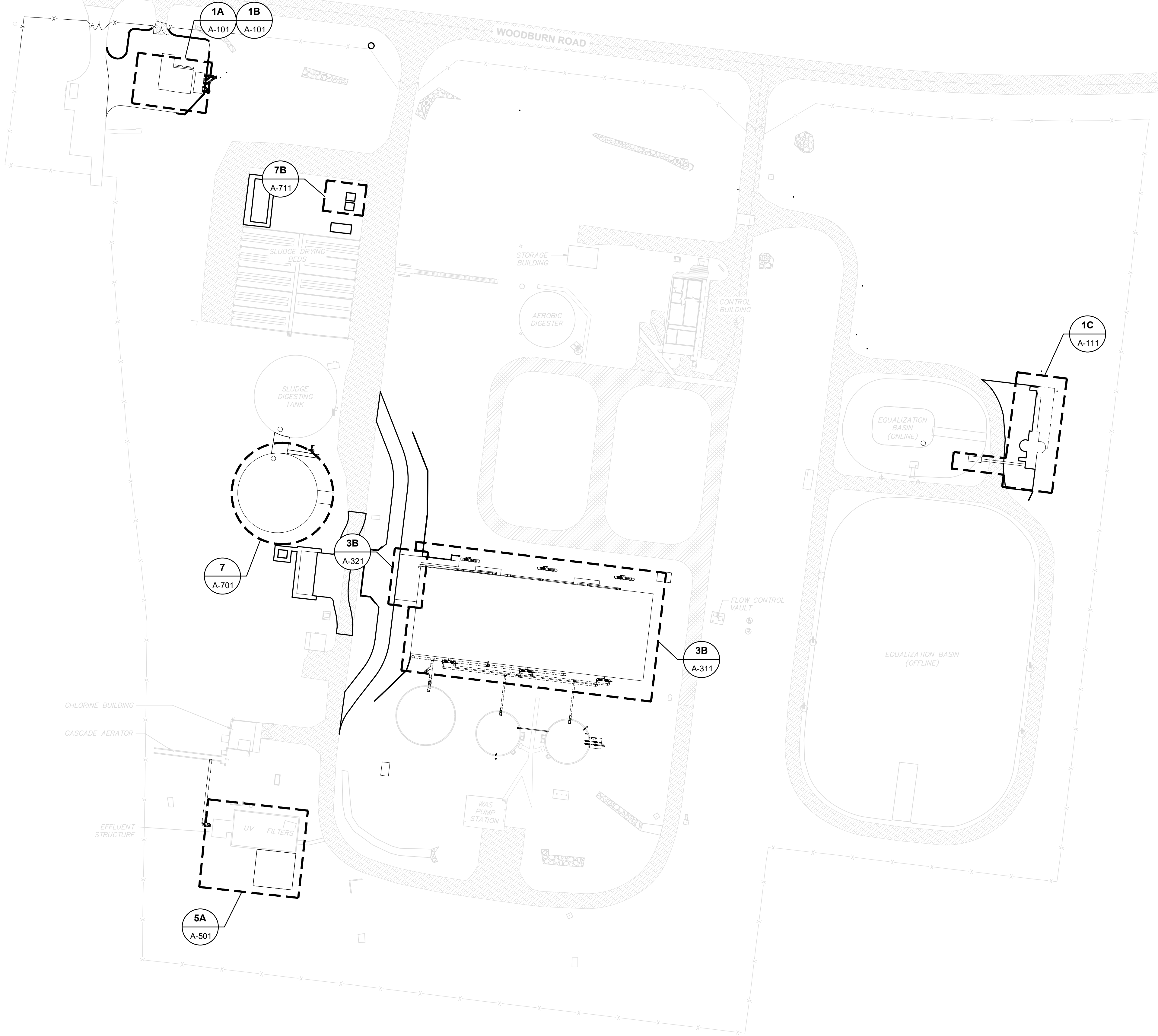
S-802

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PLOTTED: Mar 11, 2024 - 4:09pm



1
A-001

SITE PLAN
SCALE: 1" = 60'-0"



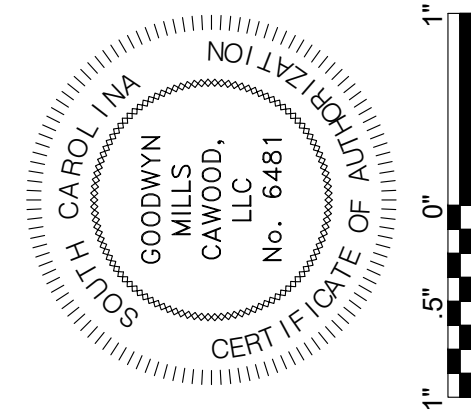
**ARCHITECTURAL
SITE PLAN**

A-001

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PENDLETON, SOUTH CAROLINA
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Conformed Set	
Project Manager:	WN
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Designer:	JX
Drawn By:	HKD



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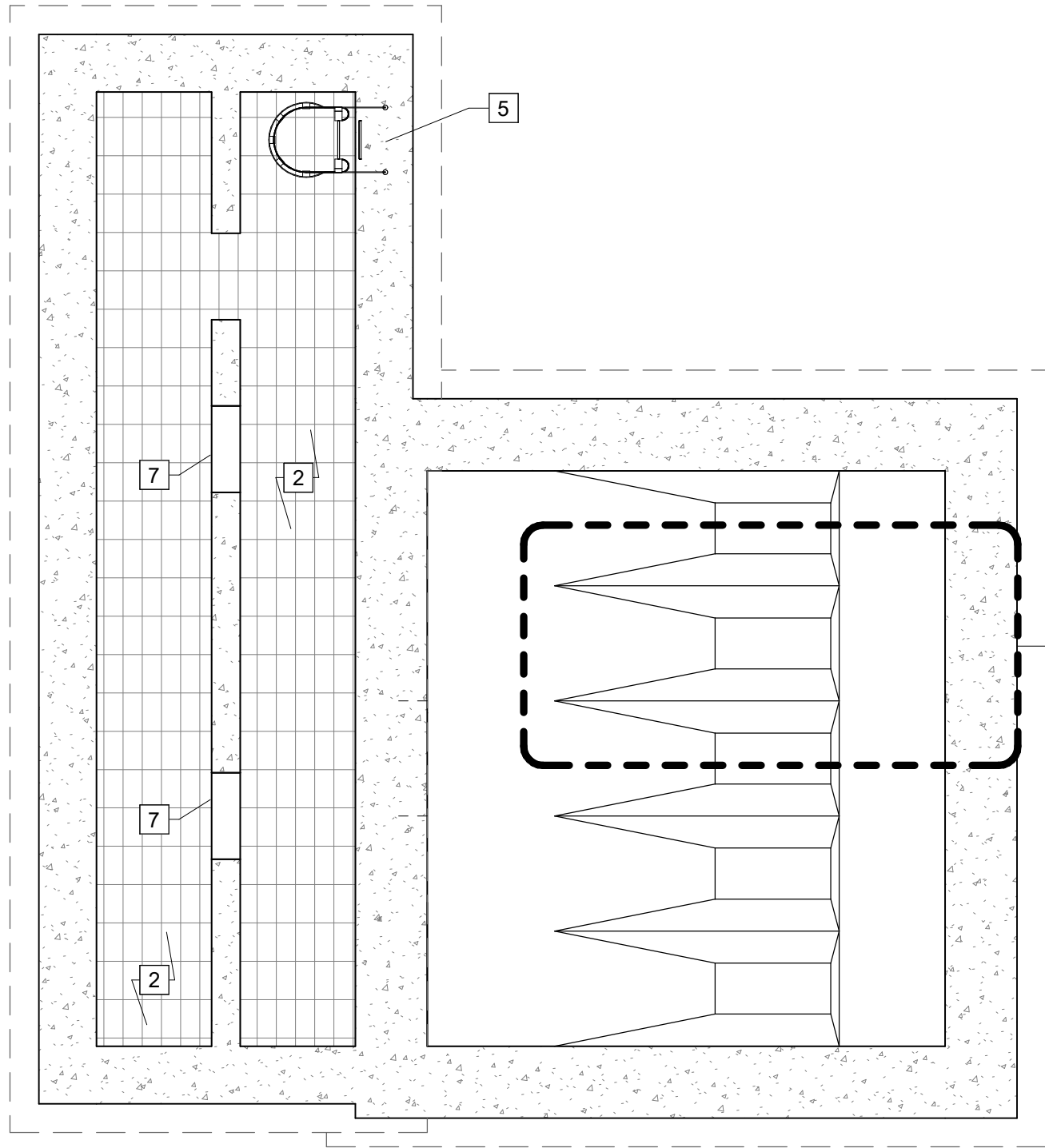


1B

LOWER PLAN

A-101

SCALE: 3/16" = 1'-0"

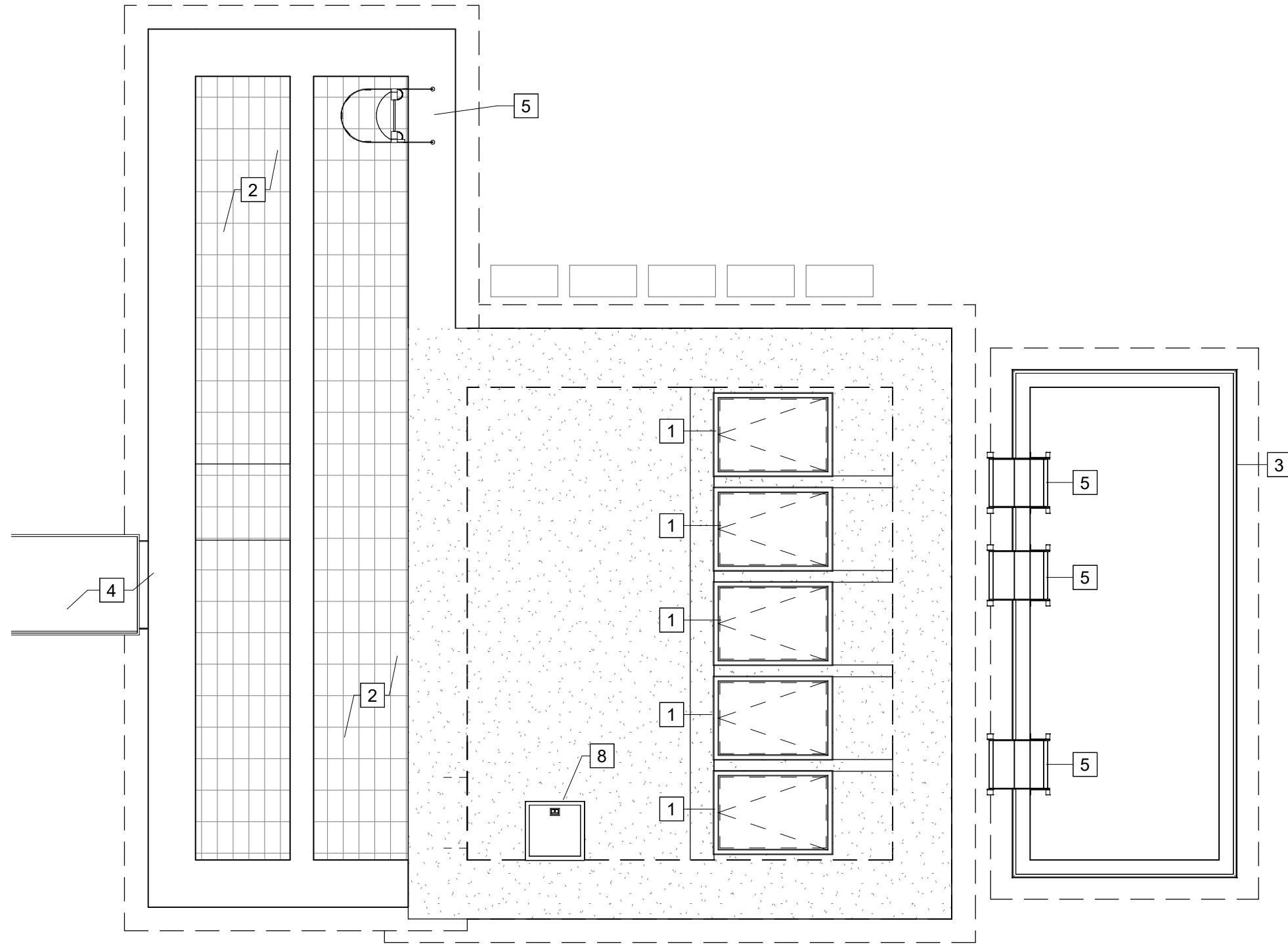


1A

UPPER PLAN

A-001

SCALE: 3/16" = 1'-0"

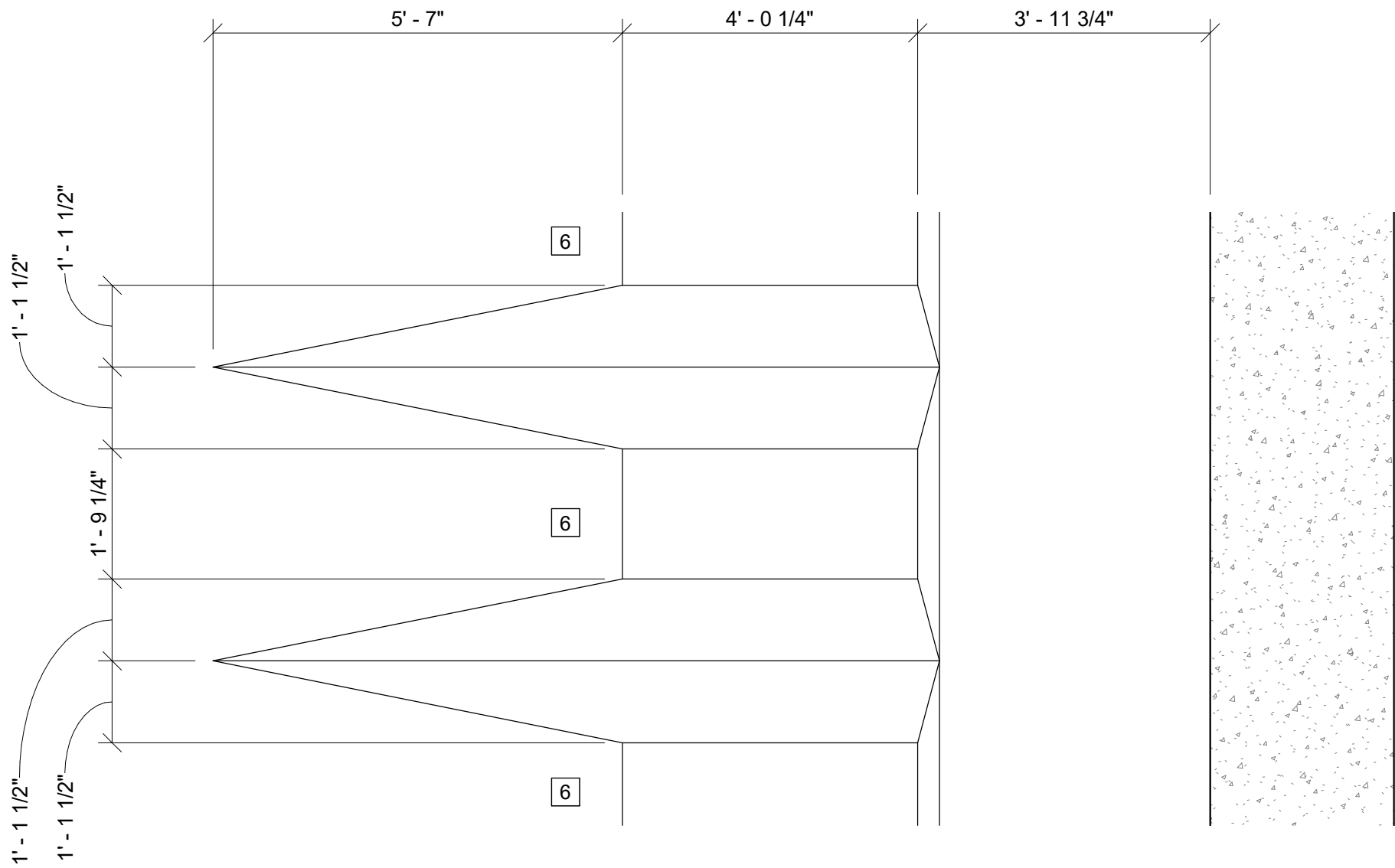


1C

ENLARGED PLAN

A-101

SCALE: 1/2" = 1'-0"



KEY NOTES: #

1. SINGLE LEAF DRIP PROOF ALUMINUM HATCH W/ SAFETY GRATE
2. ALUMINUM BAR GRATING
3. ALUMINUM HANDRAILING W/ TOE BOARD
4. DUMPSTER (FURNISHED BY OWNER)
5. ALUMINUM ACCESS LADDER
6. GROUT
7. 3'-0" X 7'-0" CASED OPENING
8. 30" X 30" ALUMINUM HATCH

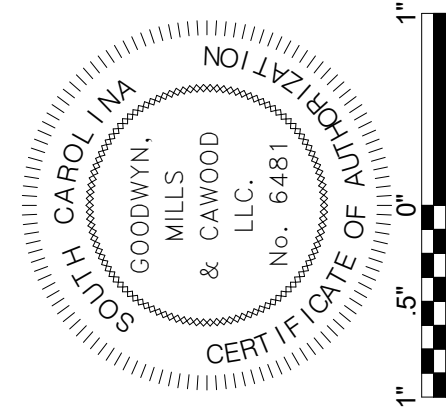
INFLUENT PUMP
STATION - PLANS

A-101

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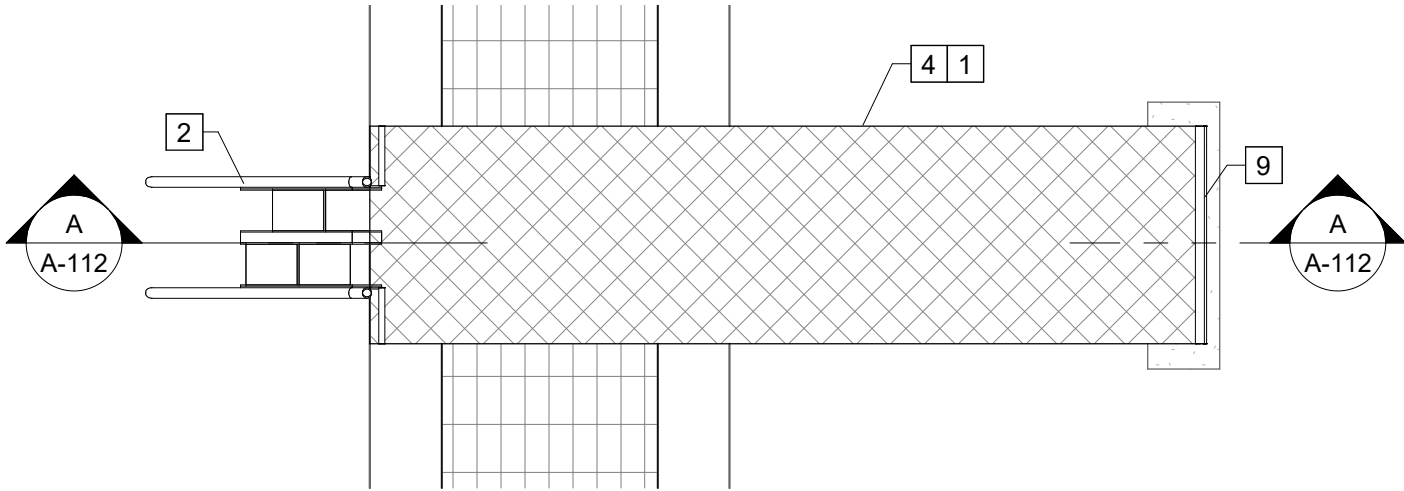
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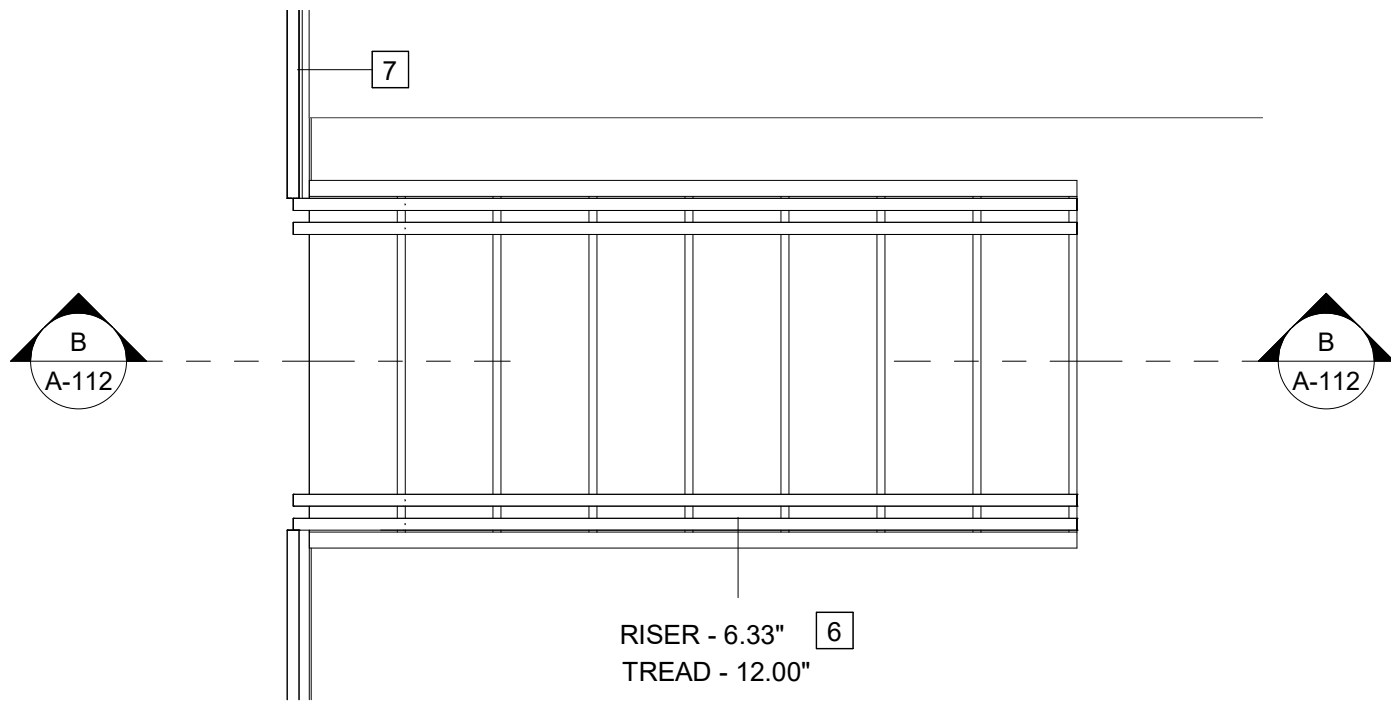
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A-111

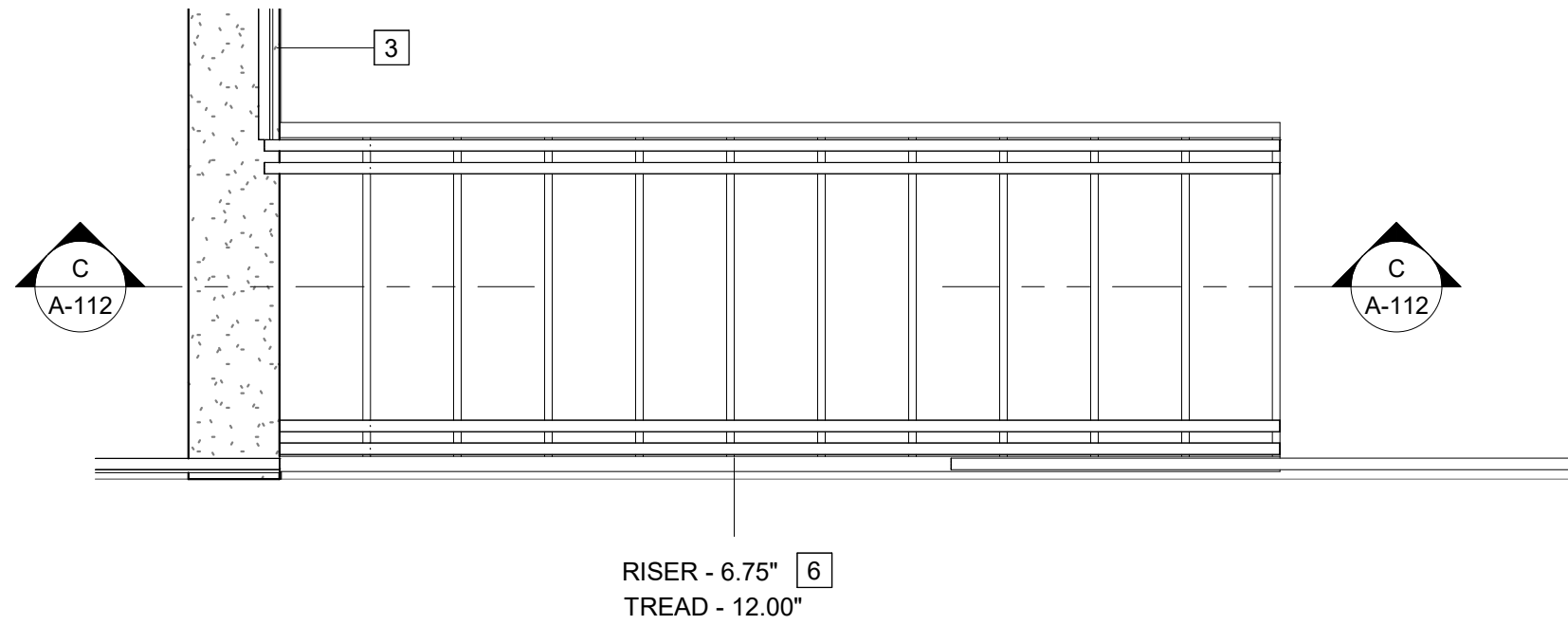
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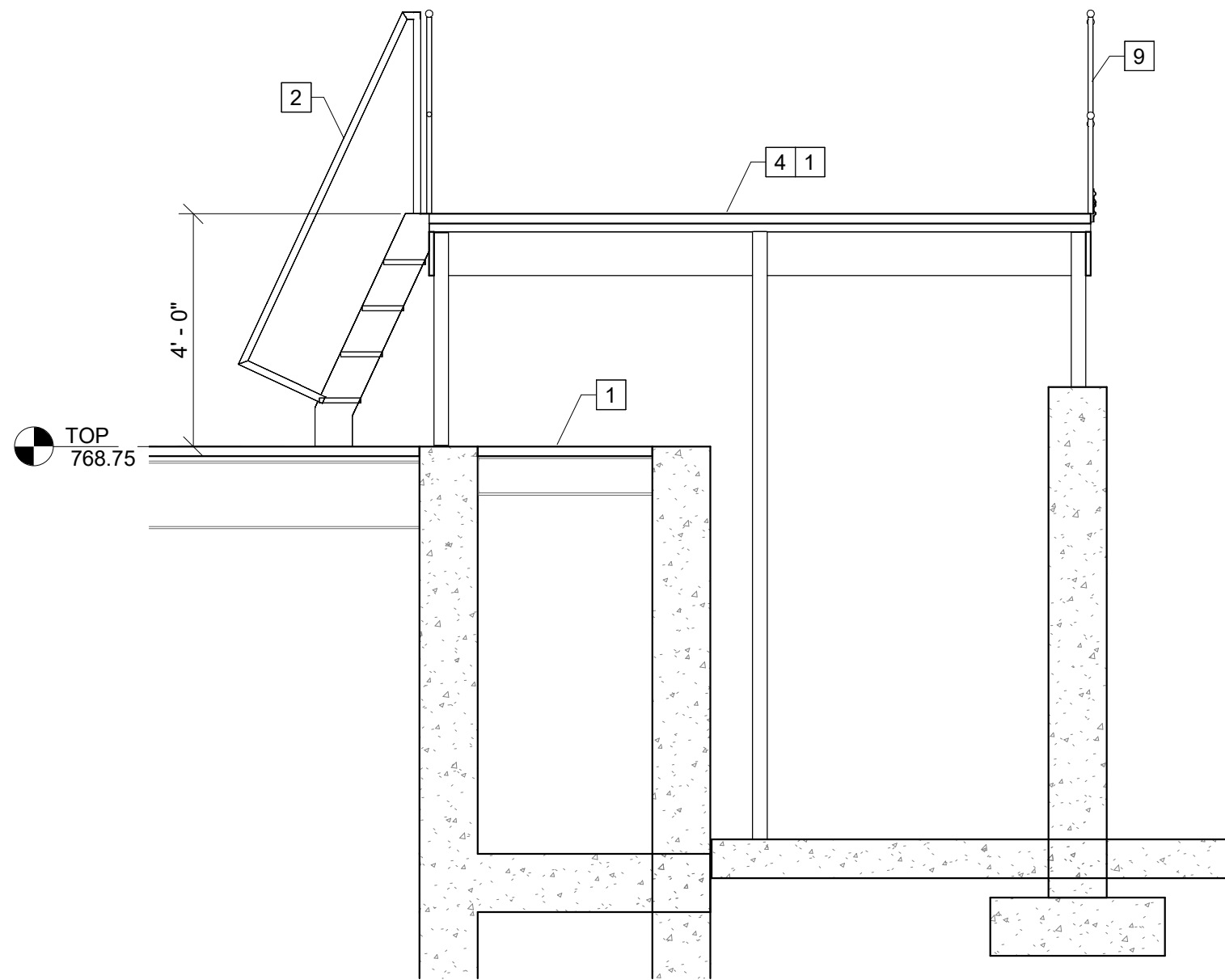
1 ENLARGED PLAN
A-111 SCALE: 3/8" = 1'-0"



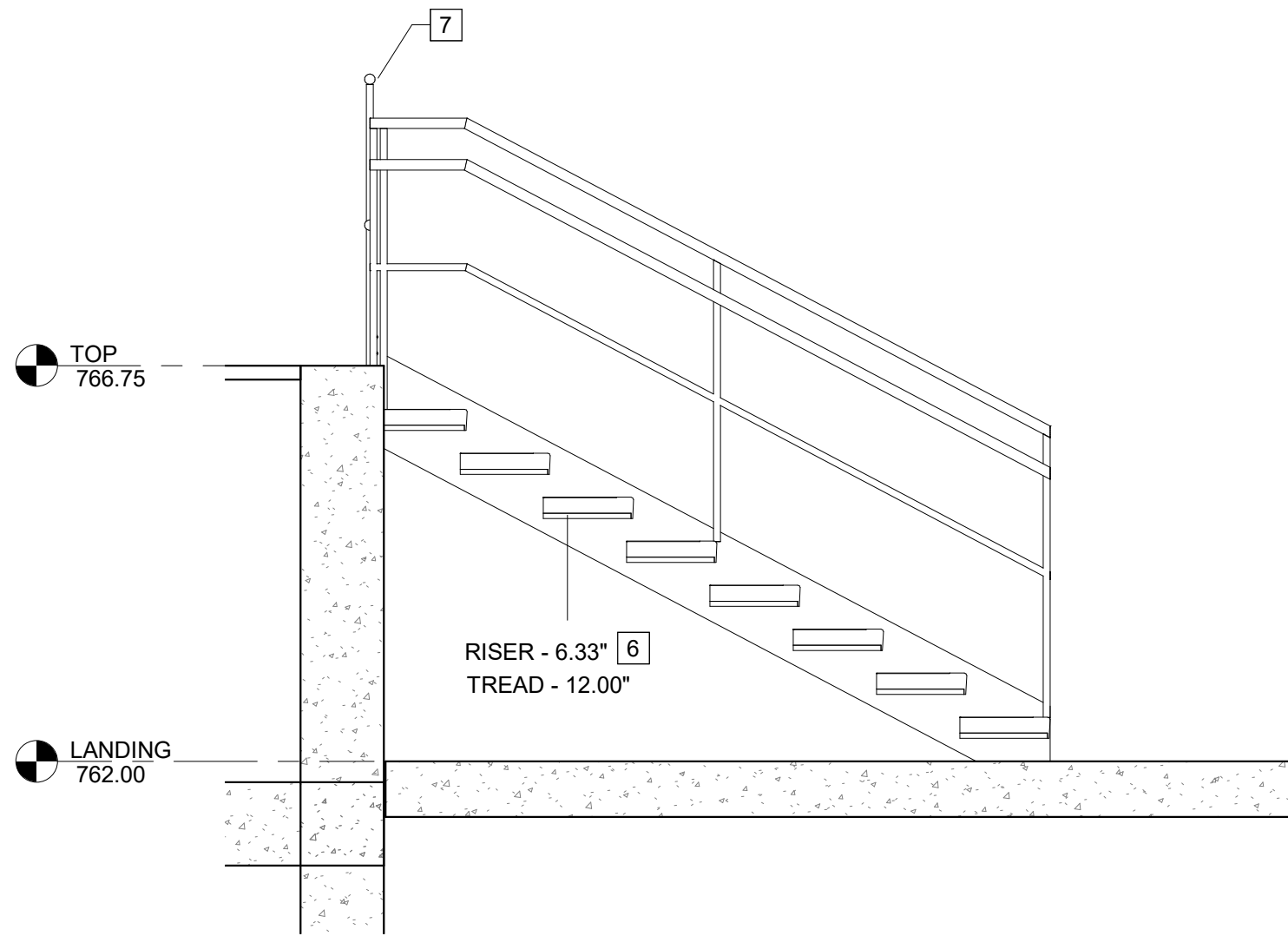
2 ENLARGED PLAN
A-111 SCALE: 1/2" = 1'-0"



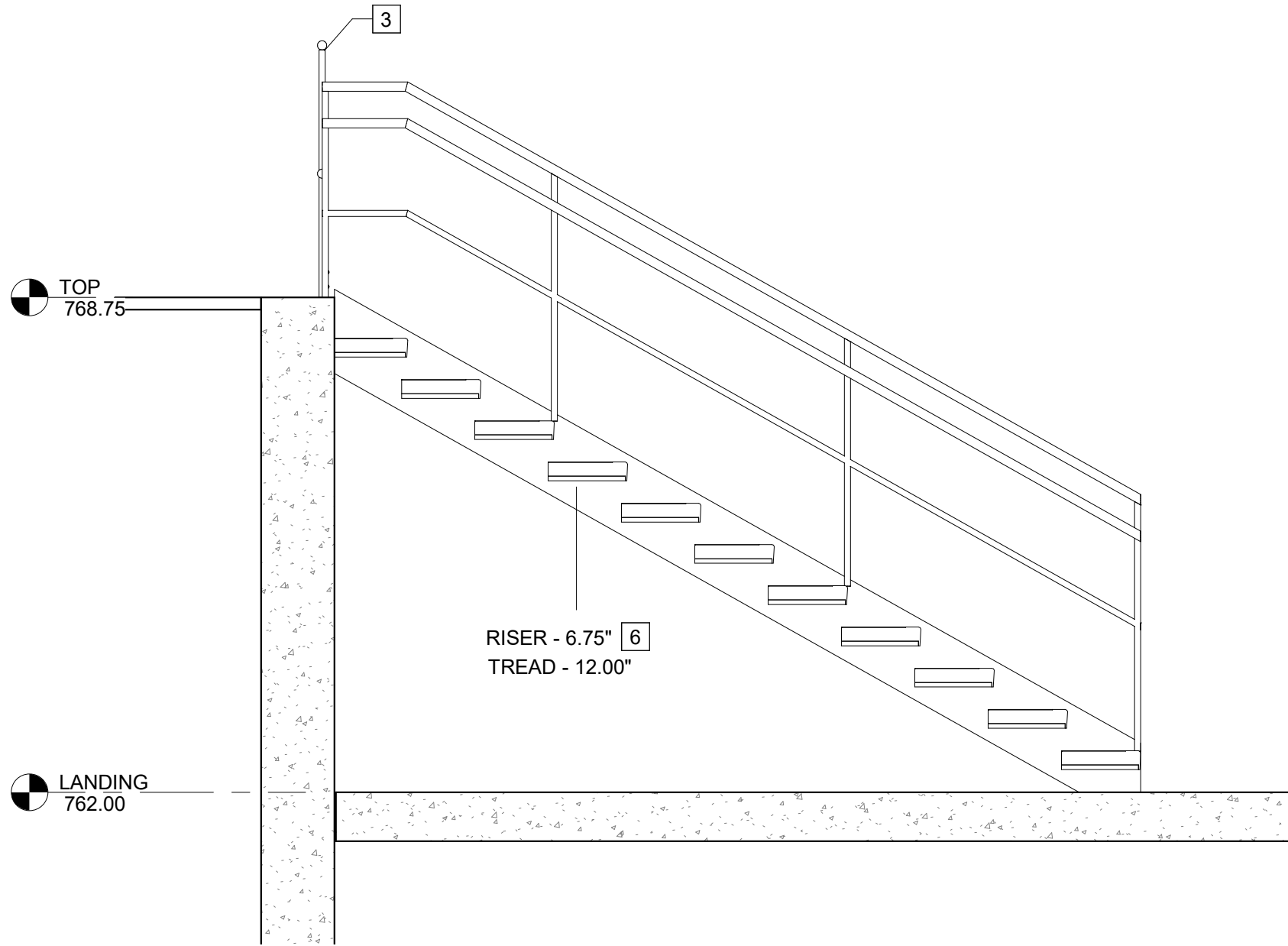
3 ENLARGED PLAN
A-111 SCALE: 1/2" = 1'-0"



A SECTION
A-112 SCALE: 3/8" = 1'-0"



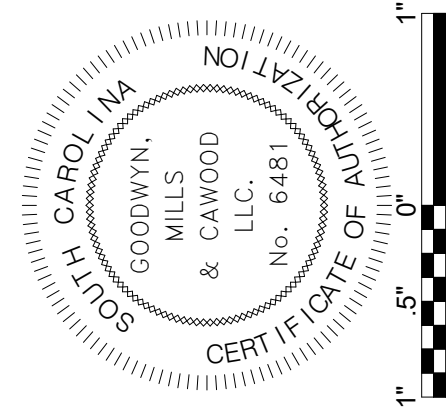
B SECTION
A-112 SCALE: 1/2" = 1'-0"



C SECTION
A-112 SCALE: 1/2" = 1'-0"

KEY NOTES: #

1. ALUMINUM BAR GRATING
2. ALUMINUM LADDER
3. 3'-6" ALUMINUM HANDRAIL W/ TOE PLATE
4. WALKWAY ASSEMBLY
5. DUMPSTER; BY OWNER
6. METAL STAIRS W/ STAIR RAILING
7. 3'-6" ALUMINUM HANDRAIL



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**HEADWORKS
ENLARGED PLAN &
SECTIONS**

A-112

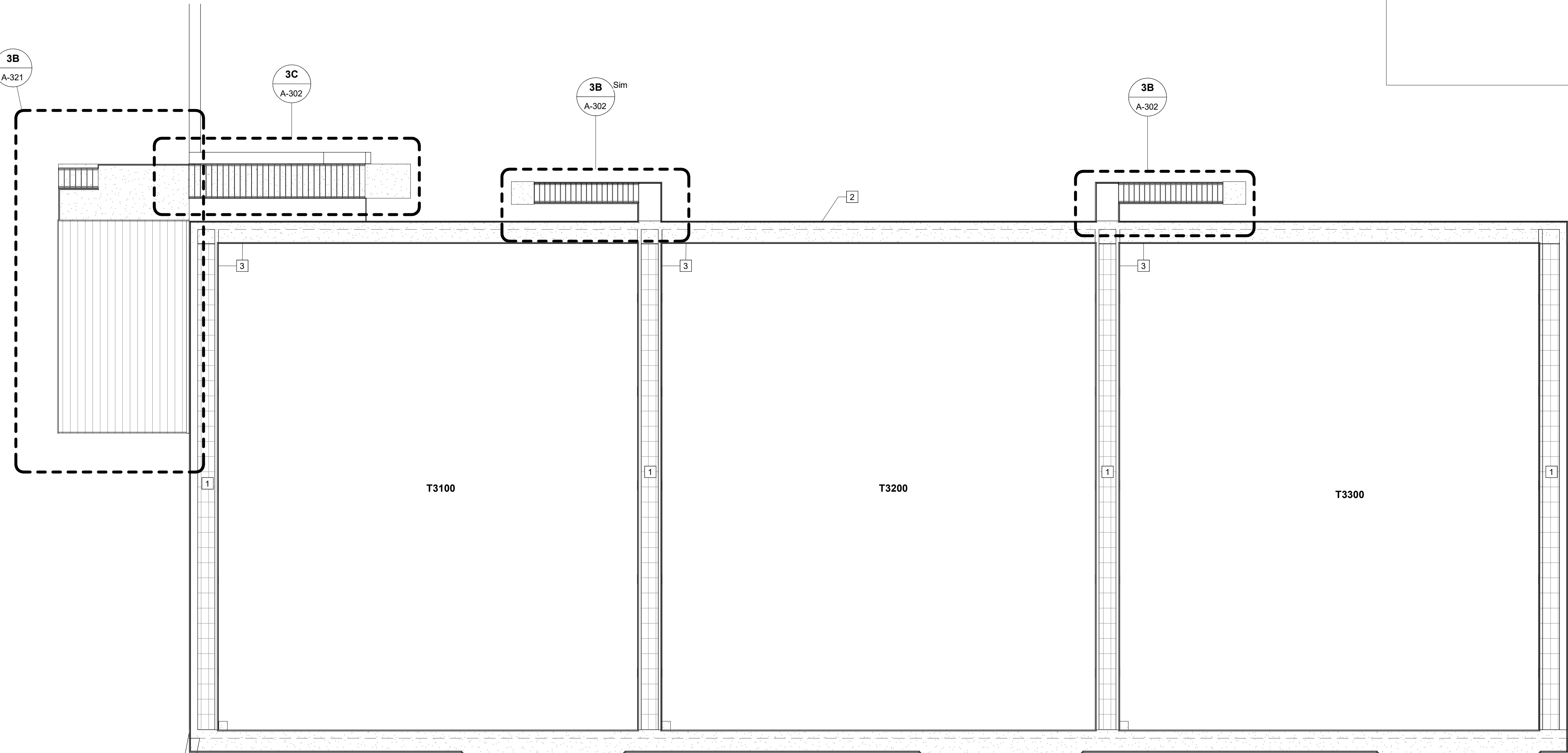
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3A
A-301

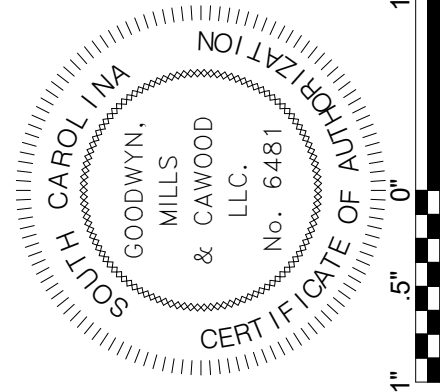
PLAN

SCALE: 3/32" = 1'-0"



KEY NOTES: #

1. ALUMINUM WALKWAY
2. 8" CONCRETE
3. HANDRAIL WITH TOE BOARD



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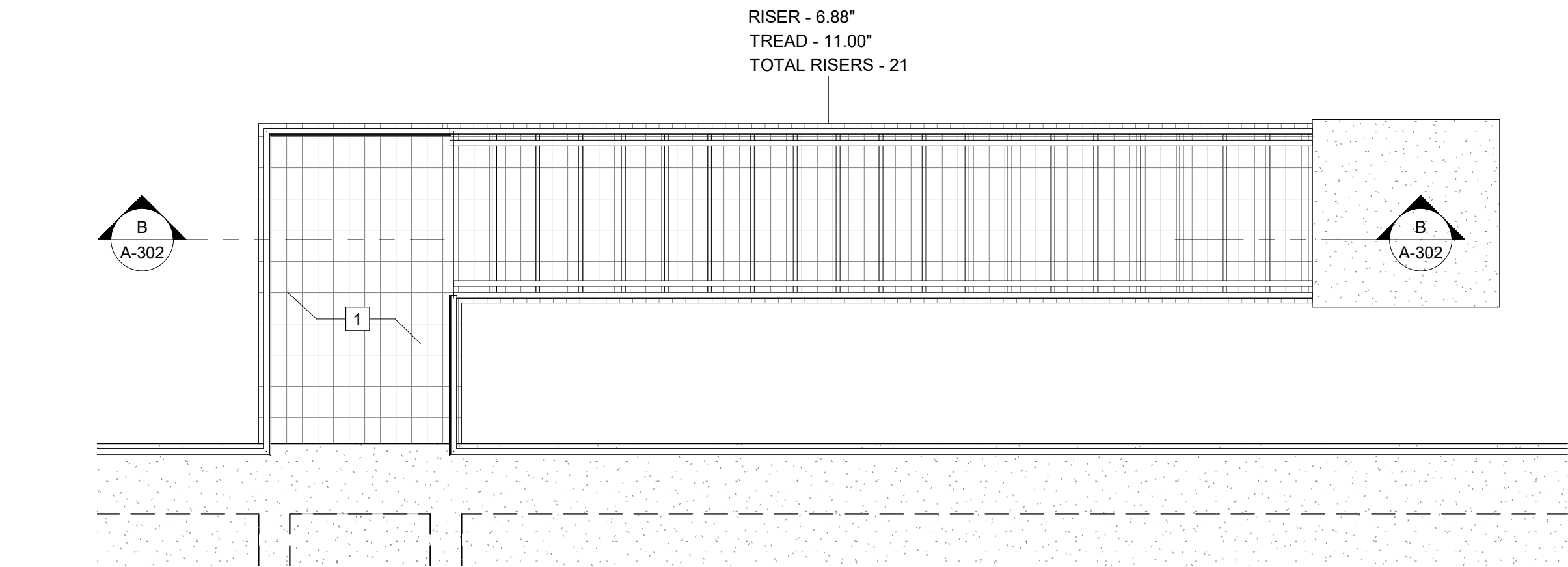
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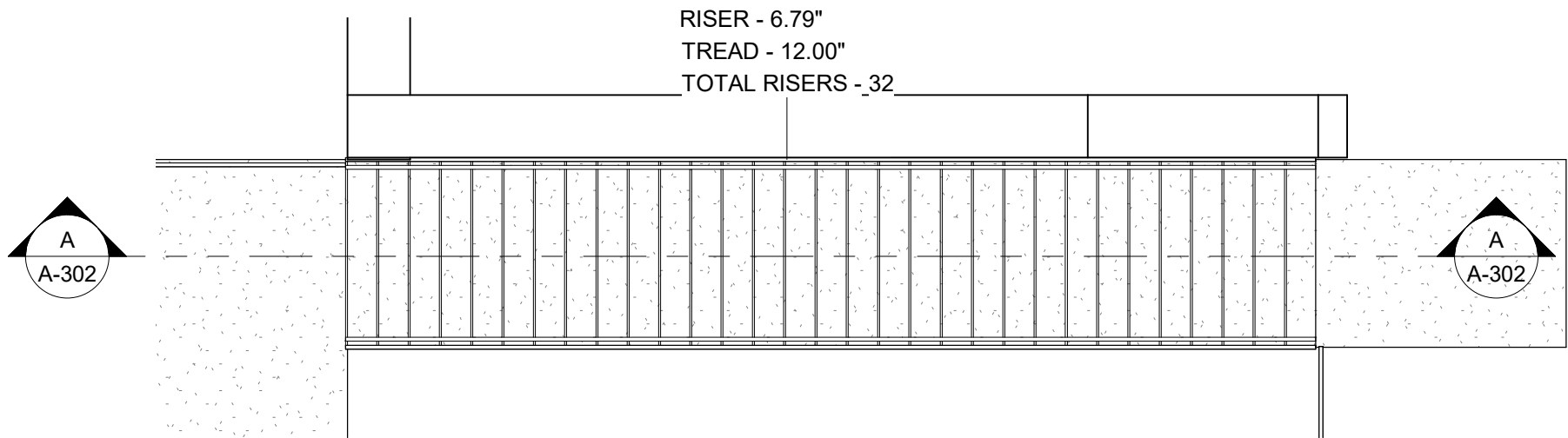
BIOLOGICAL
NUTRIENT
BIOREACTOR - PLAN

A-301

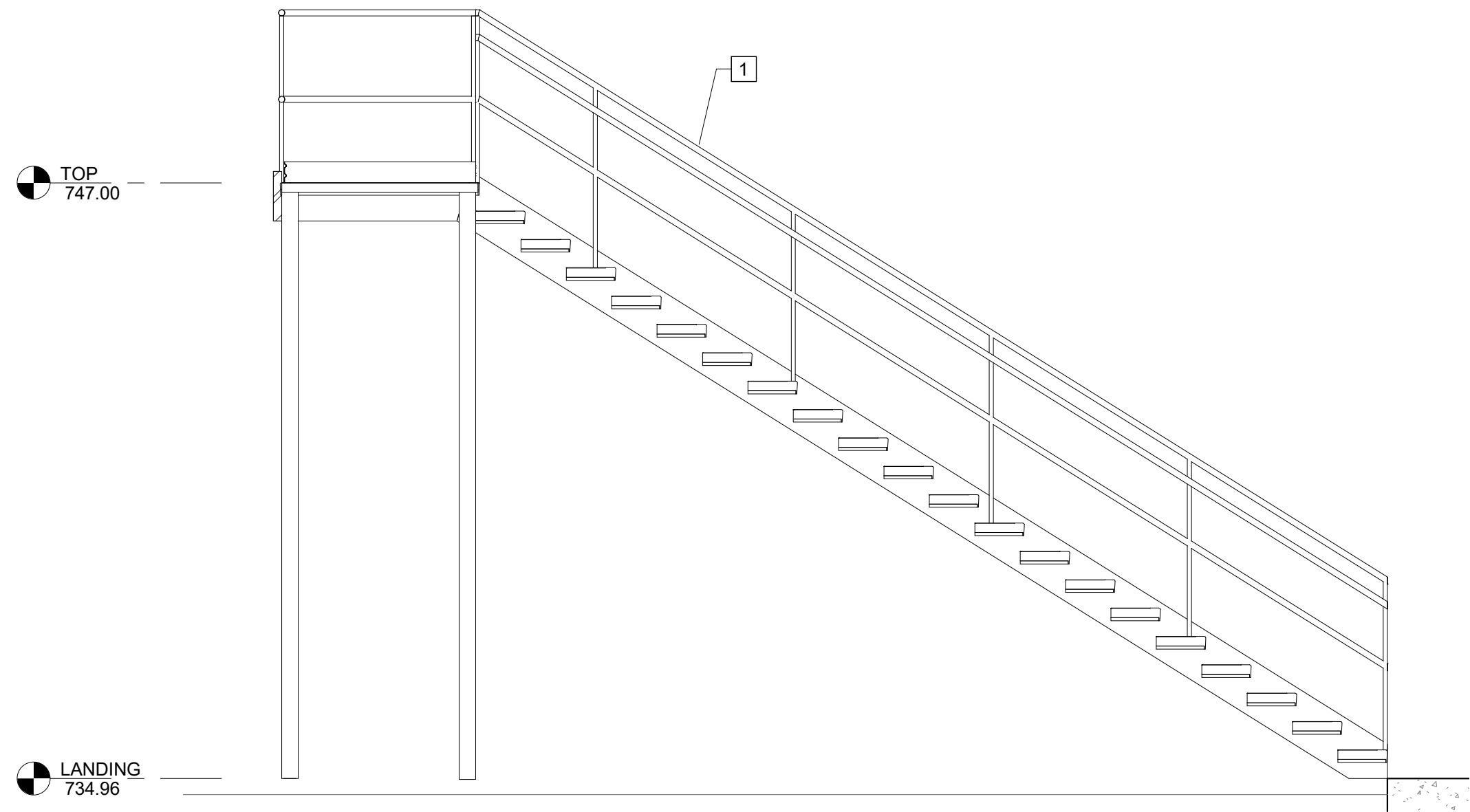
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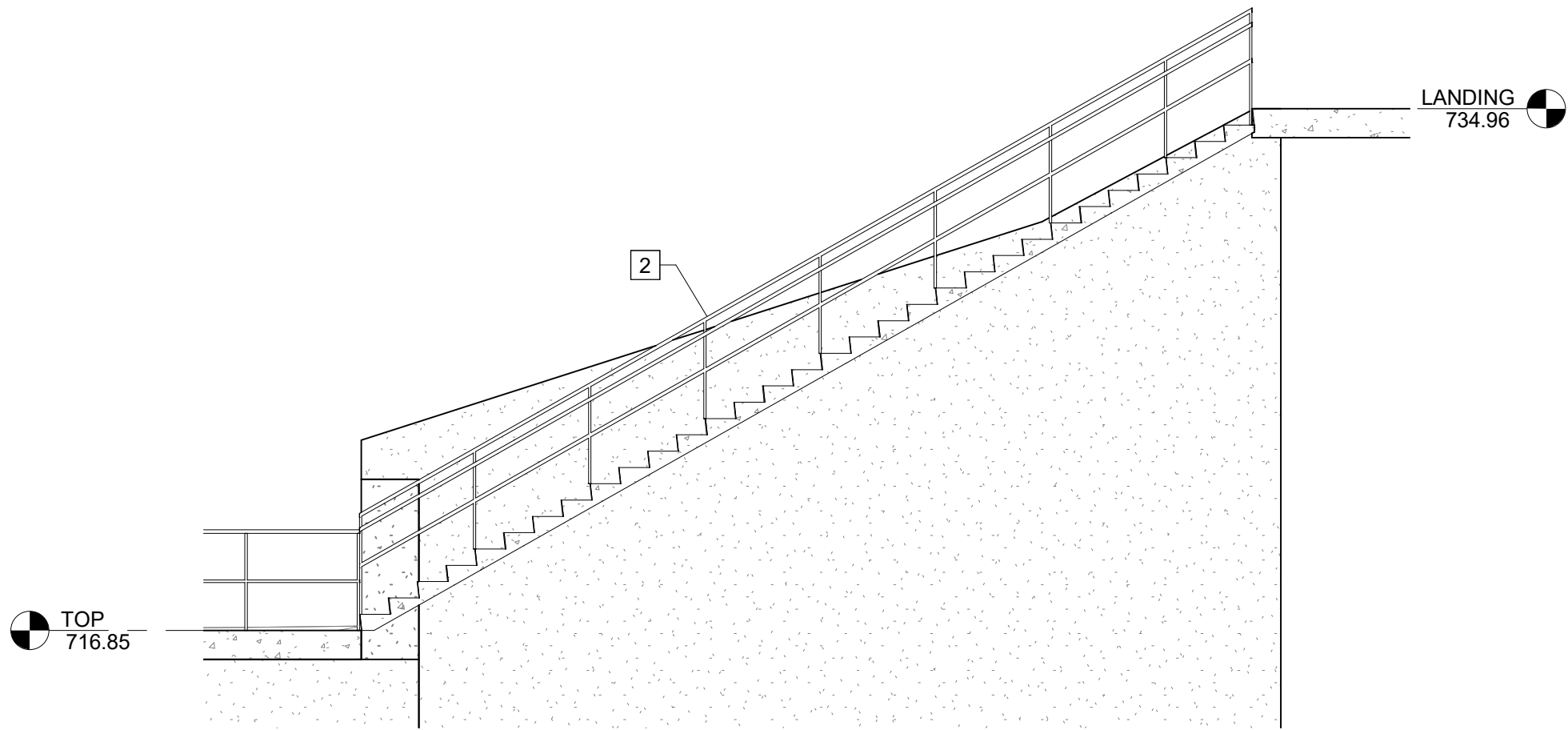
3B PLAN
A-302 SCALE: 3/8" = 1'-0"



3C PLAN
A-302 SCALE: 3/16" = 1'-0"



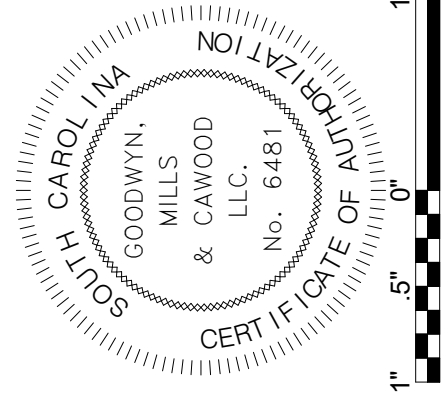
B SECTION
A-302 SCALE: 3/8" = 1'-0"



A SECTION
A-302 SCALE: 3/16" = 1'-0"

KEY NOTES: #

1. CONCRETE STAIRS WITH HANDRAILS
2. METAL STAIRS WITH HANDRAILS ATTACHED



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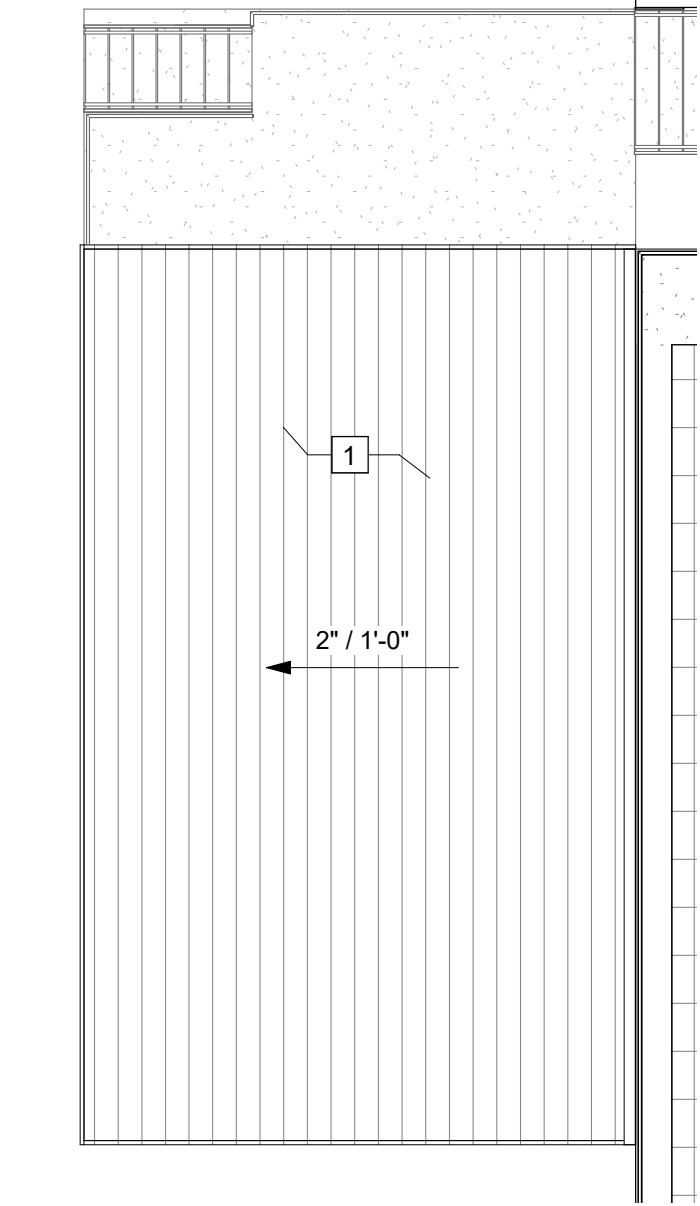
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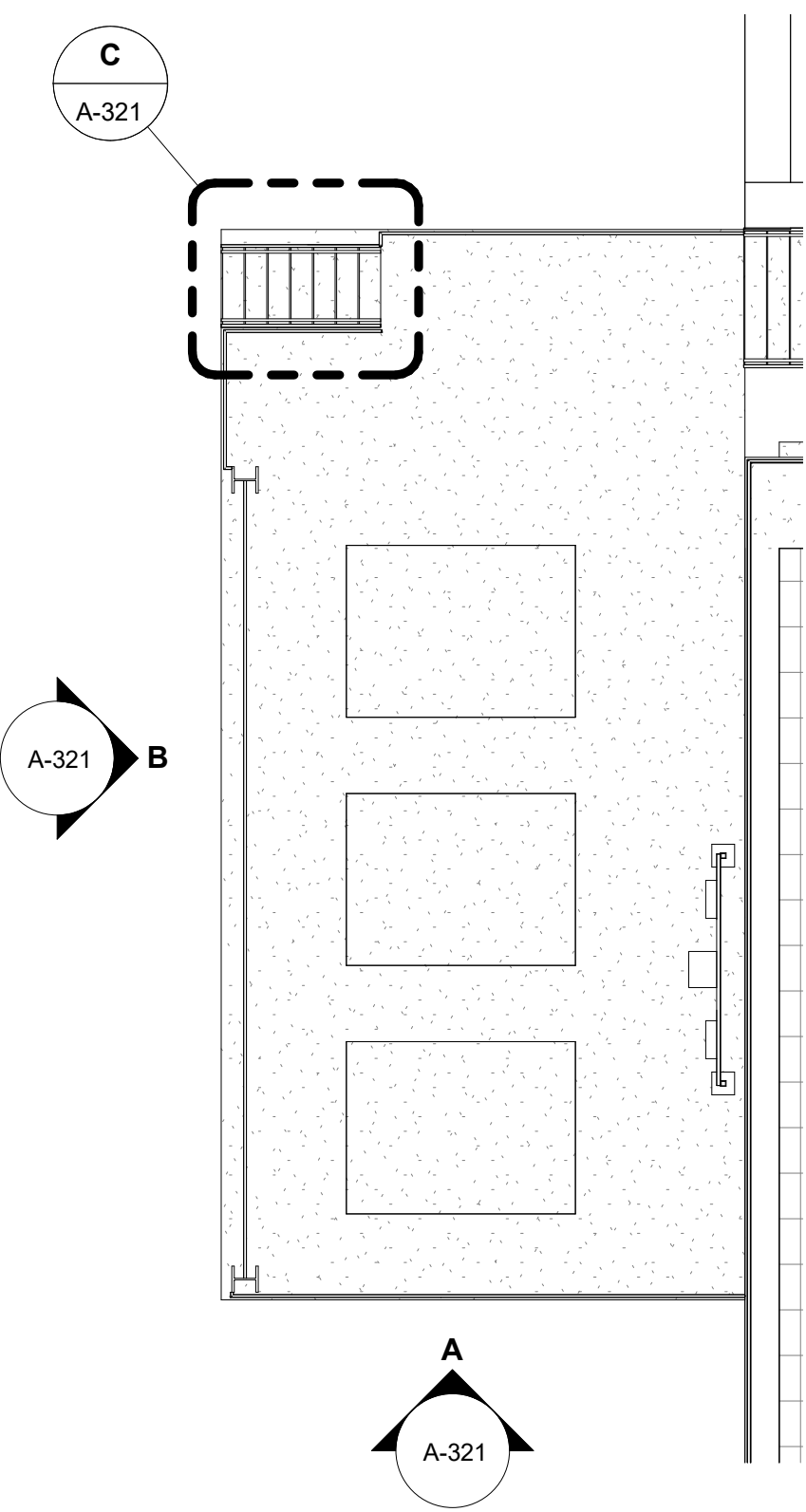
BIOLOGICAL
NUTRIENT
BIOREACTOR-ENLARGED
PLANS & SECTIONS

A-302

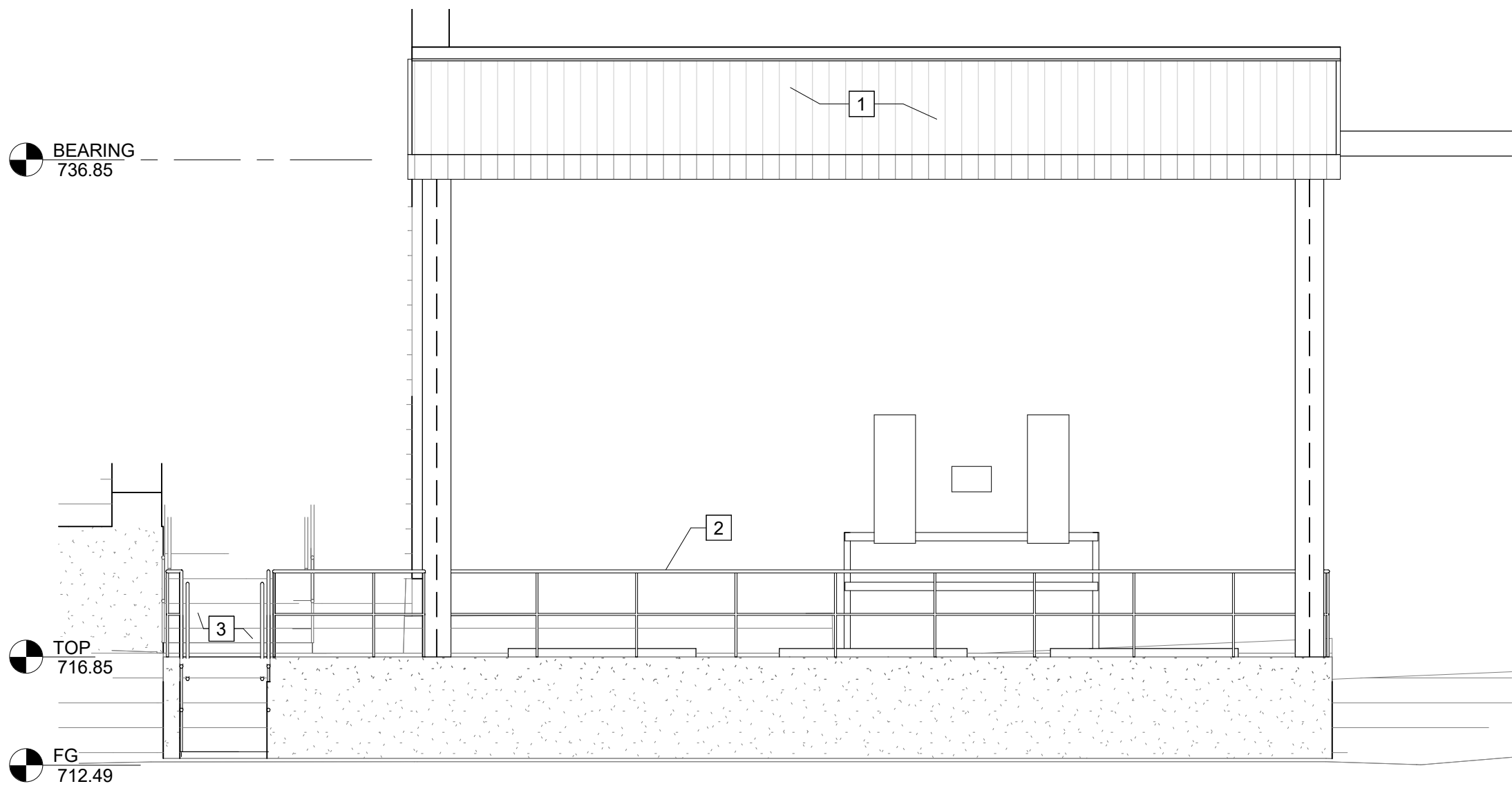
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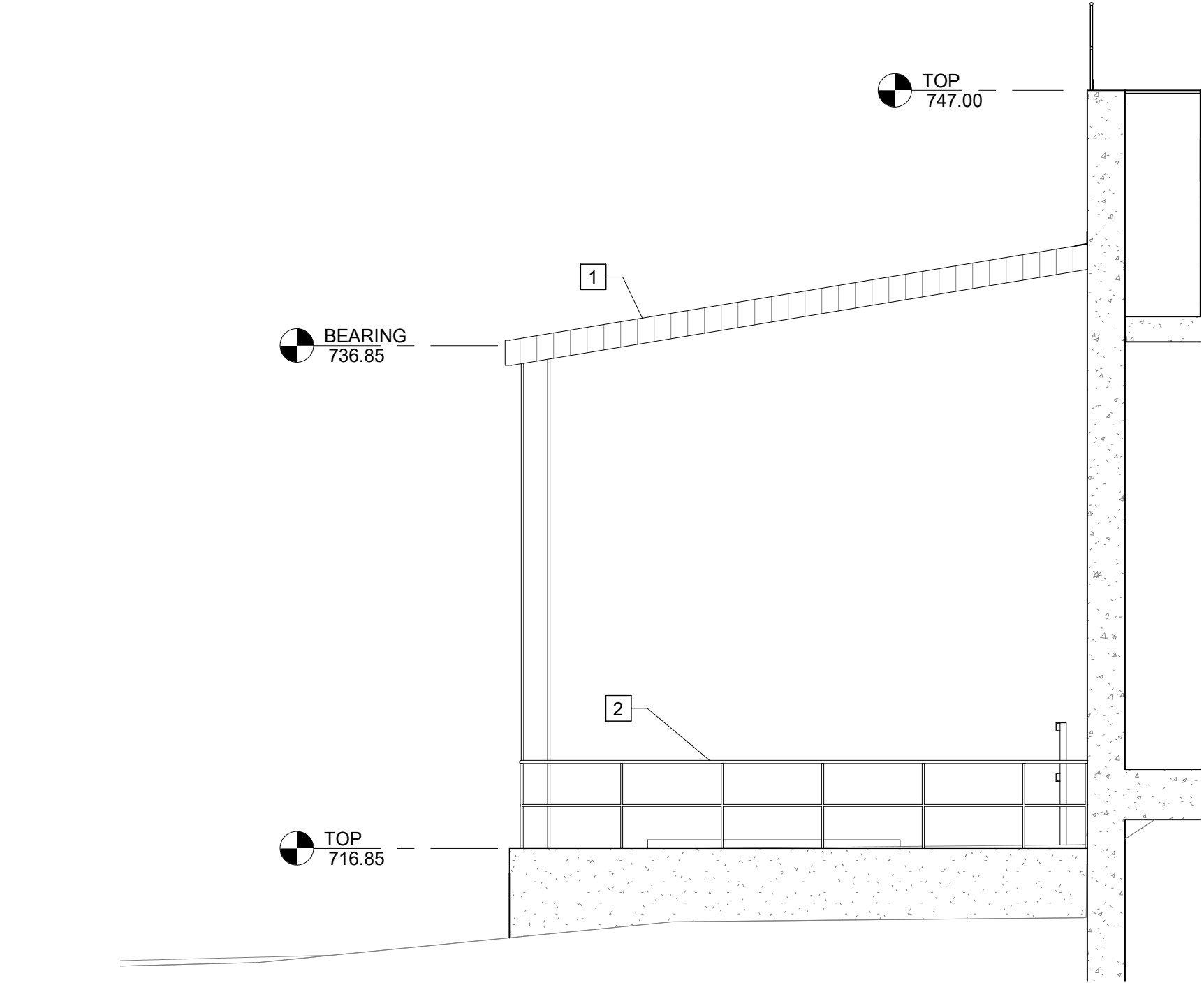
3C ROOF PLAN
A-321 SCALE: 1/8" = 1'-0"



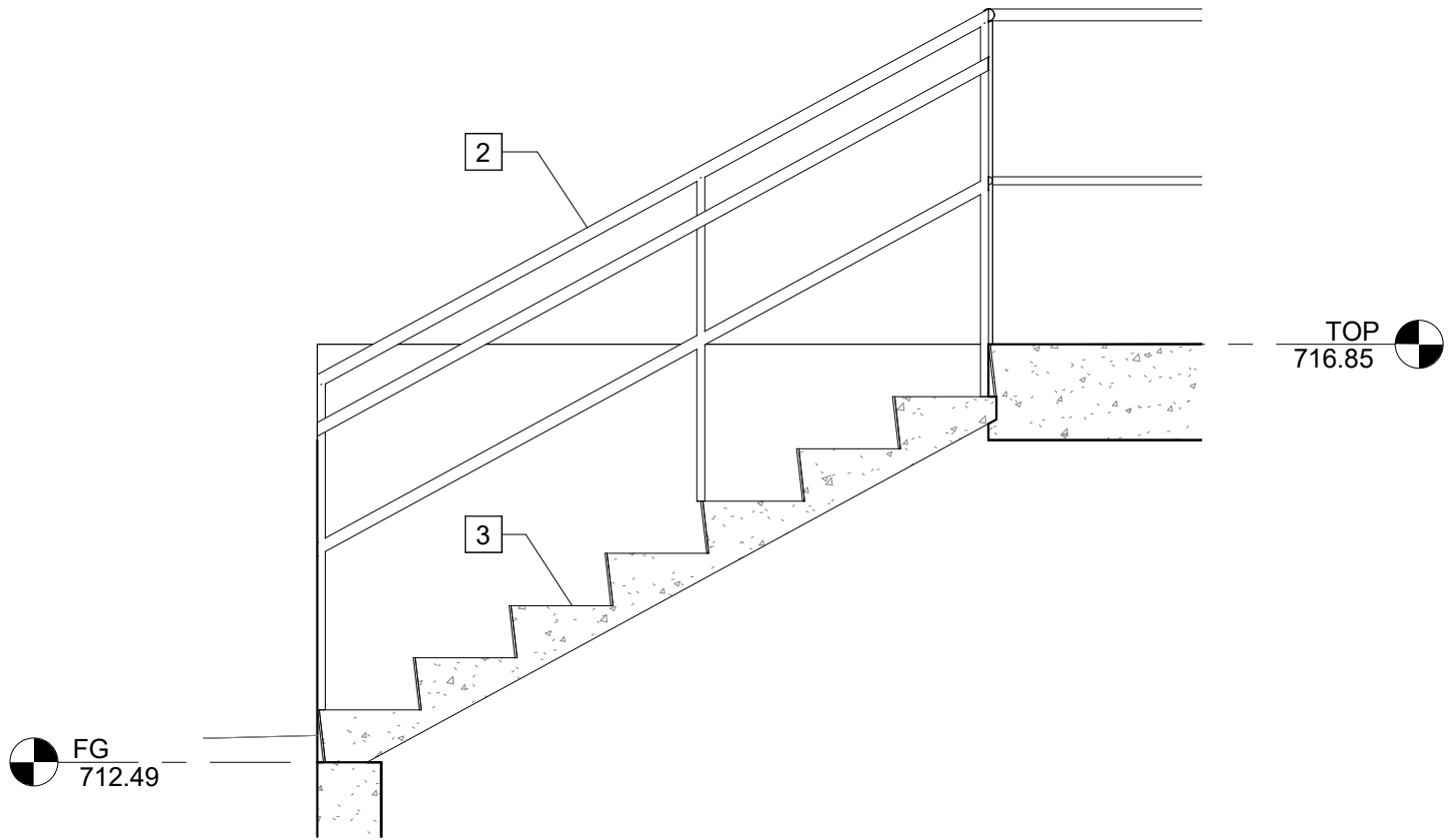
3B FLOOR PLAN
A-301 SCALE: 1/8" = 1'-0"



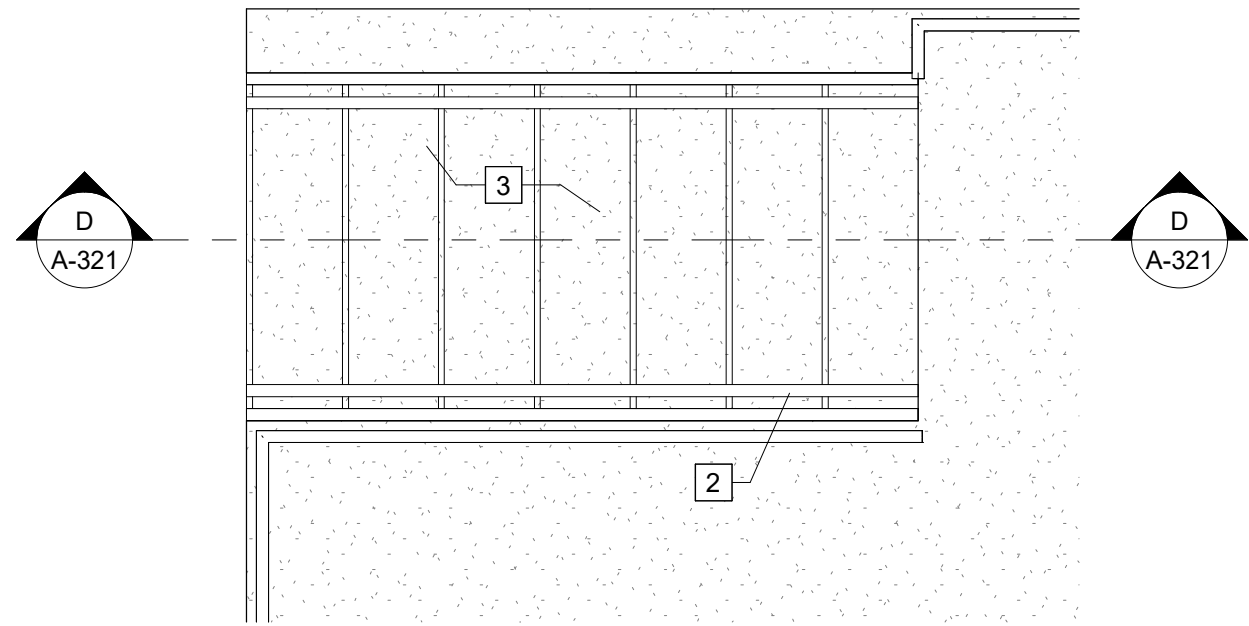
B EXTERIOR ELEV.
A-321 SCALE: 3/16" = 1'-0"



A EXTERIOR ELEV.
A-321 SCALE: 3/16" = 1'-0"



D SECTION
A-321 SCALE: 1/2" = 1'-0"



C ENLARGED PLAN
A-321 SCALE: 1/2" = 1'-0"

- KEY NOTES:** #
1. METAL ROOF
 2. ALUMINUM HANDRAILS
 3. CAST-IN-PLACE STAIRS

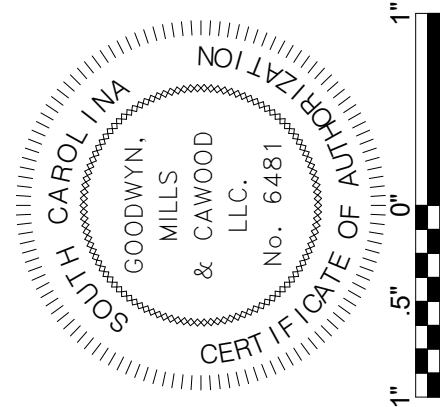
**BIOLOGICAL
NUTRIENT
BIOREACTOR
BLOWERS - PLANS**

A-321

**PENDLETON - CLEMSON
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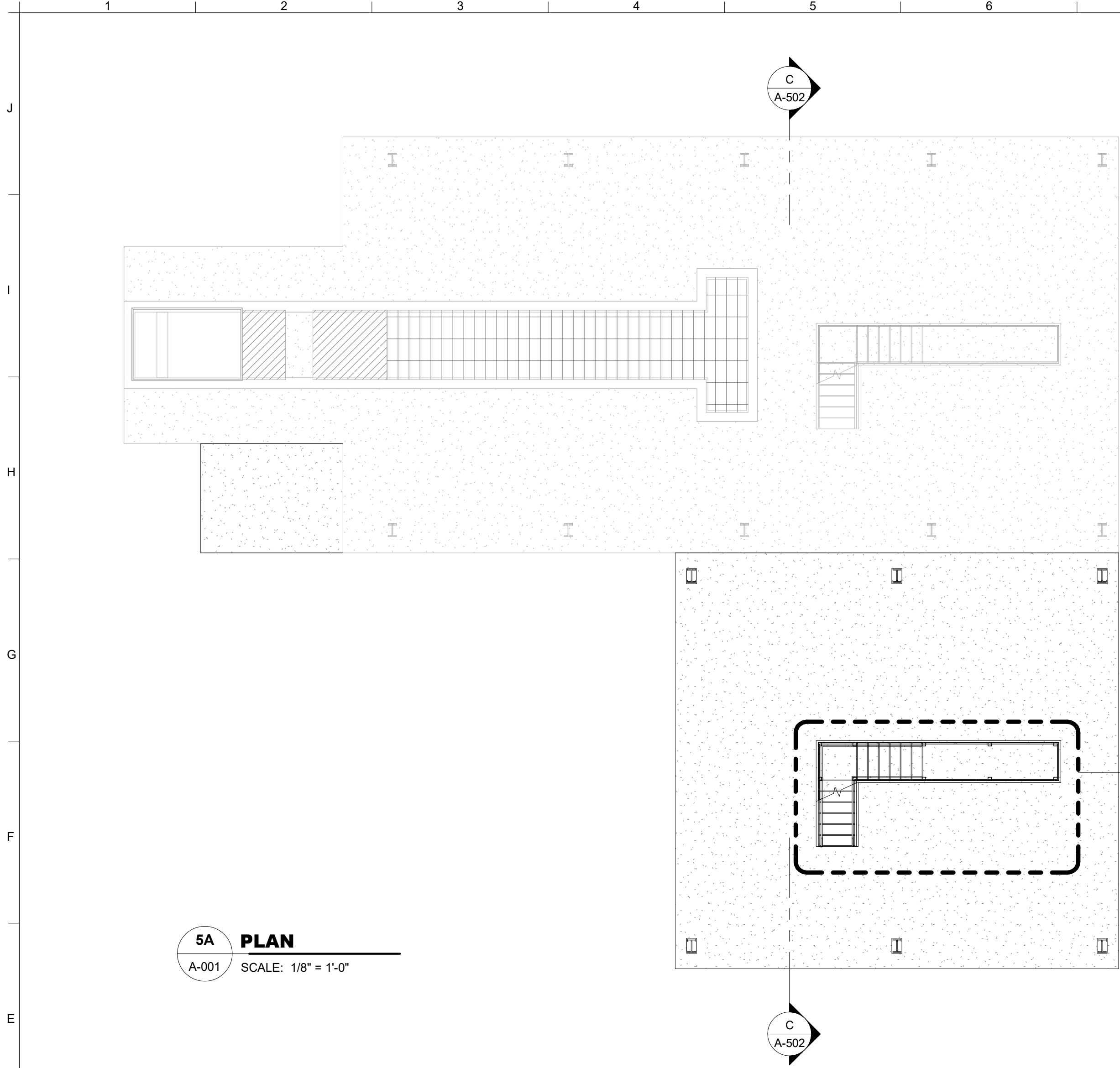
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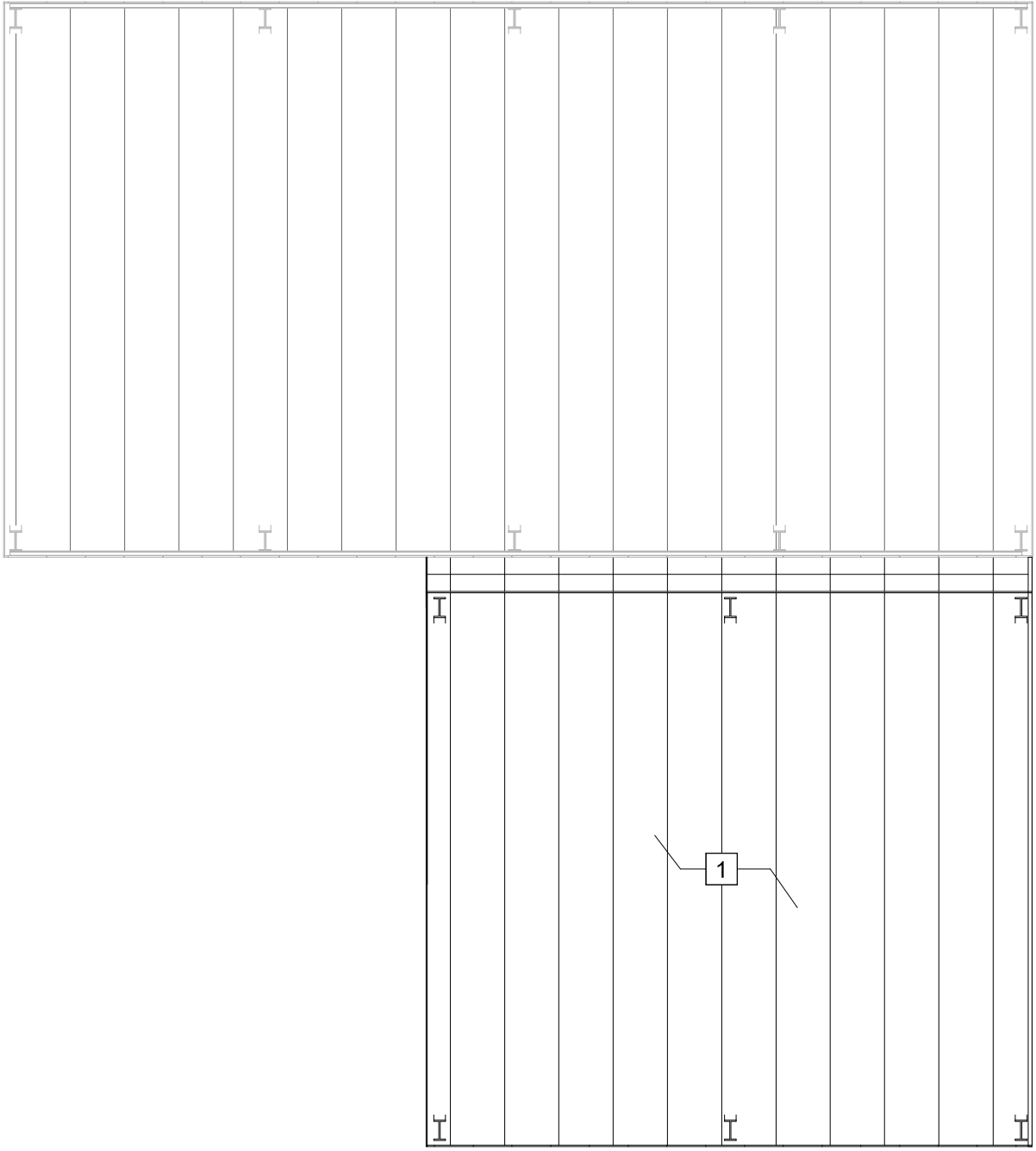


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5A **PLAN**
A-001 SCALE: 1/8" = 1'-0"



5B **ROOF PLAN**
A-501 SCALE: 3/32" = 1'-0"

5C
A-502

KEY NOTES: #

1. METAL PANEL ROOF

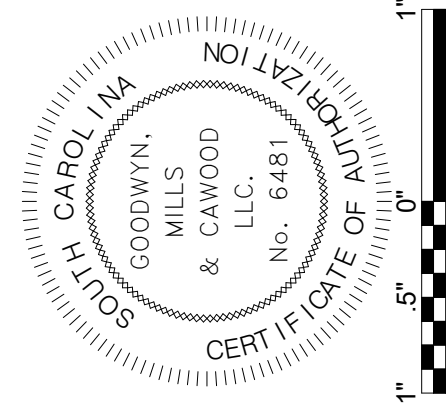
FILTERS - PLANS

A-501

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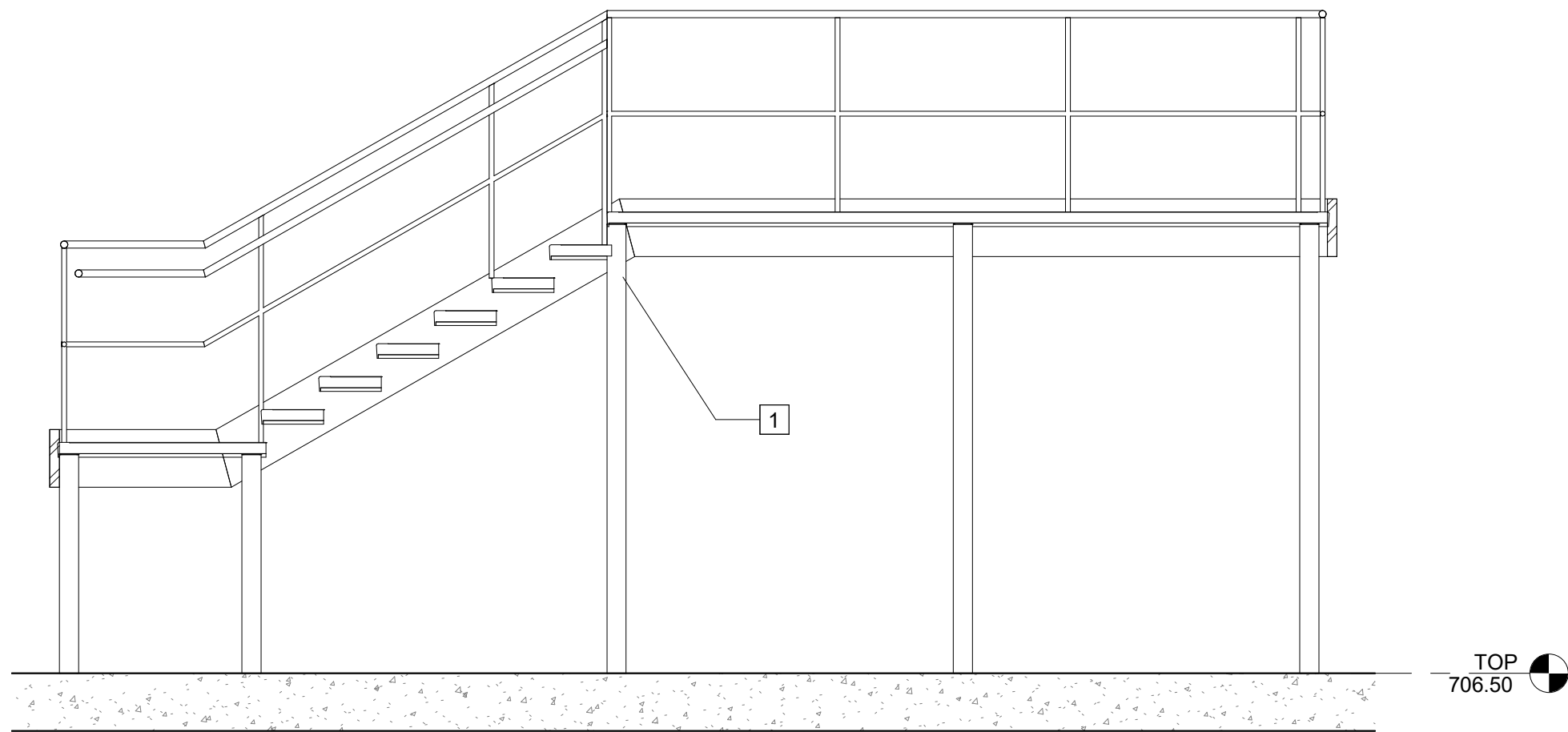
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Drawn By:	HKD



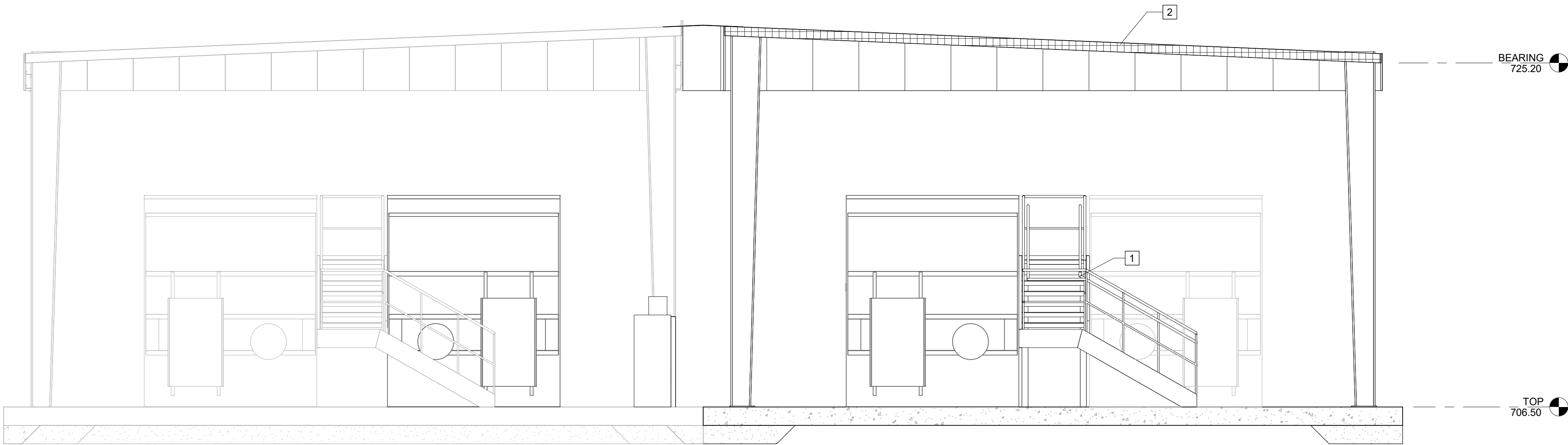
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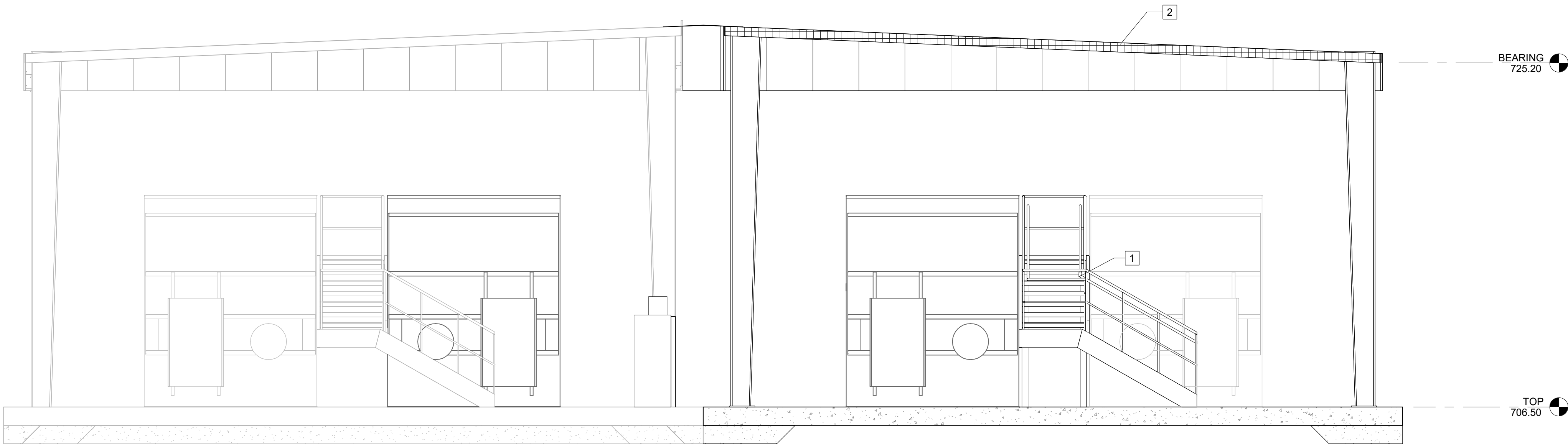
5C ENLARGED PLAN
A-501 SCALE: 3/8" = 1'-0"



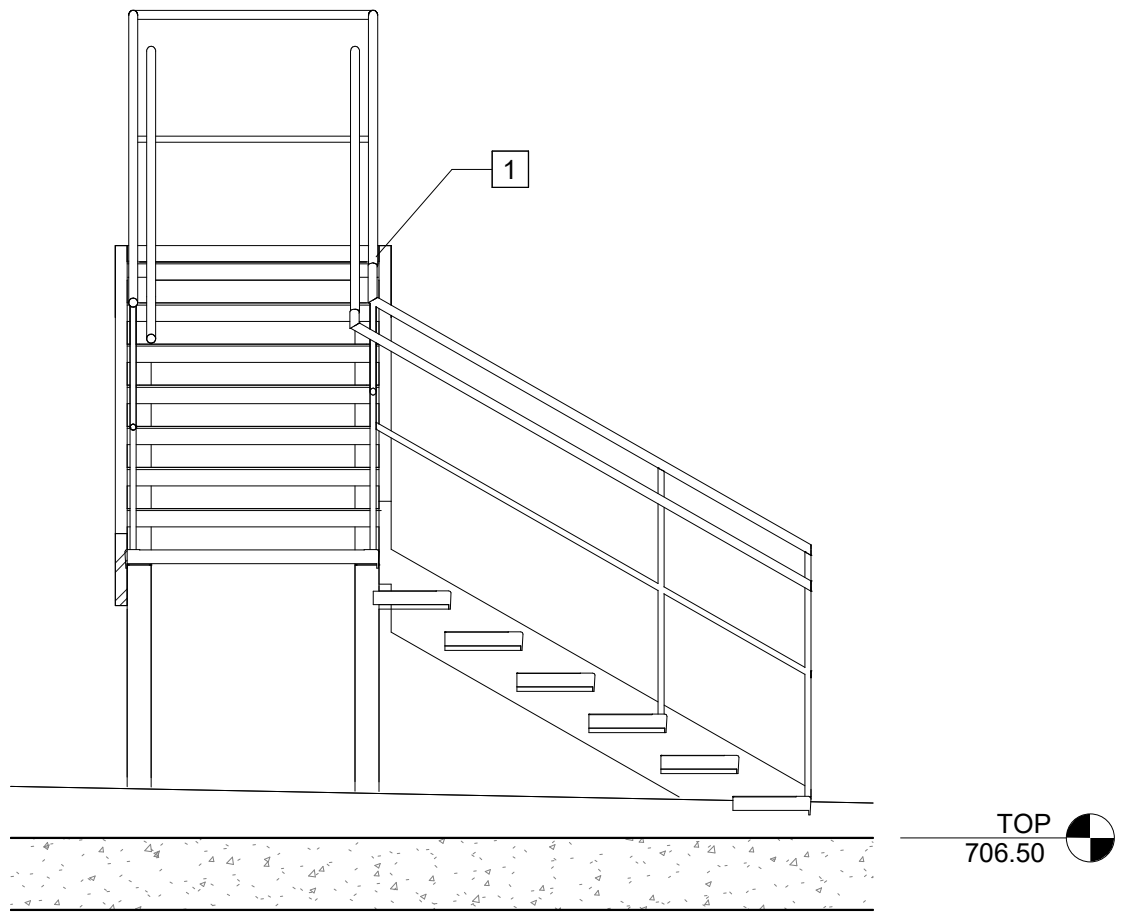
A SECTION
A-502 SCALE: 3/8" = 1'-0"



C SECTION
A-501 SCALE: 1/4" = 1'-0"

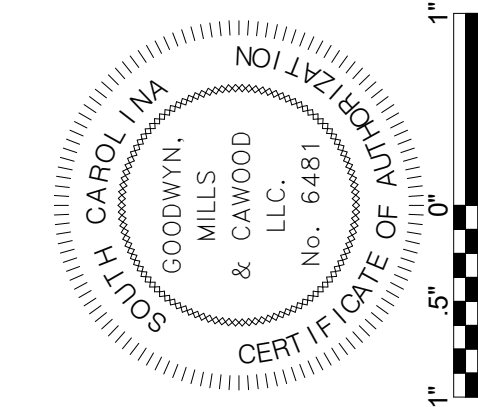


B SECTION
A-502 SCALE: 3/8" = 1'-0"



KEY NOTES: #

1. STAIR WITH ALUMINUM HANDRAILS
2. METAL PANEL ROOF



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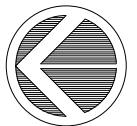
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**FILTERS - ENLARGED
PLAN & SECTIONS**

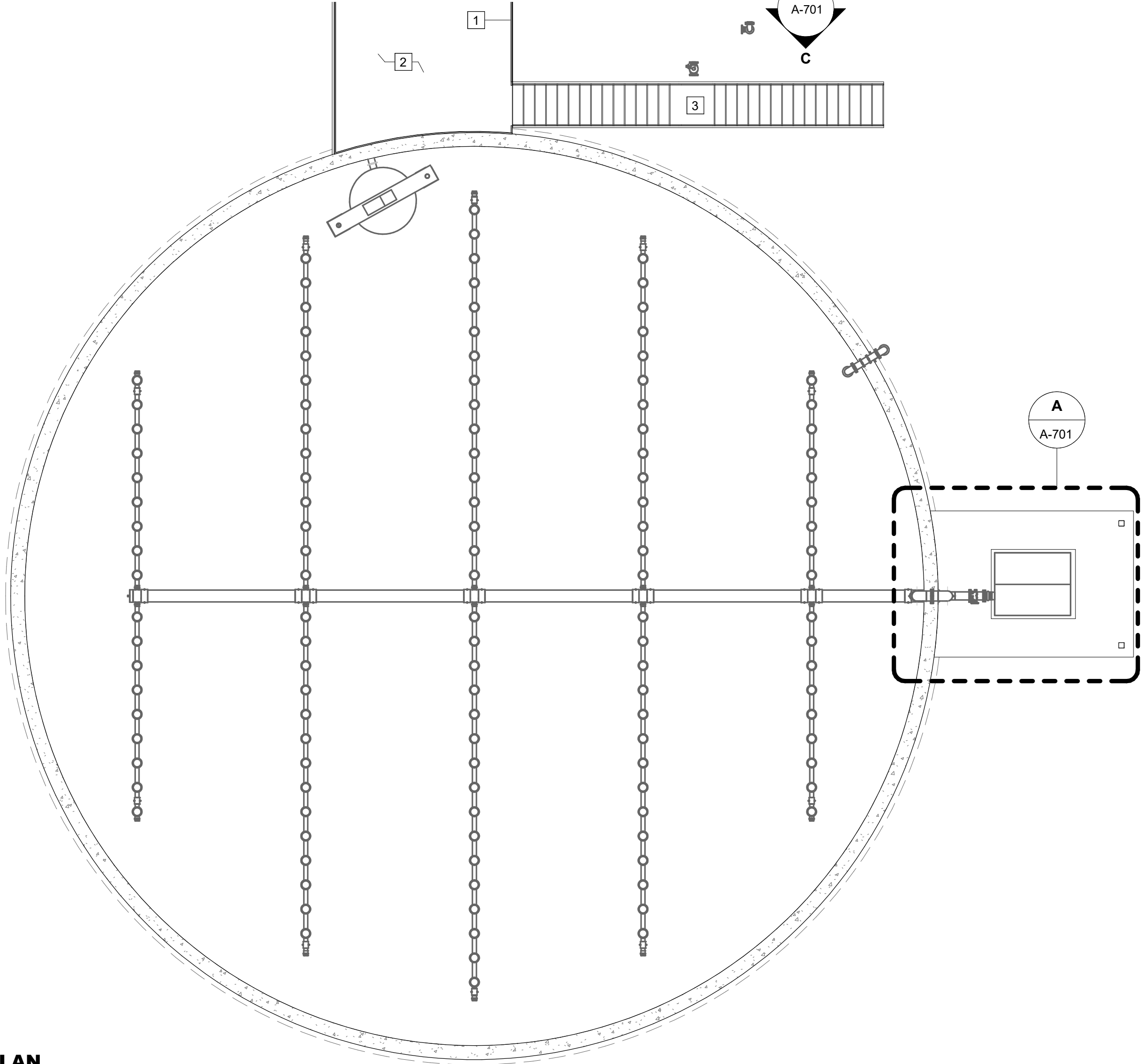
A-502

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7A PLAN
A-701 SCALE: 1/8" = 1'-0"

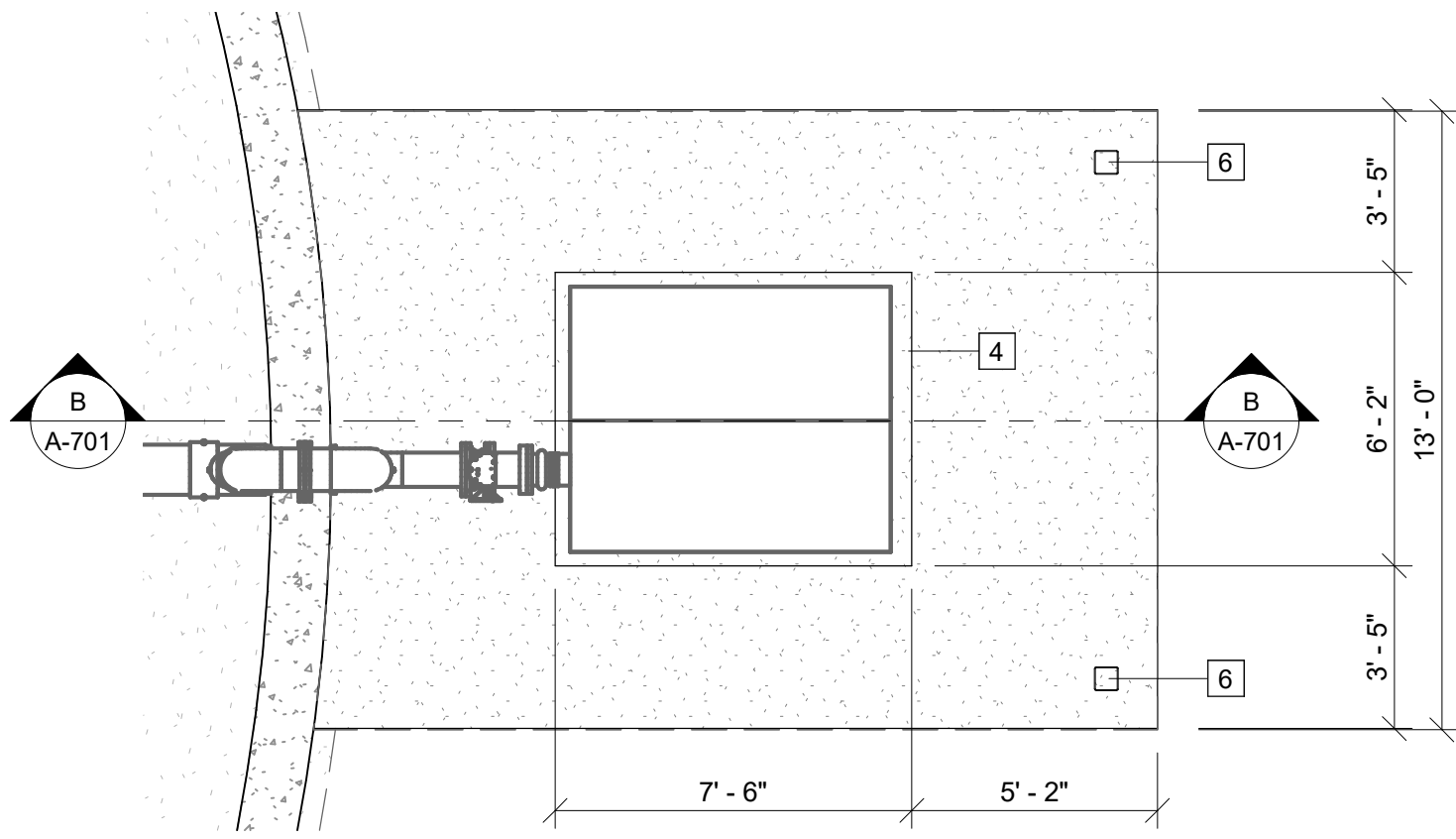
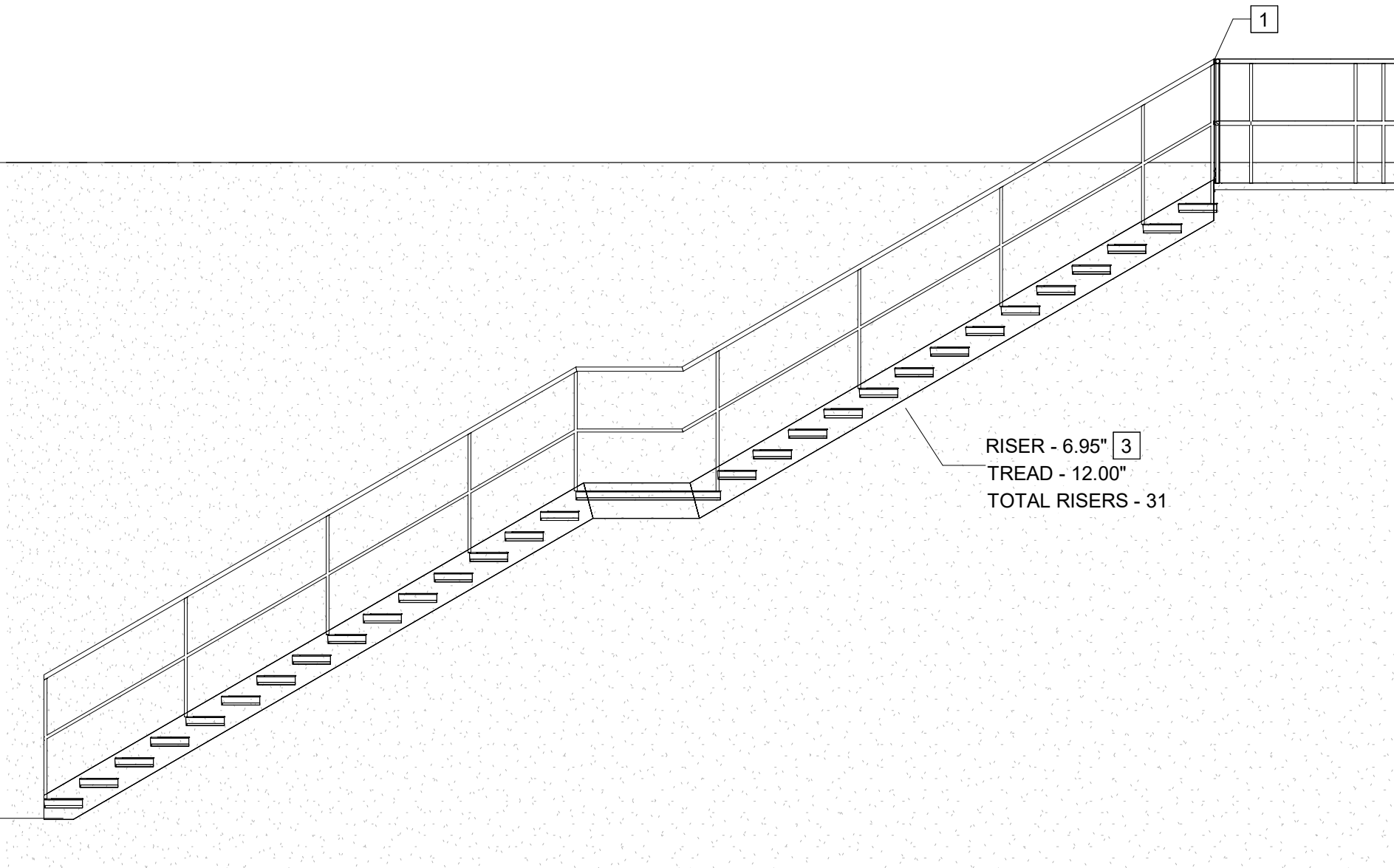


TOP
726.50

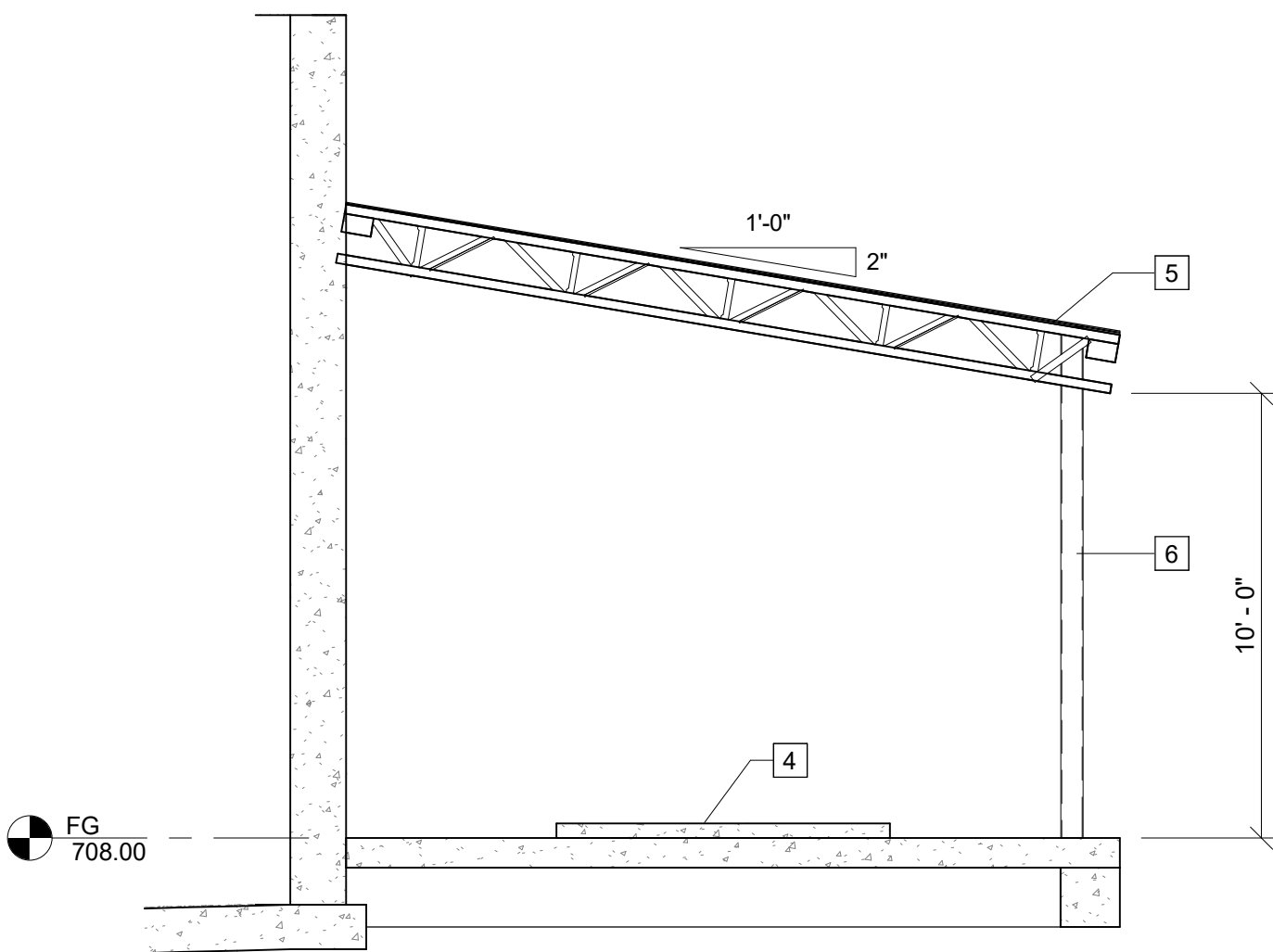
FG
708.00

RISER - 6.95"
TREAD - 12.00"
TOTAL RISERS - 31

C ELEVATION
A-701 SCALE: 1/4" = 1'-0"



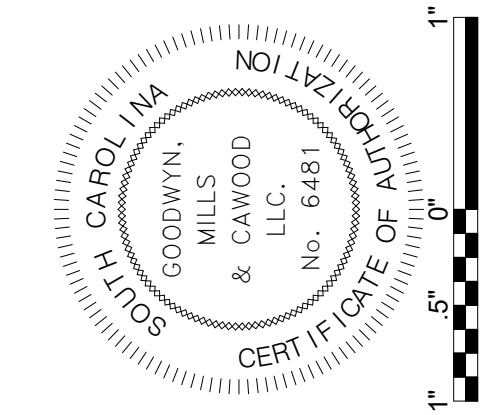
A ENLARGED PLAN
A-701 SCALE: 1/4" = 1'-0"



B SECTION
A-701 SCALE: 1/4" = 1'-0"

KEY NOTES: #

- 3'-6" ALUMINUM HANDRAIL W/ TOE PLATE
- WALKWAY ASSEMBLY (SEE SHEET D-701)
- METAL STAIRS W/ STAIR RAILING
- EQUIPMENT PAD
- STANDING SEAM METAL ROOF SYSTEM
- STRUCTURAL COLUMN (SEE STRUCTURAL)



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Drawn By:	HKD

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**AEROBIC DIGESTER -
PLAN**

A-701

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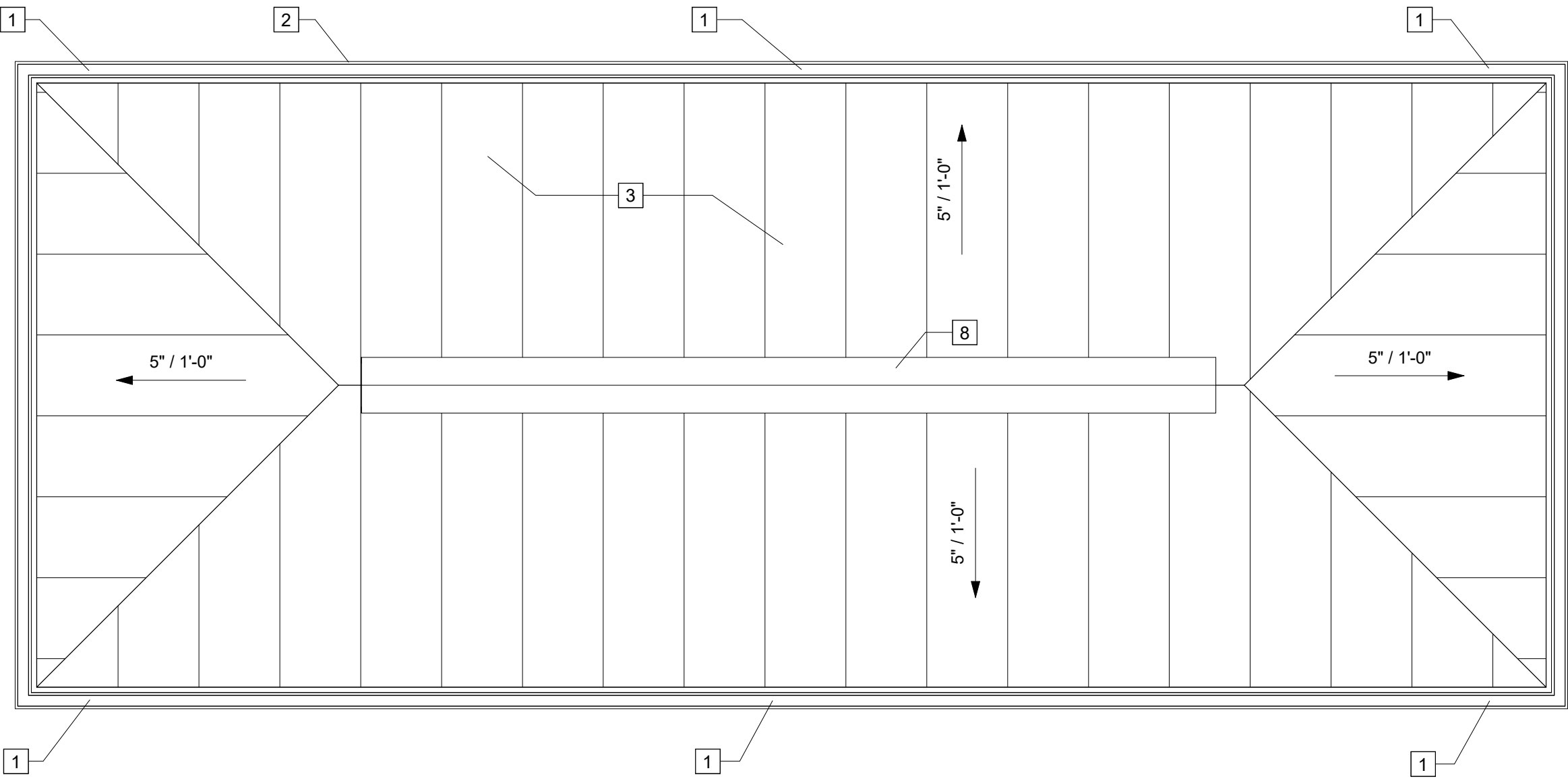
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8C

A-801

ROOF

SCALE: 1/4" = 1'-0"

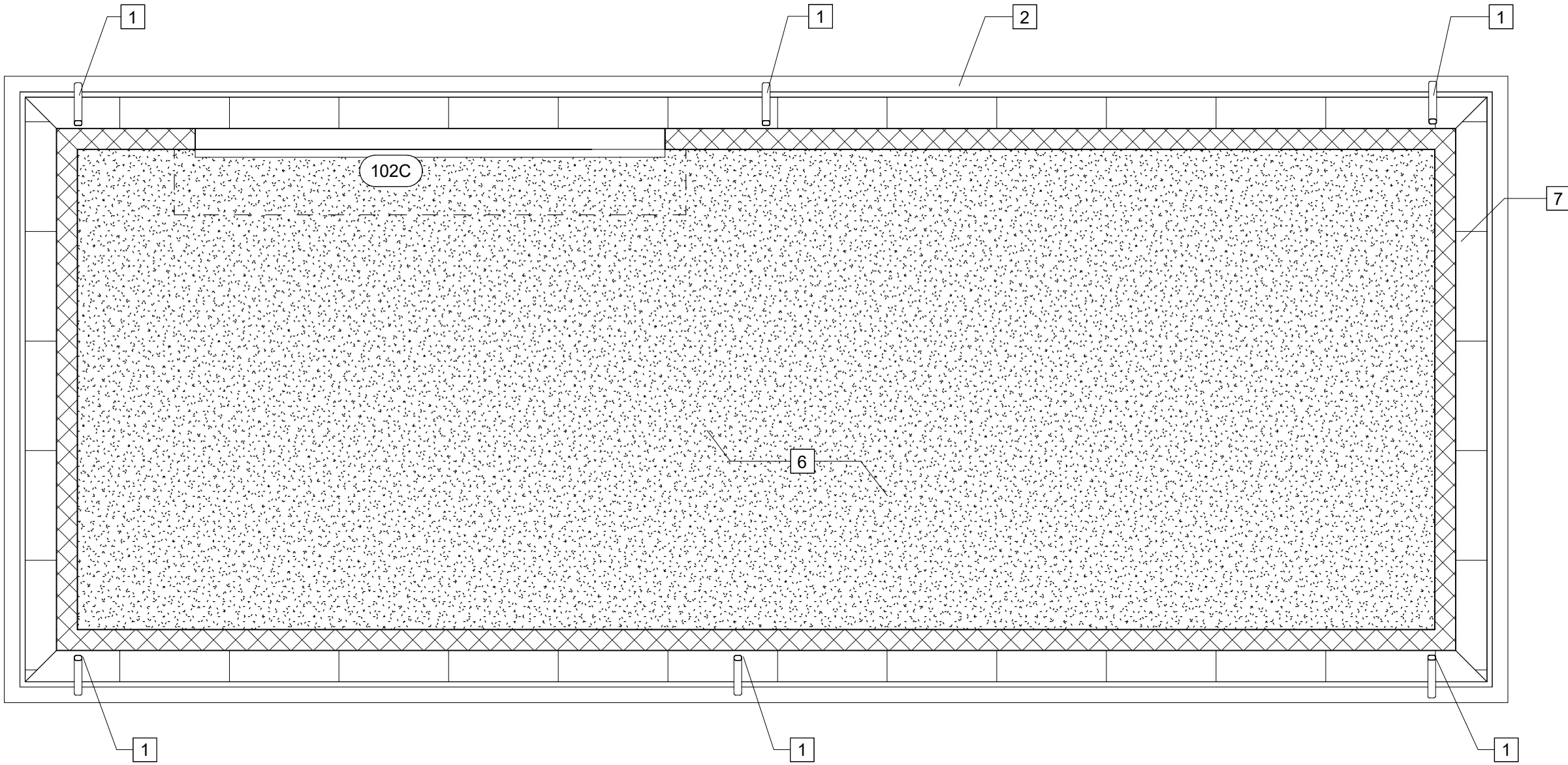


8B

A-801

REFLECTED CEILING PLAN

SCALE: 1/4" = 1'-0"

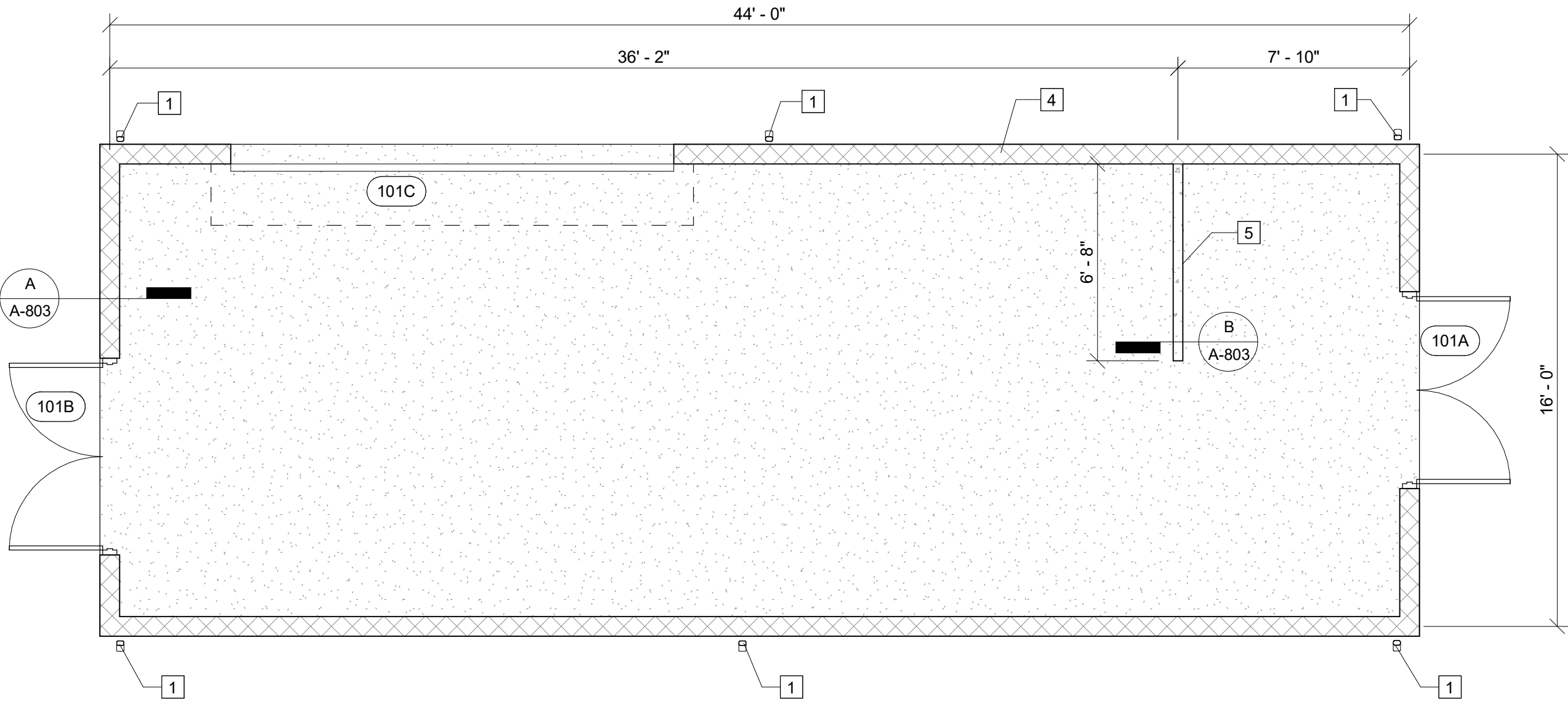


8A

A-802

FLOOR PLAN

SCALE: 1/4" = 1'-0"



KEY NOTES: #

1. DOWNSPOUT
2. ALUMINUM GUTTERS
3. METAL PANEL ROOF
4. SPLIT FACE 8" CMU
5. 4" CMU
6. GWB OVER METAL STUDS FRAMING
7. FASCIA
8. RIDGE VENT

MAIN ELECTRICAL
BUILDING - PLANS

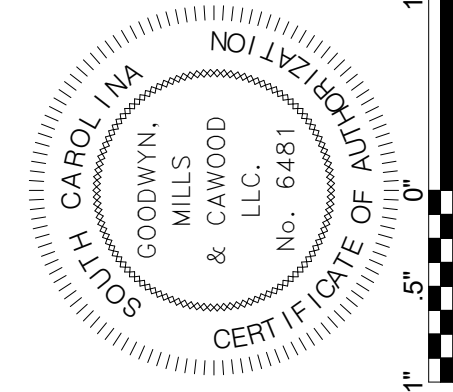
A-801

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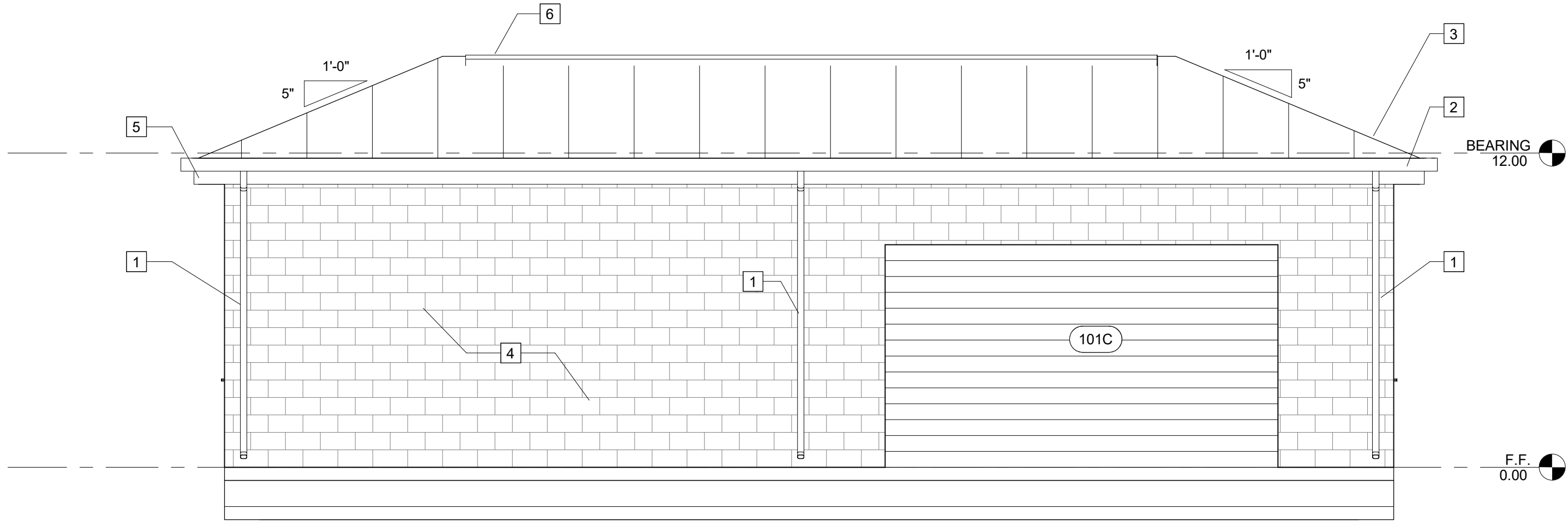
ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD



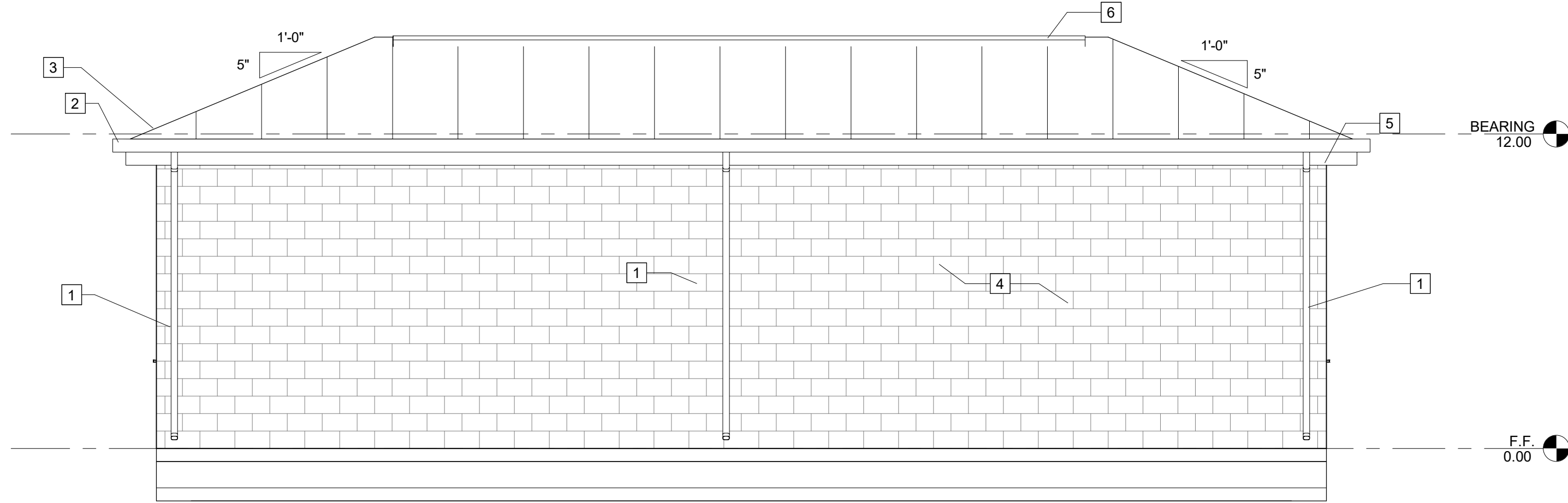
GMC
117 Welborn St.
Greenville, SC 29601
T 864.527.0460

BM 360\\CGCRE220027 - Pendleton-Clemson WWTP Expansion\\Main Electrical bldw.rvt
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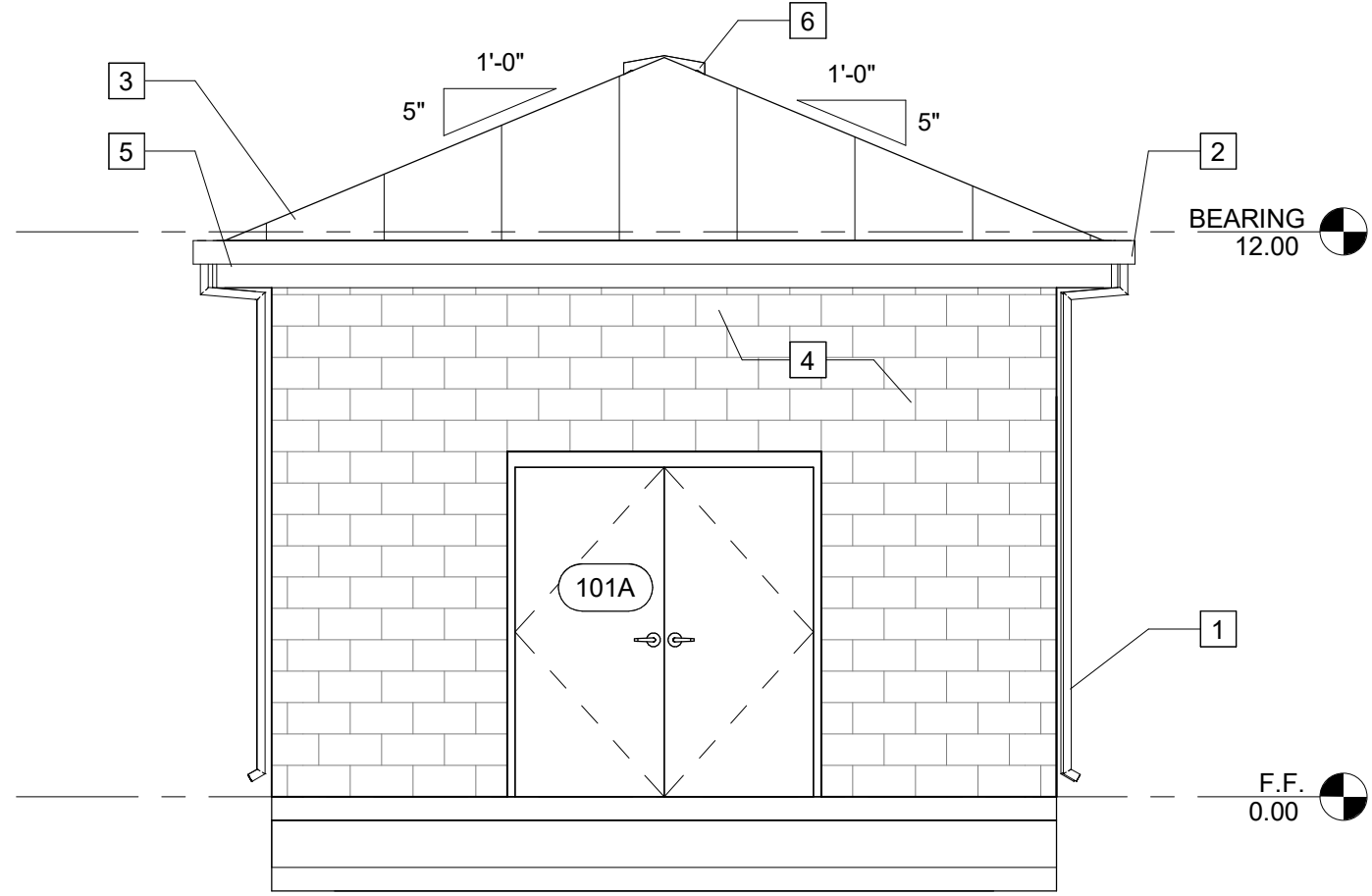
D EXTERIOR ELEV.
SCALE: 1/4" = 1'-0"



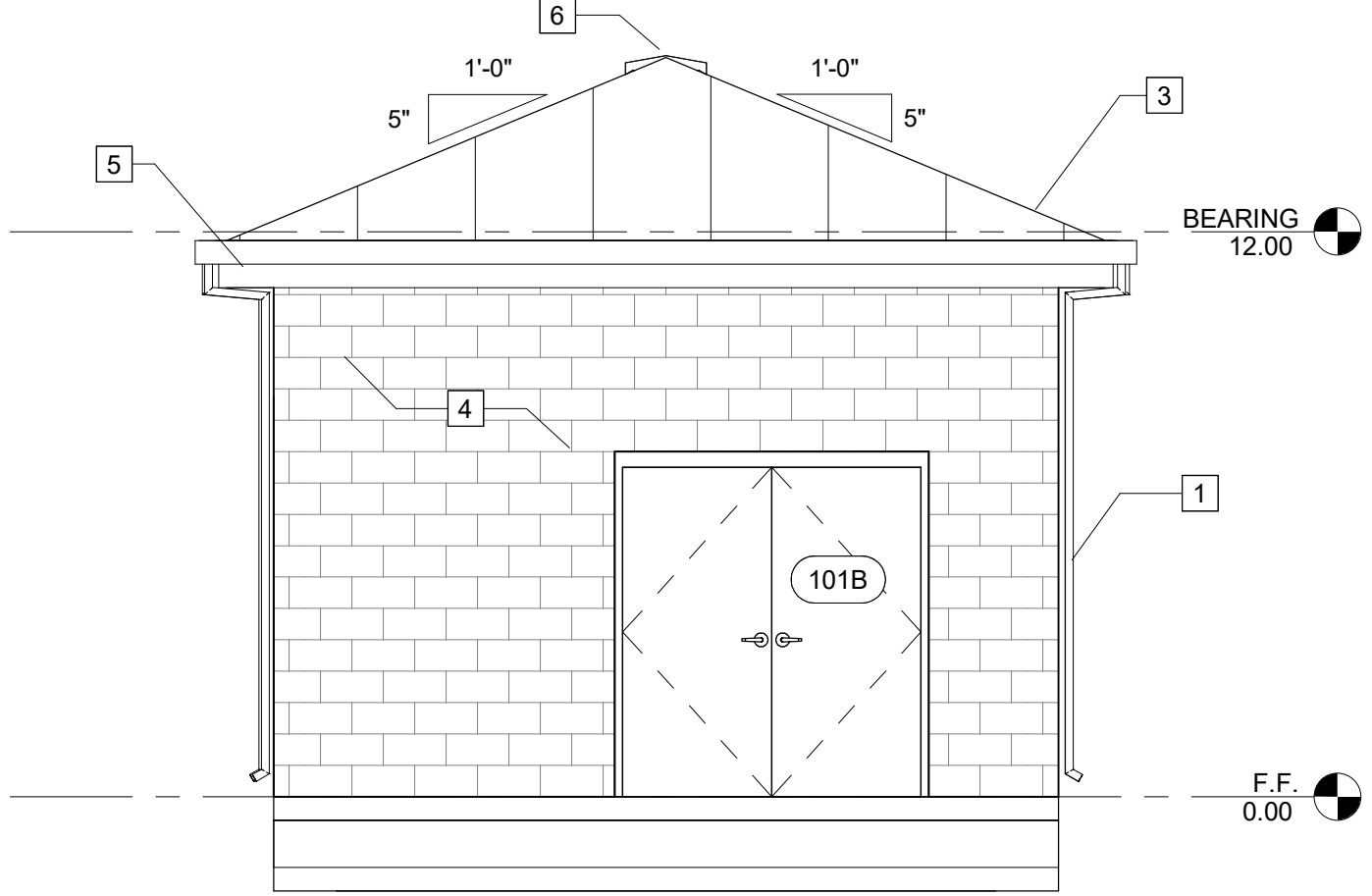
C EXTERIOR ELEV.
SCALE: 1/4" = 1'-0"



A EXTERIOR ELEV.
SCALE: 1/4" = 1'-0"



B EXTERIOR ELEV.
SCALE: 1/4" = 1'-0"



KEY NOTES: #

1. ALUMINUM DOWNSPOUT
2. ALUMINUM GUTTER
3. STANDING SEAM METAL ROOF
4. SPLIT FACE 8" CMU
5. FASCIA
6. RIDGE VENT

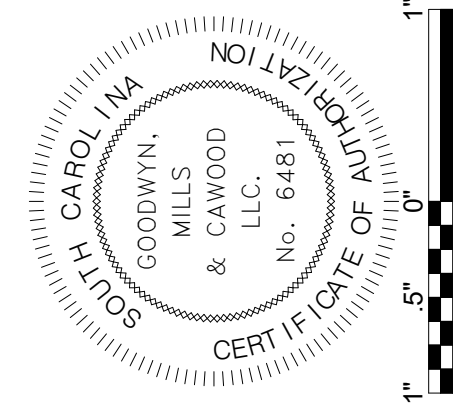
MAIN ELECTRICAL
BUILDING - EXTERIOR
ELEVATIONS

A-802

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

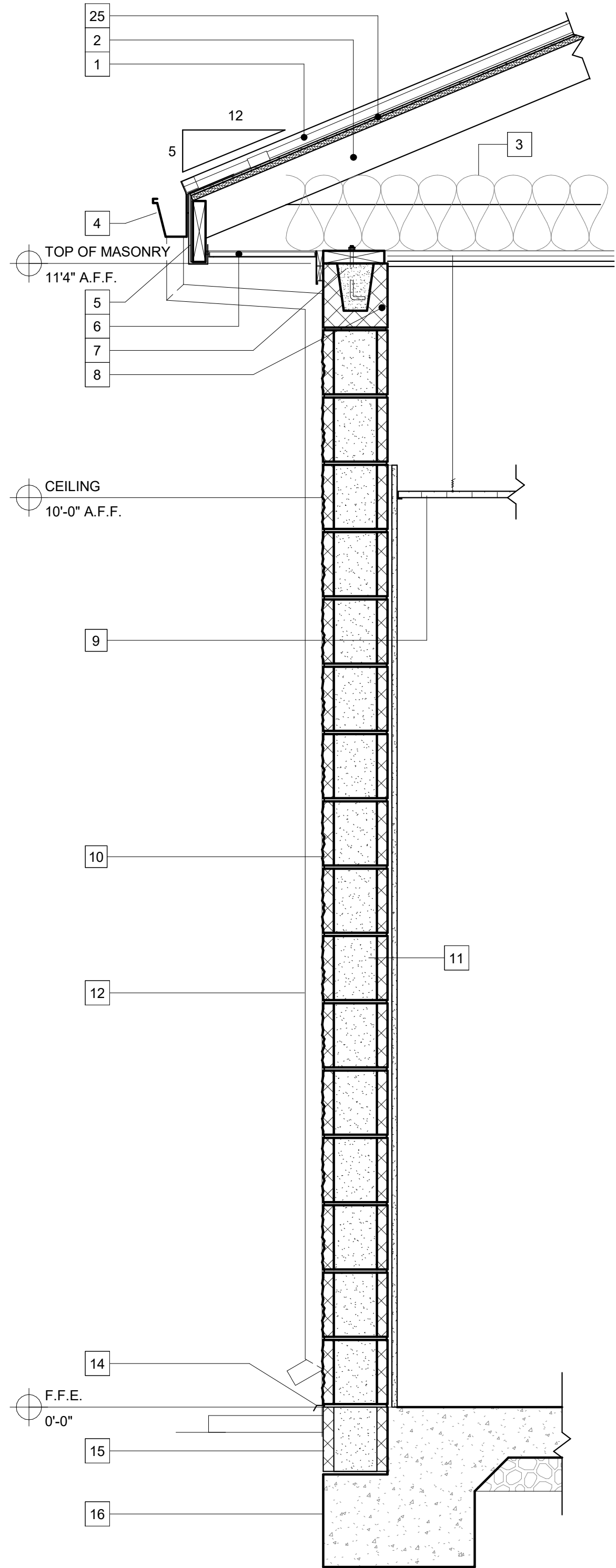
GMC PROJECT #CGRE220027

ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

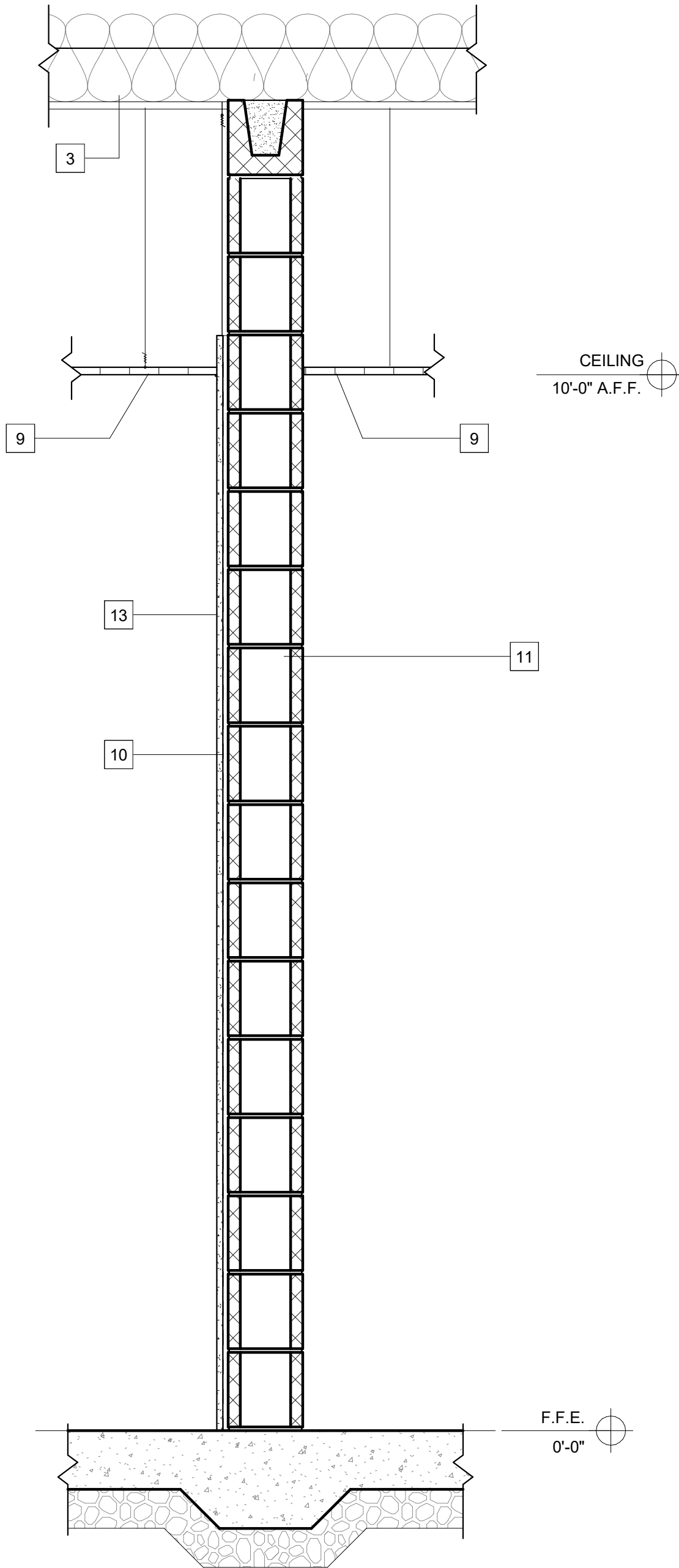


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3/11/2024 3:47:58 PM



A SECTION
A-801 SCALE: 1" = 1'-0"



B SECTION
A-801 SCALE: 1" = 1'-0"

KEY NOTES: #

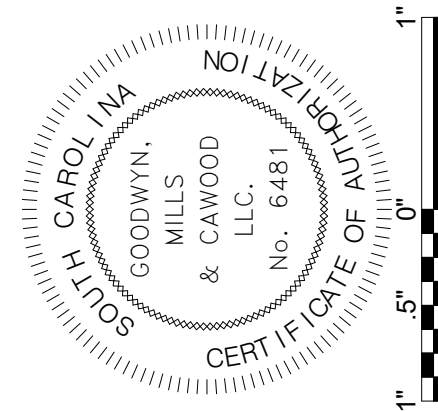
1. STANDING SEAM METAL ROOFING
2. PRE-ENGINEERED METAL TRUSS @ 4'-0" O.C.
3. **BATT INSULATION ON SUSPENSION SYSTEM**
4. ALUMINIUM GUTTER
5. PRE-FINISHED METAL FASCIA ON P.T. 2X SUBFASCIA
6. PRE-FINISHED VENTED METAL SOFFIT WITH CLIPS
7. P.T. 2X12 PLATE ANCHORED TO BOND BEAM
8. SMOOTH FACE BOND BEAM (SEE STRUCT.)
9. SUSPENDE ACOUSTICAL TILE CEILING
10. SLIPT FACE 8" CMU
11. 3-5/8" METAL STUDS @ 12" O.C.
12. ALUMINIUM DOWNSPOUT
13. 5/8" GYPSUM BOARD
14. FLASHING
15. SMOOTH FACE CMU AT BASE
16. CONCRETE

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GMC PROJECT #CGRE220027

**MAIN ELECTRICAL
BUILDING - WALL
SECTIONS**

A-803



ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

BM 360\\CGCRE220027 - Pendleton-Clemson WWTP Expansion\\Main Electrical bldw.rvt
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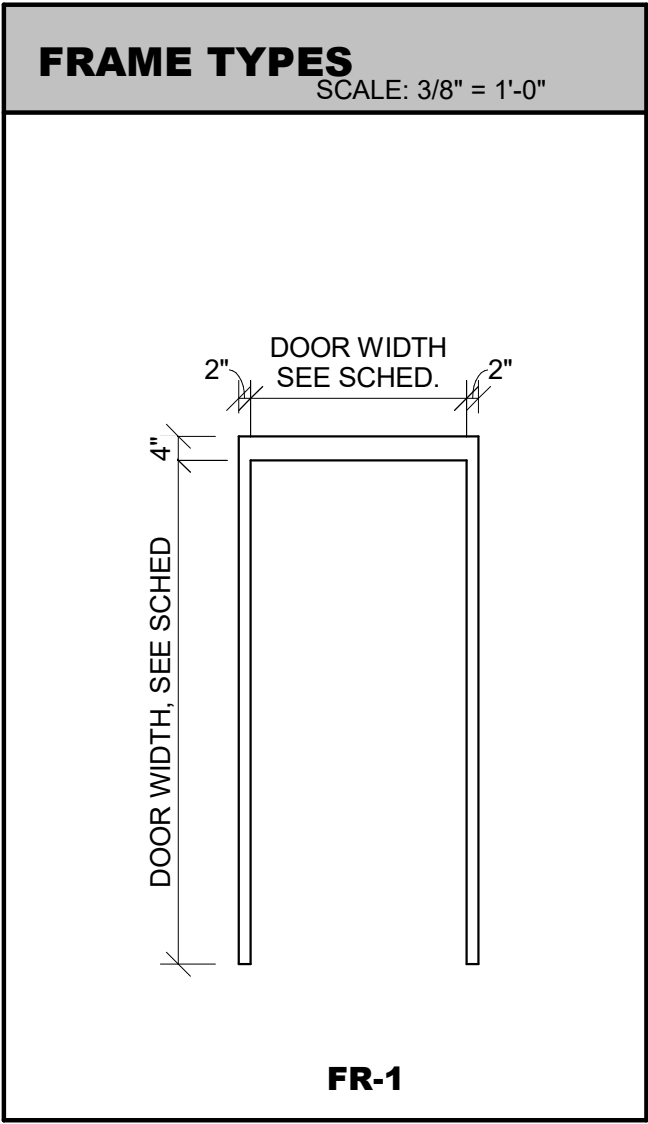
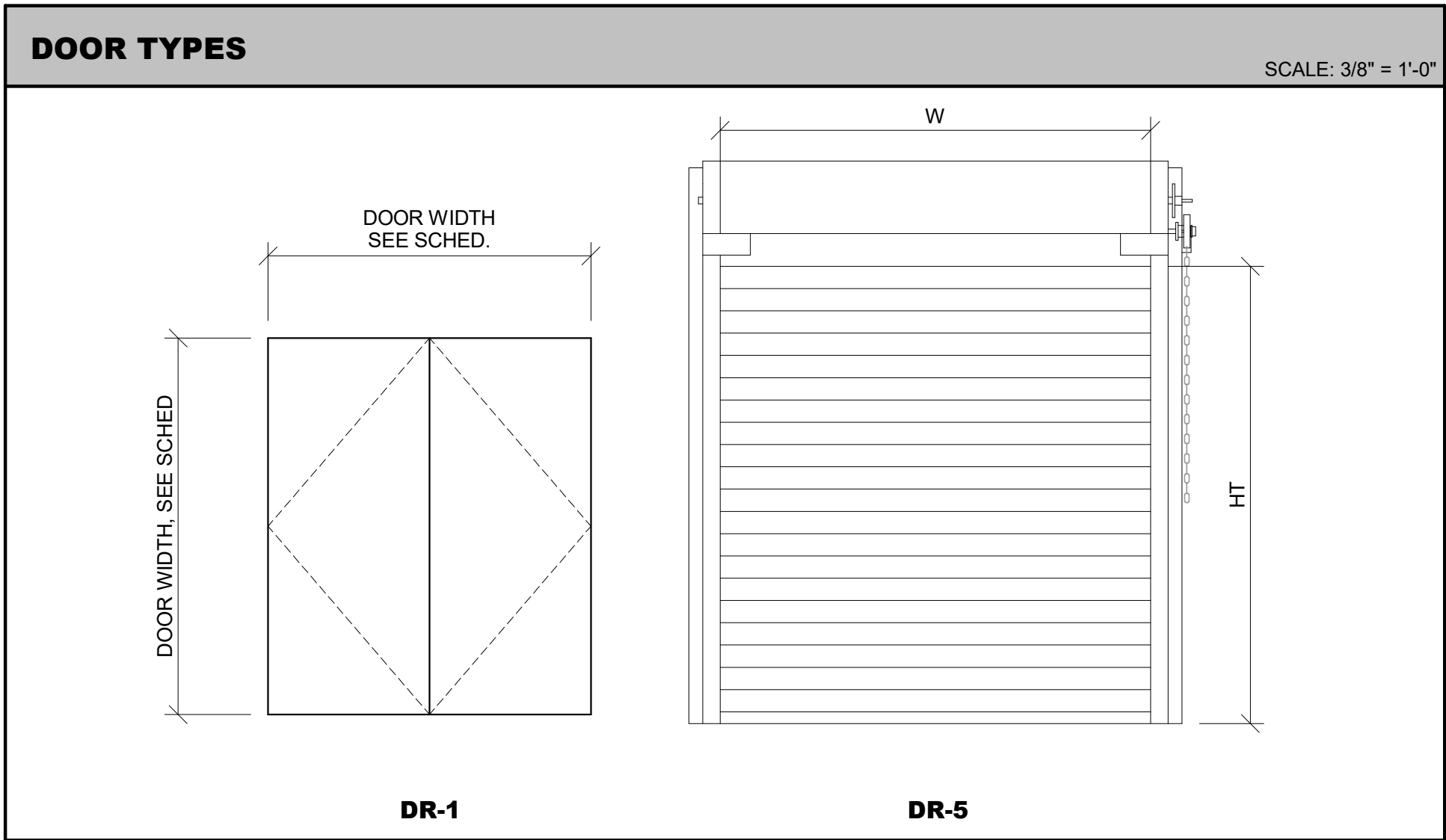
DOOR SCHEDULE										
DOOR #	DOOR			FRAMES						COMMENTS
	SIZE		TYPE	MATERIAL	TYPE	MATERIAL	DETAILS			
	WIDTH	HEIGHT					HEAD	JAMB	SILL	
101A	6.33'	7.00'								
101B	6.33'	7.00'								
101C	15.00'	8.50'								

WALLS LEGEND		
NUMBER	TYPE	DESCRIPTION
PNT-1	PAINT	PRODUCT EQUAL TO; MANUFACTURER; TNEMEC COLOR: BY OWNER
FRP-1	4" HIGH FRP WALL PANELS	PRODUCT EQUAL TO; MANUFACTURER; MARLITE, STYLE/COLOR: BY OWNER, SIZE 4"X8"X3/32"
GYP-1	TYPE X GYPSUM BOARD	PRODUCT EQUAL TO; PAINTED GYP BOARD, STYLE/COLOR: BY OWNER; REFER TO SPECIFICATION 09 29 00
GYP-2	TYPE XP GYPSUM BOARD	PRODUCT EQUAL TO; PAINTED GYP BOARD, STYLE/COLOR: BY OWNER; REFER TO SPECIFICATION 09 29 00

CEILING LEGEND		
NUMBER	TYPE	DESCRIPTION
PLY-1	PLYWOOD	PRODUCT EQUAL TO; PAINTED TREATED PLYWOOD, STYLE/COLOR: BY OWNER

MISCELLANEOUS LEGEND		
NUMBER	TYPE	DESCRIPTION
SSC-1	SOLID SURFACE COUNTERTOP	PRODUCT EQUAL TO; PHENOIC RESIN COUNTERTOPS
CMU-1	CONCRETE MASONRY UNITS	PRODUCT EQUAL TO; COLOR: BY OWNER
SSMR	METAL ROOF	PRODUCT EQUAL TO; COLOR: BY OWNER

ABBREVIATIONS	
ACT-2	LAY-IN ACOUSTICAL CEILING TILE- MOISTURE RESISTANT
ALUM	ANODIZED INSULATED ALUMINUM
CONC	CONCRETE
FRP	FIBER REINFORCED PLASTIC
GYP-1	TYPE X GYPSUM BOARD
GYP-2	TYPE XP GYPSUM BOARD
HM	HOLLOW METAL
PNT	PAINT
RUB-1	4" RUBBER BASE
TCF-1	TROWEL CONCRETE FINISH
VCT-1	VINYL COMPOSITE TILE



- SIGNAGE NOTES
1.

RAISED CHARACTERS SHALL BE 1/32 INCH MINIMUM ABOVE THEIR BACKGROUND.
2.

CHARACTERS SHALL BE UPPERCASE.
3.

CHARACTERS SHALL BE SANS SERIF. CHARACTERS SHALL NOT BE ITALIC, OBLIQUE, SCRIPT, HIGHLY DECORATIVE, OR OF OTHER UNUSUAL FORMS.
4.

CHARCTERS SHALL BE SELECTED FROM FONTS WHERE THE WIDTCH OF THE UPPERCASE LETTER "O" IS 55 PERCENT MINIMUM AND 110 PERCENT MAXIMUM OF THE HEIGHT OF THE UPPPERCASE LETTER "I".
5.

STROKE THICKNESS OF THE UPPERCASE LETTER "I" SHALL BE 15 PERCENT MAXIMUM OF HEIGHT OF CHARACTER.
6.

SPACING BETWEEN THE BASELINES OF SEPARATE LINES OF RAISED CHARACTERS WITHIN A MESSAGE SHALL BE 135 PERCENT MINIMUM AND 170 PERCENT MAXIMUM OF THE RAISED CHARACTER HEIGHT.

- NOTES
1.

ALL BUILDING MATERIALS STYLE/COLOR SHALL BE COORDINATED WITH THE OWNER VIA THE SUBMITTAL PROCESS AS OUTLINED IN SPECIFICATION 01330 PRIOR TO PLACING ORDERS.
2.

THRESHOLDS AT DOORWAYS SHALL NOT EXCEED 1/2" IN HEIGHT. RAISED THRESHOLDS AND DOOR LEVEL CHANGES AT ACCESSIBLE DOORWAYS SHALL BE BEVELED WITH A SLOPE NO GREATER THAN 1:2.
3.

SEE SPECIFICATIONS FOR HARDWARE INFORMATION.

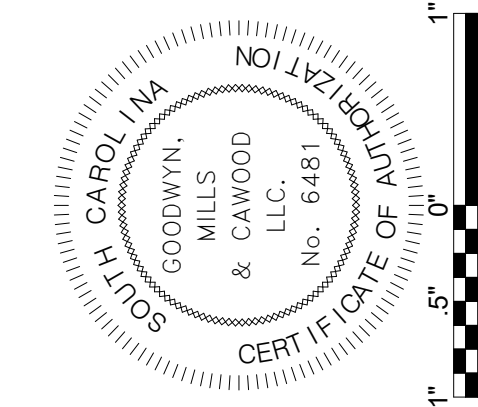
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PENDLETON, SOUTH CAROLINA
Town of Pendleton
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GMC PROJECT #CGCRE220027

MAIN ELECTRICAL
BUILDING - SCHEDULE

A-804

ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD



DRAWING FILE: T:\1 Projects\SC\Pendleton, Town of\CGRE220027 - Pendleton-Clemson WWTP\DWG\CAD\01 BID DRAWINGS\10 PROCESS\D-001.dwg
PLOTTED: Mar 11, 2024 - 3:54pm



1
D-001

SITE PLAN
SCALE: 1" = 60'-0"



PROCESS NOTES:

1. PROCESS EQUIPMENT DIMENSIONS, LOCATIONS, AND PIPING SYSTEM LAYOUTS SHOWN ON THE DRAWINGS ARE BASED ON EQUIPMENT SELECTED BY ENGINEER AND INFORMATION AVAILABLE TO ENGINEER. CONTRACTOR SHALL VERIFY FIELD CONDITIONS, ACTUAL EQUIPMENT DIMENSIONS AND INSTALLATION REQUIREMENTS BASED ON SHOP DRAWINGS, AND ALL NECESSARY DETAILS FOR COMPLETE INSTALLATION.
2. EQUIPMENT ARRANGEMENTS ARE BASED ON THE EQUIPMENT BASIS OF DESIGN IN THE SPECIFICATIONS. CHANGES TO THE LISTED BASIS OF DESIGN RESULTING IN DIFFERENCES OF THE SHOWN ARRANGEMENT SHALL BE THE CONTRACTORS RESPONSIBILITY. NO PAYMENT WILL BE ISSUED TO THE CONTRACTOR FOR MODIFICATIONS TO THE LAYING LENGTH, CONCRETE LAYOUT, ELECTRICAL OR MECHANICAL REQUIREMENTS, ETC.
5. VALVES, PIPES, MOTORS, ELECTRICAL PANELS, ETC. SHALL BE POSITIONED SO THAT THEY DO NOT INTERFERE WITH PEDESTRIAN TRAFFIC.
6. ALL ELECTRICAL APPURTENANCES AND EQUIPMENT SHOWN ON THIS SHEET AND EXCLUDED FOR CLARITY SHALL BE COORDINATED WITH THE ELECTRICAL PLANS AND SPECIFICATIONS.
7. ALL STRUCTURAL ENTITIES SHOWN ON THIS SHEET AND EXCLUDED FOR CLARITY SHALL BE COORDINATED WITH THE STRUCTURAL PLANS AND SPECIFICATIONS.
8. DRAWINGS MAY NOT SHOW ALL VALVES, GAUGES, SWITCHES, OPERATORS, DRAINS, VENTS, ETC., REQUIRED FOR THE COMPLETE SYSTEM. CERTAIN SMALL DIAMETER PROCESS PIPING RUNS MAY NOT BE SHOWN IN THEIR ENTIRETY. GENERALLY, NOT EVERY FITTING AND OFFSET IS SHOWN. SOME VALVES AND APPURTENANCES MAY BE OMITTED FOR THE SAKE OF CLARITY. THE CONTRACTOR SHALL FURNISH, INSTALL, AND TEST ALL PIPING SYSTEMS AS INDICATED ON THE PROCESS SYSTEM FLOW SCHEMATICS AND/OR AS DEFINED IN THE SPECIFICATIONS AND/OR AS REQUIRED TO PROVIDE THE COMPLETE SYSTEM.

EQUIPMENT NOTES:

1. PROPOSED CONCRETE SHALL CLEANLY TRANSITION FROM EXISTING SURROUNDING SURFACES PROVIDING POSITIVE DRAINAGE.
2. PROCESS EQUIPMENT DIMENSIONS, LOCATIONS, AND PIPING SYSTEM LAYOUTS SHOWN ON THE DRAWINGS ARE BASED ON EQUIPMENT SELECTED BY ENGINEER AND INFORMATION AVAILABLE TO ENGINEER. CONTRACTOR SHALL VERIFY FIELD CONDITIONS, ACTUAL EQUIPMENT DIMENSIONS AND INSTALLATION REQUIREMENTS BASED ON SHOP DRAWINGS, AND ALL NECESSARY DETAILS FOR COMPLETE INSTALLATION.
3. EQUIPMENT ARRANGEMENTS ARE BASED ON THE EQUIPMENT BASIS OF DESIGN IN THE SPECIFICATIONS. CHANGES TO THE LISTED BASIS OF DESIGN RESULTING IN DIFFERENCES OF THE SHOWN ARRANGEMENT SHALL BE THE CONTRACTORS RESPONSIBILITY. NO PAYMENT WILL BE ISSUED TO THE CONTRACTOR FOR MODIFICATIONS TO THE LAYING LENGTH, CONCRETE LAYOUT, ELECTRICAL OR MECHANICAL REQUIREMENTS, ETC.
4. VALVES, PIPES, MOTORS, ELECTRICAL PANELS, ETC. SHALL BE POSITIONED SO THAT THEY DO NOT INTERFERE WITH PEDESTRIAN TRAFFIC. WHEN APPLICABLE, MOTORS SHALL BE PROVIDE WITH VERTICAL HELICAL GEAR MOTOR SO THAT MOTOR EXTENDS VERTICALLY AND NOT HORIZONTALLY AND SHOULD BE PROVIDED BY THE MANUFACTURER.
5. ALL ELECTRICAL APPURTENANCES AND EQUIPMENT SHOWN ON THIS SHEET AND EXCLUDED FOR CLARITY SHALL BE COORDINATED WITH THE ELECTRICAL PLANS AND SPECIFICATIONS.
6. CONTROL PANELS PROVIDED BY THE MANUFACTURER SHALL BE SET WHERE SHOWN. PANELS REQUIRED FOR SAFETY TO BE SET ON THE ACCESS PLATFORM SHALL BE MINIMIZED AND WHEN INSTALLED, SHALL NOT RESULT IN OBSTRUCTIONS.
7. ALL STRUCTURAL ENTITIES SHOWN ON THIS SHEET AND EXCLUDED FOR CLARITY SHALL BE COORDINATED WITH THE STRUCTURAL PLANS AND SPECIFICATIONS.
8. CONTRACTOR SHALL ENSURE THAT ACCESS PANELS FOR OPERATION AND MAINTENANCE OF EQUIPMENT ARE NOT OBSTRUCTED.
9. GRATING TO CLEAR GATE FRAME & STEM

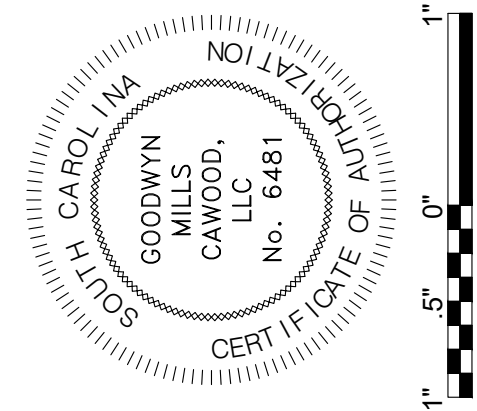
**PROCESS
SITE PLAN**

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REGIONAL WWT EXPANSION**

PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

D-001

GMC PROJECT #CGRE220027



ISSUE	DATE
30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
100% Submittal	03/08/2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

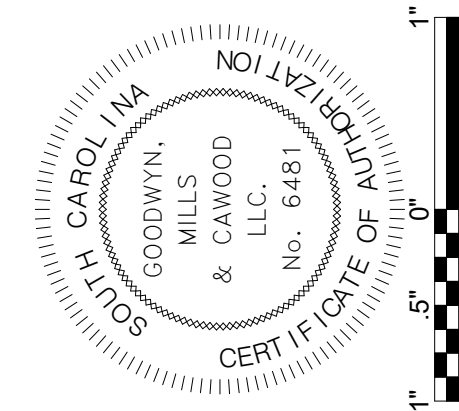
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PLAN

SCALE: 3/8" = 1'-0"



1. 4" DUCKBILL CHECK VALVE
2. GUIDERAIL SUPPORTS (FURNISHED BY PUMP MANUFACTURER)
3. 8" TEE



ISSUE	DATE
30% Submittal	01.18.2023
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Conformed Set	WN
Project Manager:	TR
Engineer:	JX
Designer:	HKD
Drawn By:	

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PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

INFLUENT PUMP STATION - LOWER PLAN

D-101



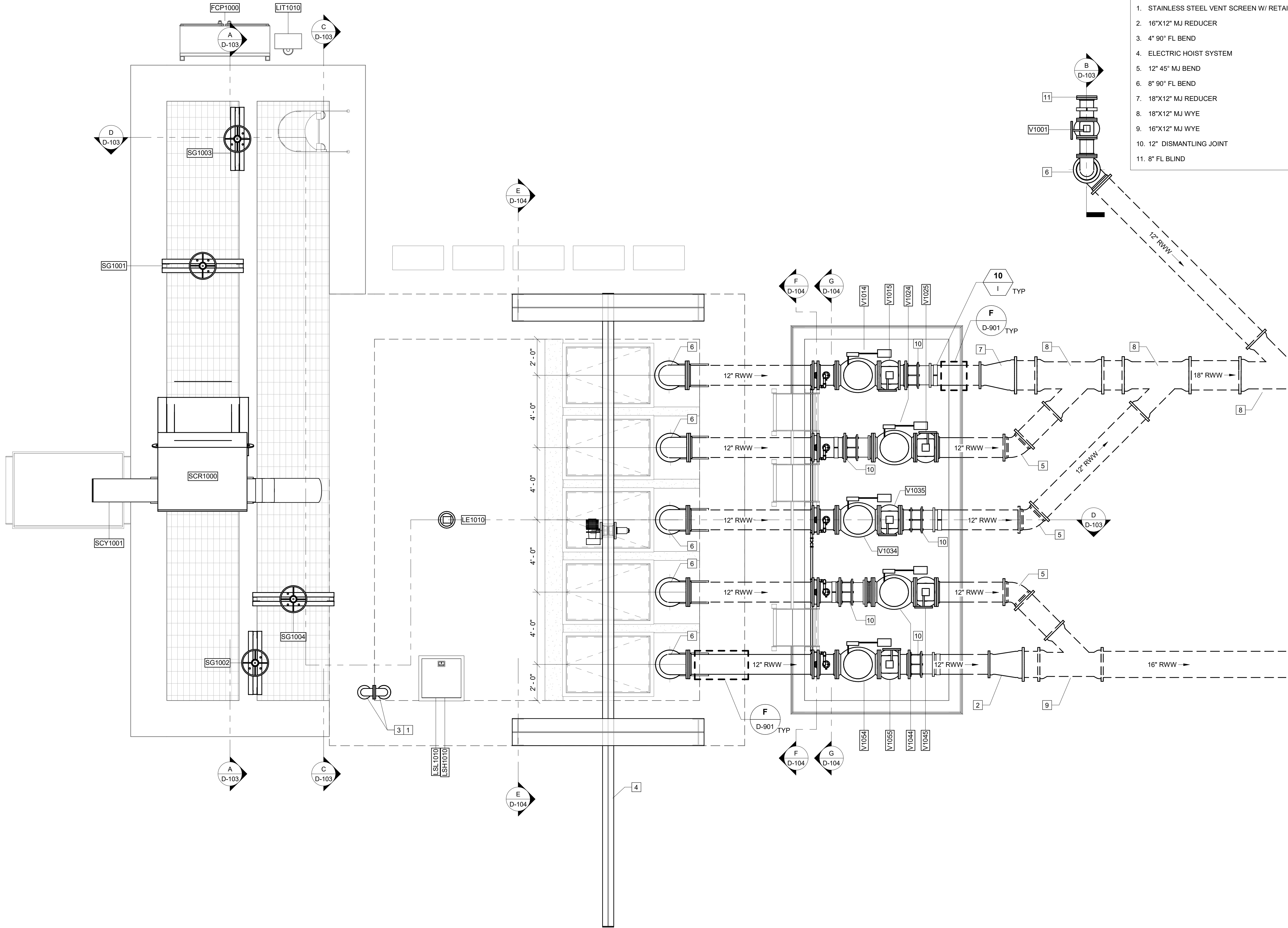
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D-001

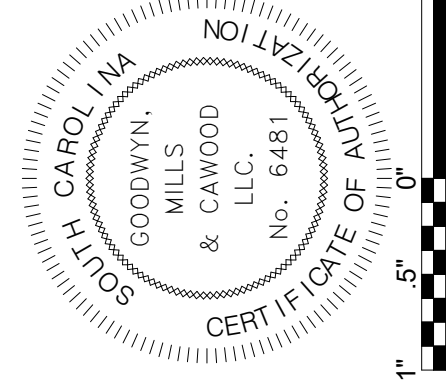
PLAN

SCALE: 3/8" = 1'-0"



KEY NOTES: #

1. STAINLESS STEEL VENT SCREEN W/ RETAINING FLANGE
2. 16"X12" MJ REDUCER
3. 4" 90° FL BEND
4. ELECTRIC HOIST SYSTEM
5. 12" 45° MJ BEND
6. 8" 90° FL BEND
7. 18"X12" MJ REDUCER
8. 18"X12" MJ WYE
9. 16"X12" MJ WYE
10. 12" DISMANTLING JOINT
11. 8" FL BLIND



ISSUE	DATE
30% Submittal	01.18.2023
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Conformed Set	
Project Manager:	WN
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Drawn By:	HKD

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Town of Pendleton
City of Clemson
Anderson County

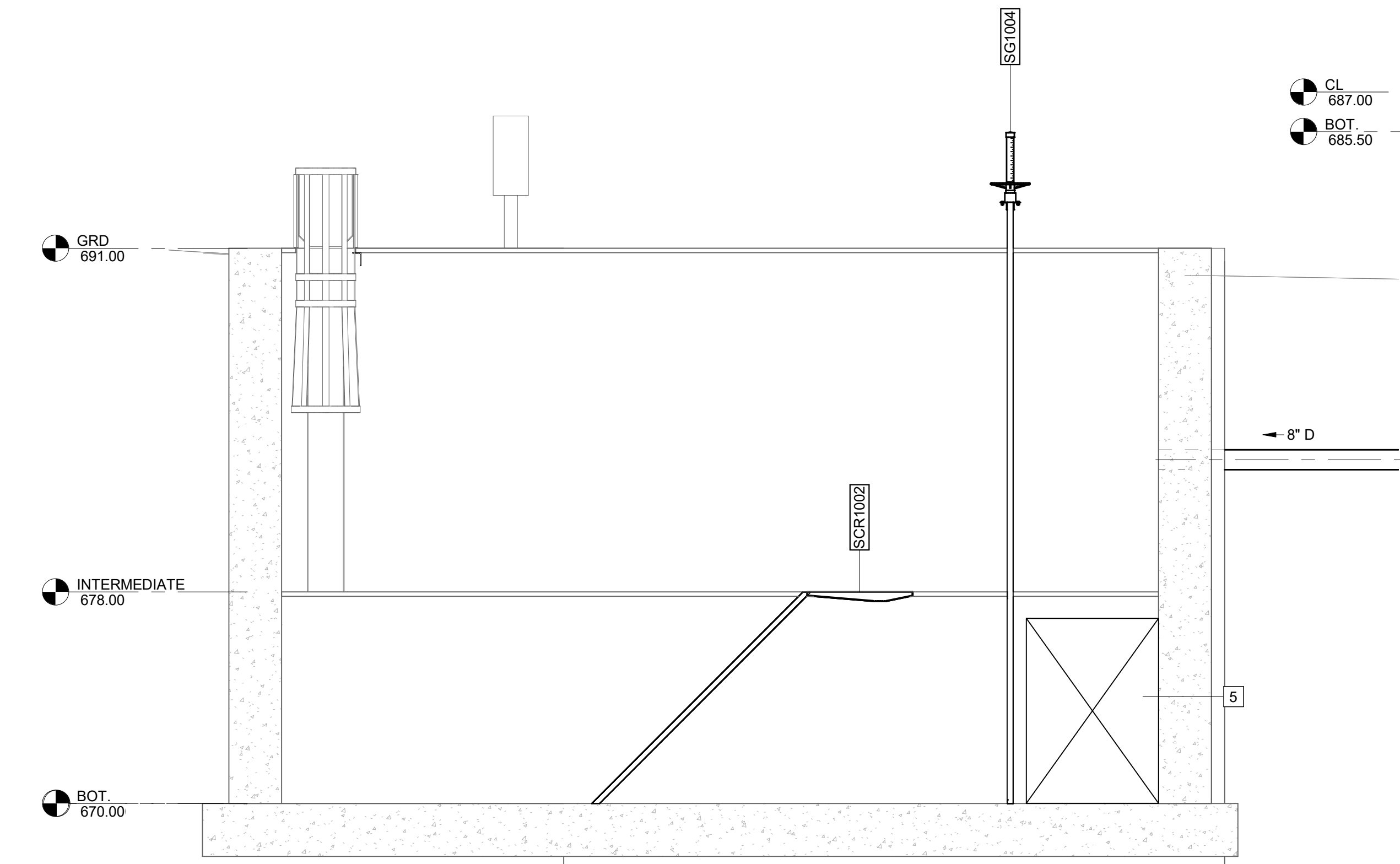
GMC PROJECT #CGRE220027

INFLUENT PUMP
STATION - UPPER
PLAN

D-102

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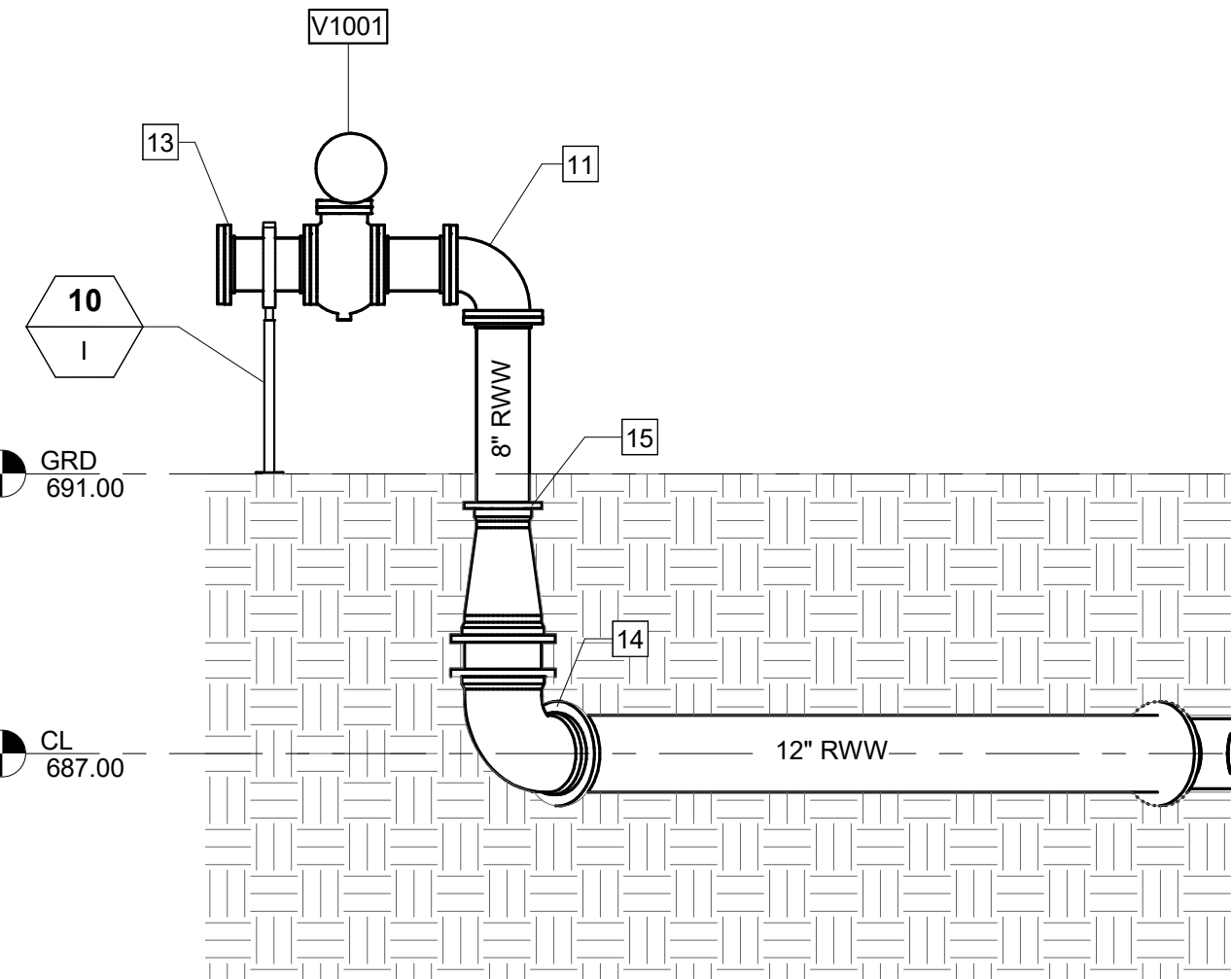
A SECTION
D-101 SCALE: 1/4" = 1'-0"



C SECTION
D-101 SCALE: 1/4" = 1'-0"



B SECTION
D-102 SCALE: 3/8" = 1'-0"



D SECTION
D-101 SCALE: 1/4" = 1'-0"



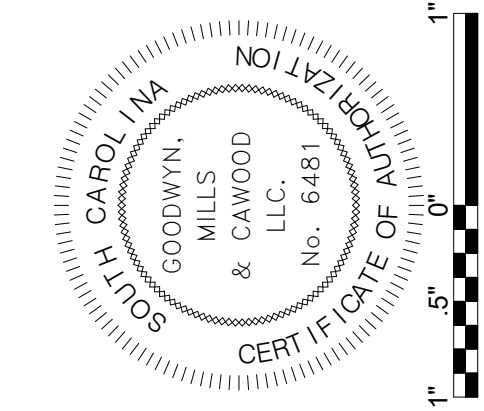
- KEY NOTES:** #
1. STAINLESS STEEL VENT SCREEN W/ RETAINING FLANGE
 2. 4" DUCKBILL CHECK VALVE
 3. 4" 90° FL BEND
 4. ELECTRIC HOIST SYSTEM
 5. 7'-0"H X 5'-0"W OPENING
 6. 12"X8" FL REDUCER
 7. 12" 90° FL BEND
 8. 4'-0" H X 3'-0" W OPENING
 9. GUIDE RAIL
 10. GUIDE RAIL WALL SUPPORT
 11. 8" 90° FL BEND
 12. 8" TEE
 13. 8" FL BLIND
 14. 12" 90° MJ BEND
 15. 8" X 12" INCREASER

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Town of Pendleton
City of Clemson
Anderson County

INFLUENT PUMP
STATION - SECTIONS

D-103

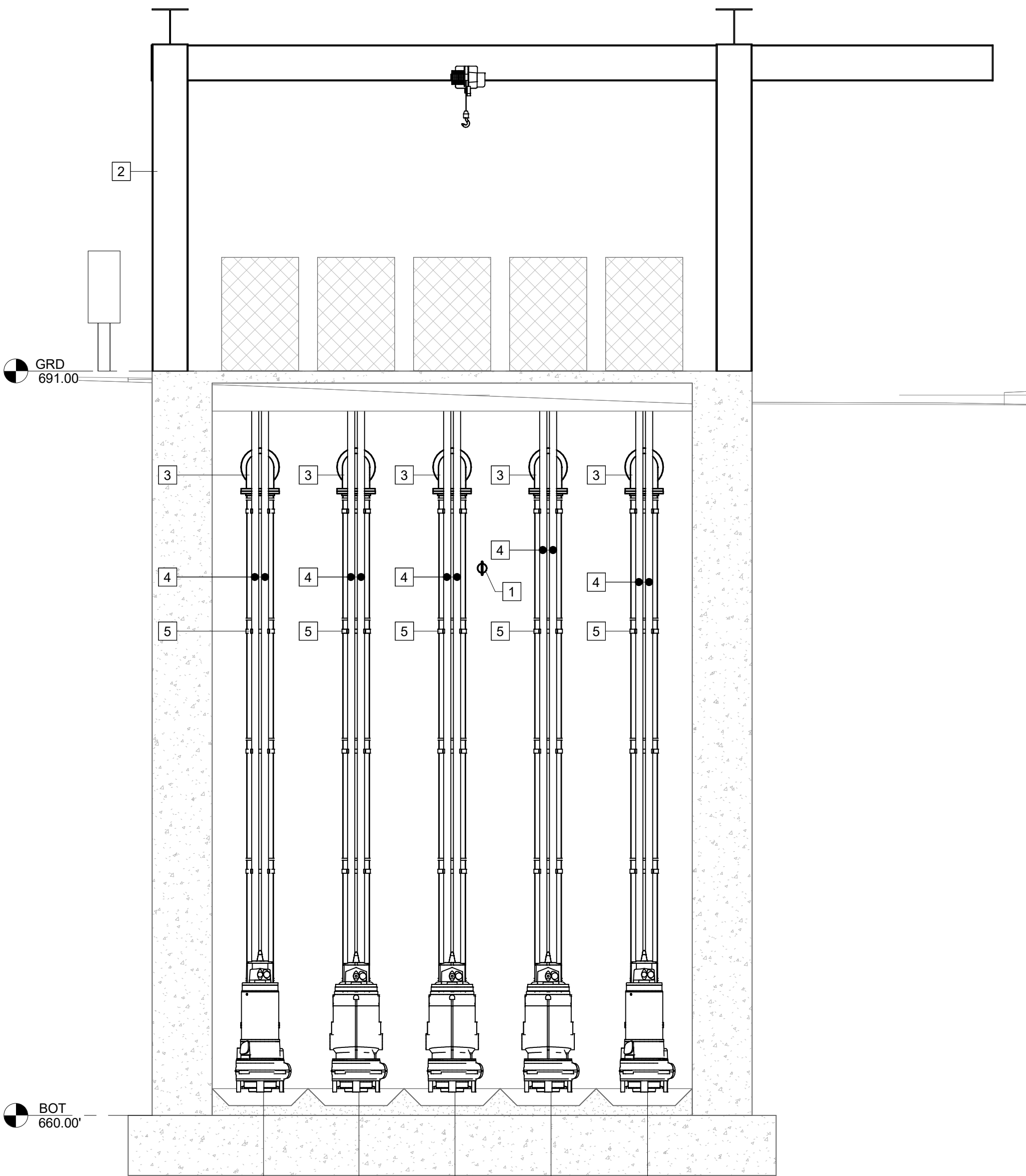
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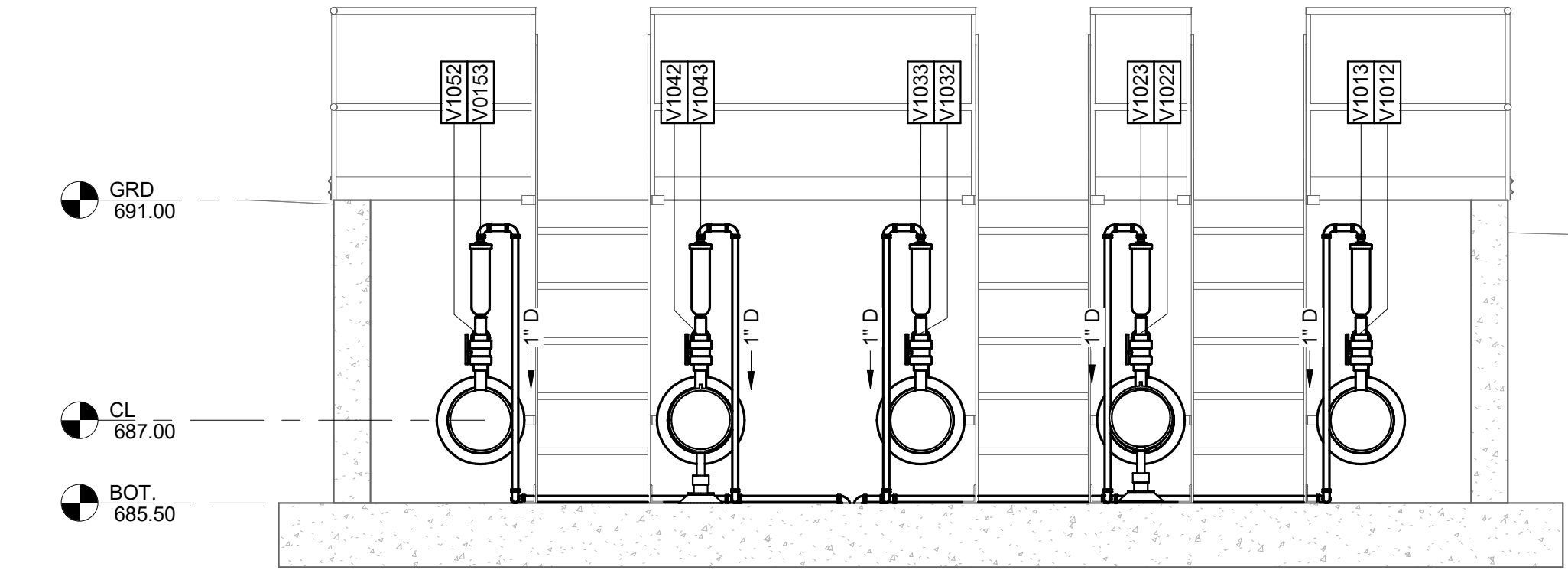
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60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

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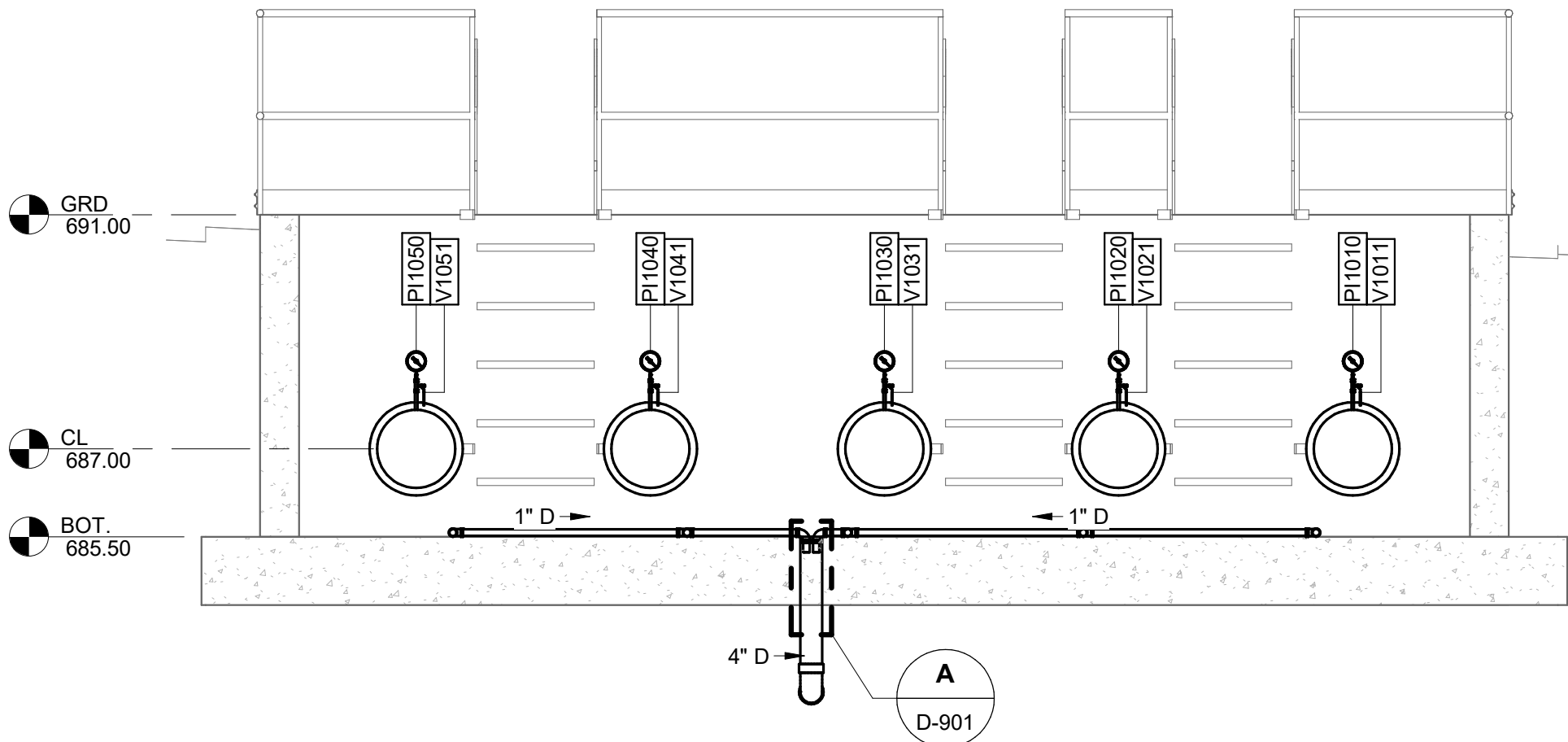
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D-101 SCALE: 1/4" = 1'-0"



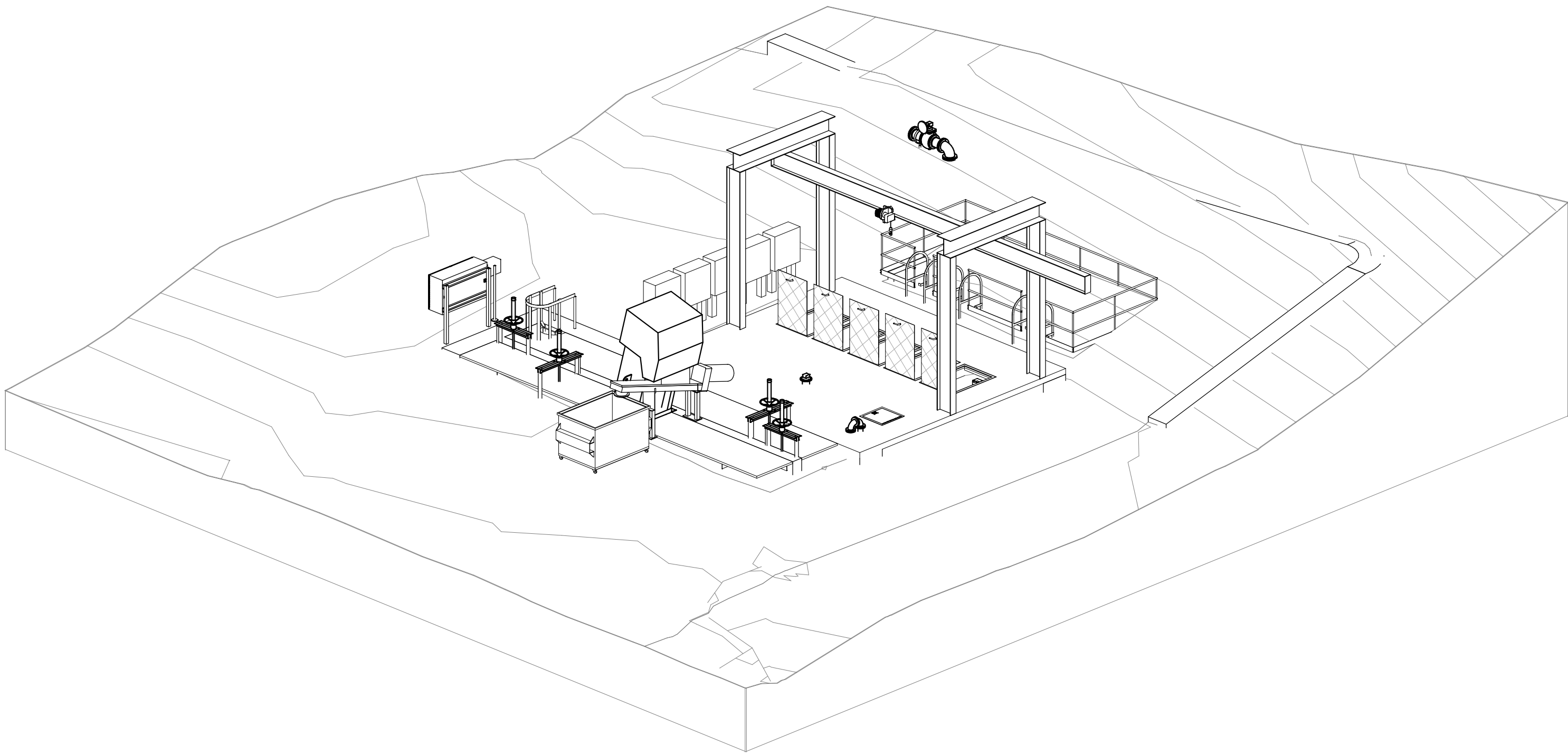
G SECTION
D-102 SCALE: 3/8" = 1'-0"



F SECTION
D-102 SCALE: 3/8" = 1'-0"



H ISOMETRIC
D-104 SCALE: NOT TO SCALE



KEY NOTES: #

1. 4" DUCKBILL CHECK VALVE
2. ELECTRIC HOIST SYSTEM
3. 12" 90° FL BEND
4. GUIDE RAIL
5. GUIDE RAIL WALL SUPPORT

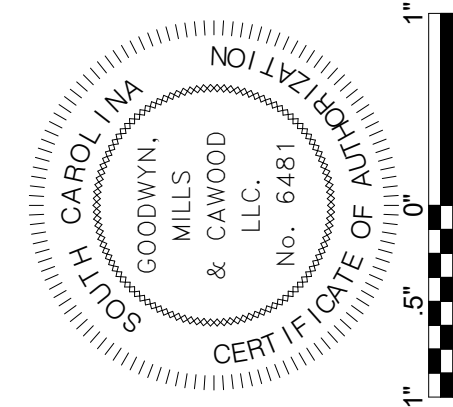
**INFLUENT PUMP
STATION - SECTIONS
& ISOMETRIC**

D-104

**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

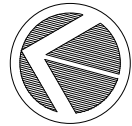
GMC PROJECT #CGRE220027

ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD



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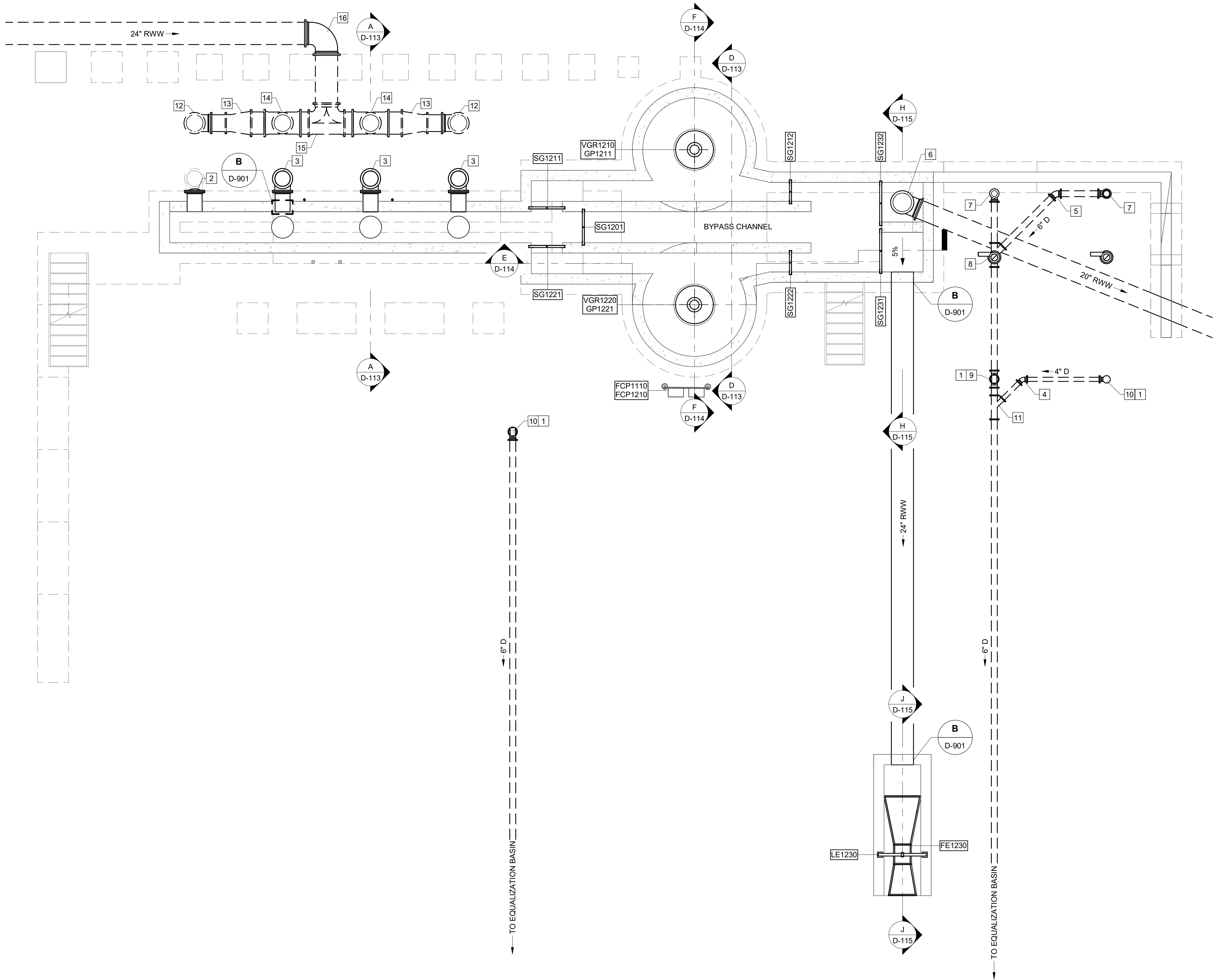
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1C

PLAN

SCALE: 3/16" = 1'-0"



KEY NOTES: #

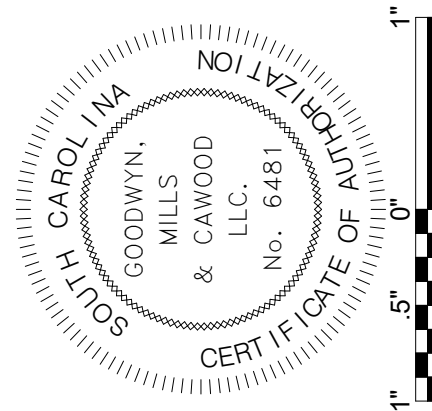
1. CIRCULAR DRAIN W/ GRATE DRAIN COVER TO BE POSITIONED UNDER DUMPSTER.
2. 16" BLIND FLANGE
3. 16" FL 90° BEND
4. 4" MJ 90° BEND
5. 6" MJ 90° BEND
6. 20" MJ 90° BEND
7. 6" MJ 90° BEND
8. 6" MJ WYE
9. 6" X 4" MJ TEE
10. 6" MJ 90° BEND
11. 6" X 4" MJ WYE
12. 18" MJ 90° BEND
13. 24" X 18" FL REDUCER
14. 24" X 18" FL TEE
15. 24" FL TEE
16. 24" MJ 90° BEND

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

HEADWORKS - LOWER
PLAN

D-111



ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
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Drawn By:	HKD

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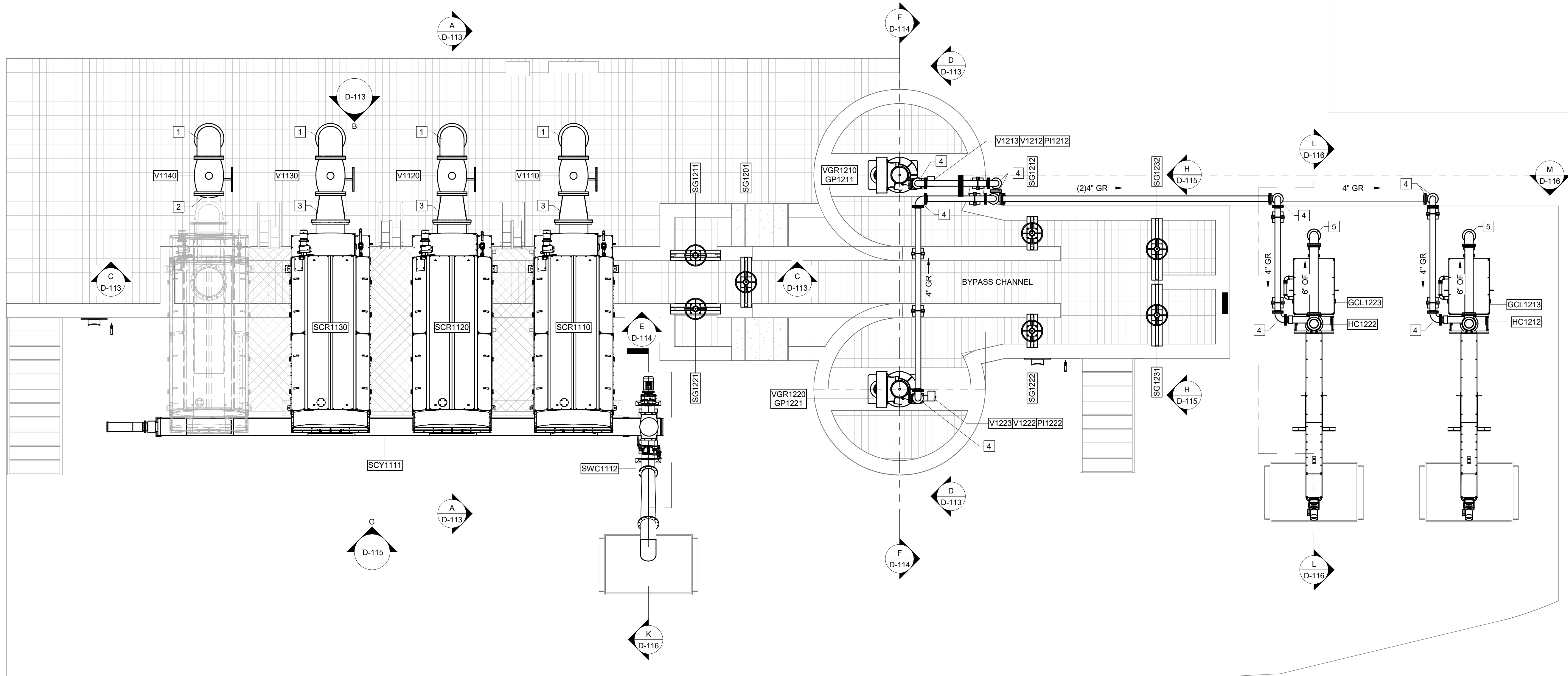
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1D
D-112

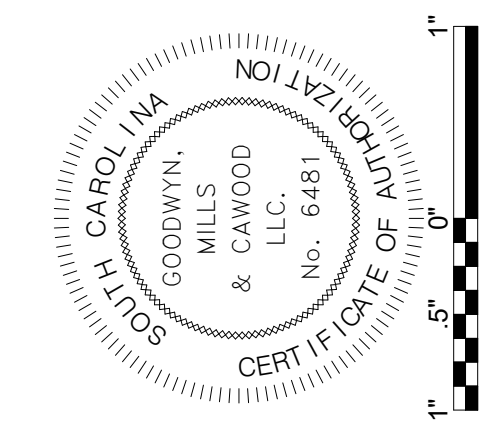
PLAN

SCALE: 1/4" = 1'-0"



KEY NOTES: #

1. 18" FL 90° BEND
2. 18" BLIND FLANGE
3. 18" X 24" FL REDUCER
4. 4" FL 90° BEND
5. 6" FL 90° BEND



ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

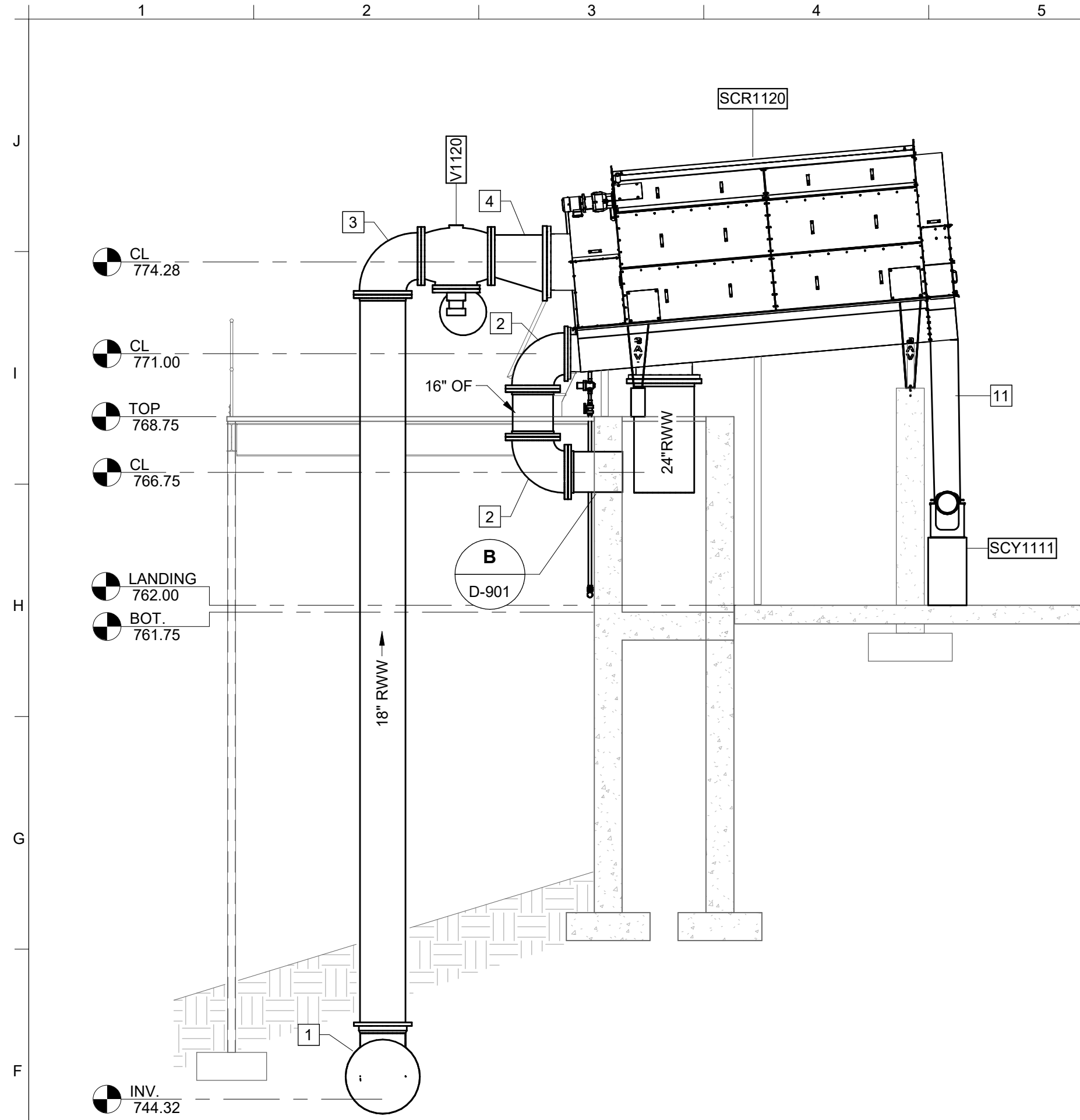
PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

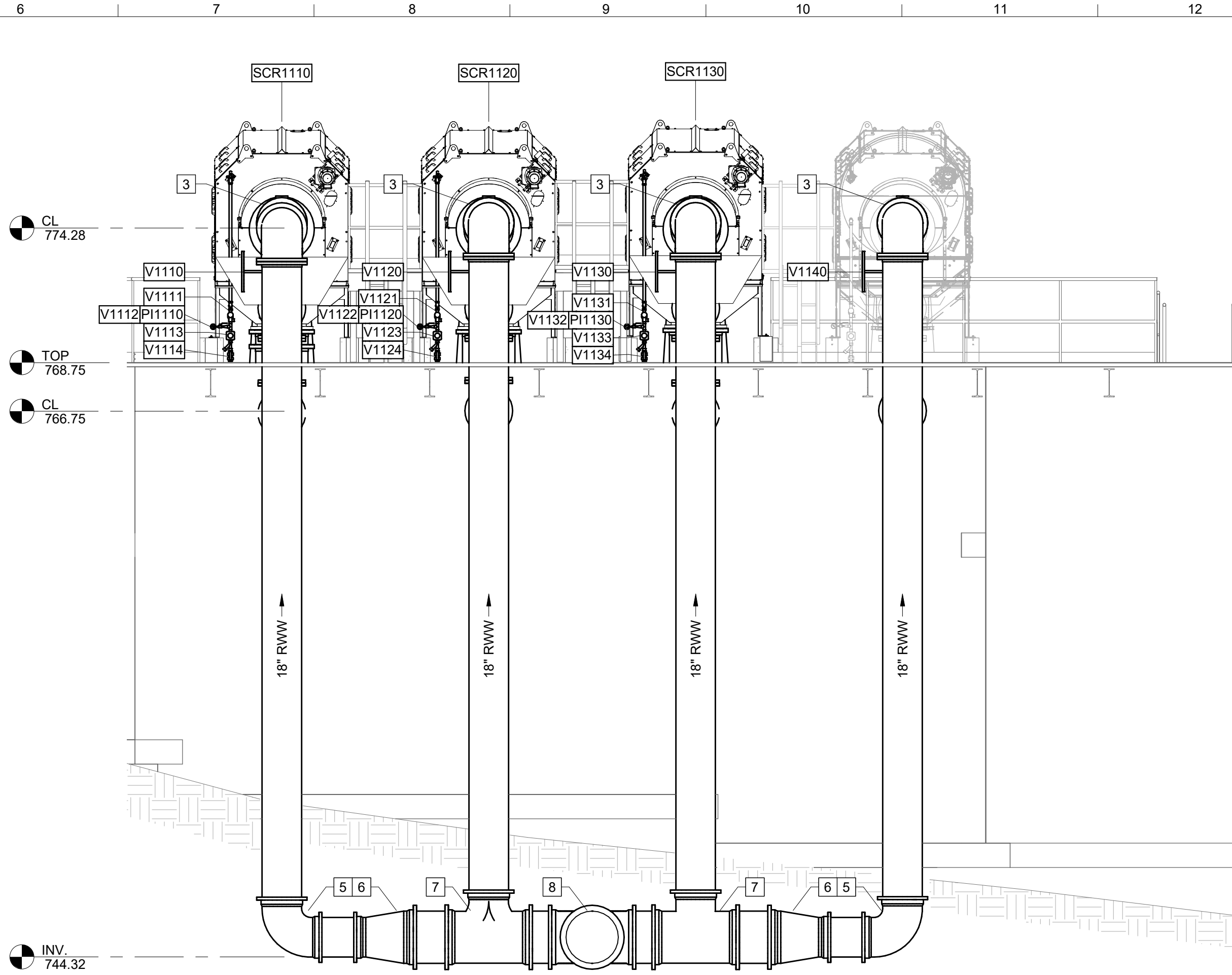
HEADWORKS - UPPER
PLAN

D-112

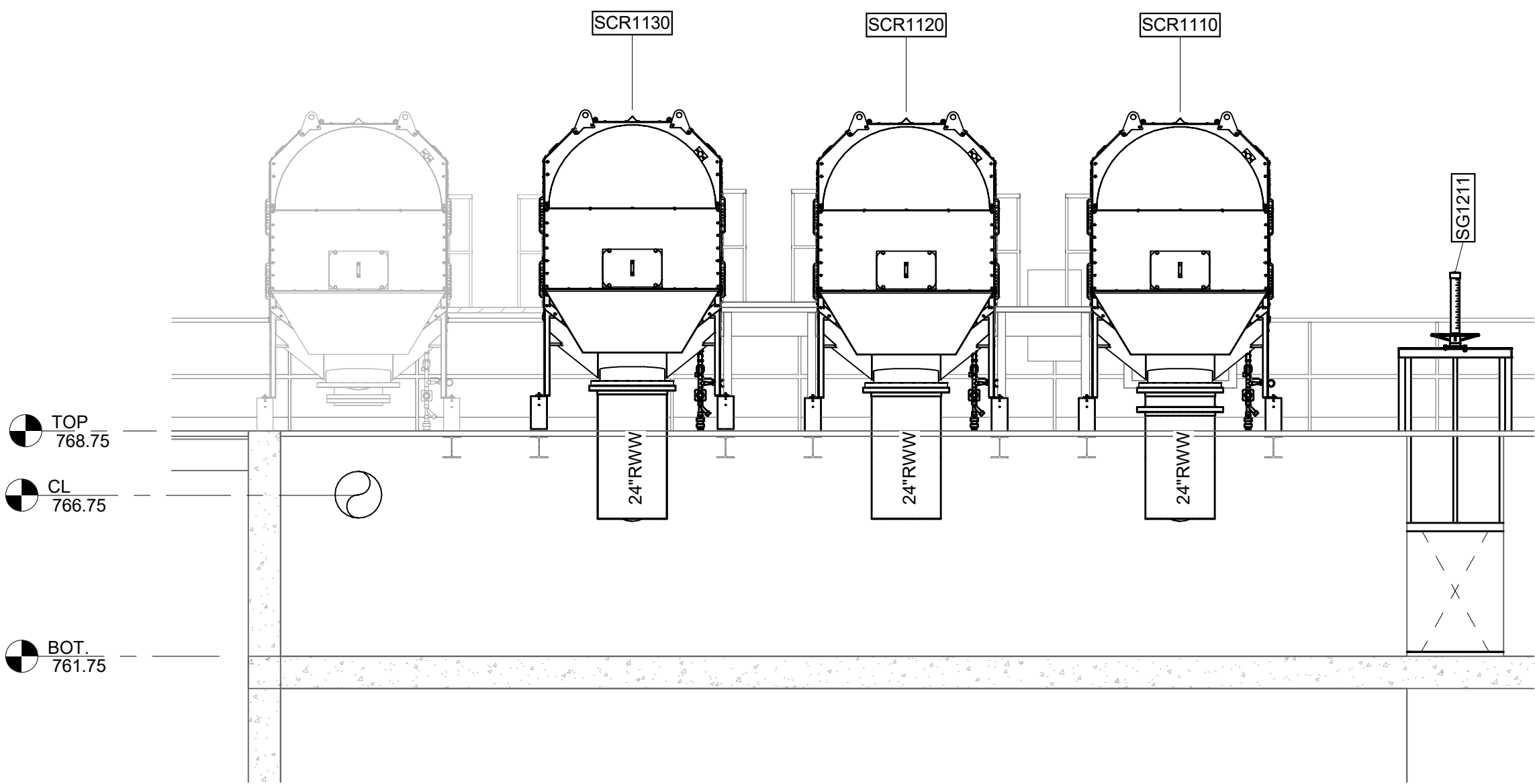
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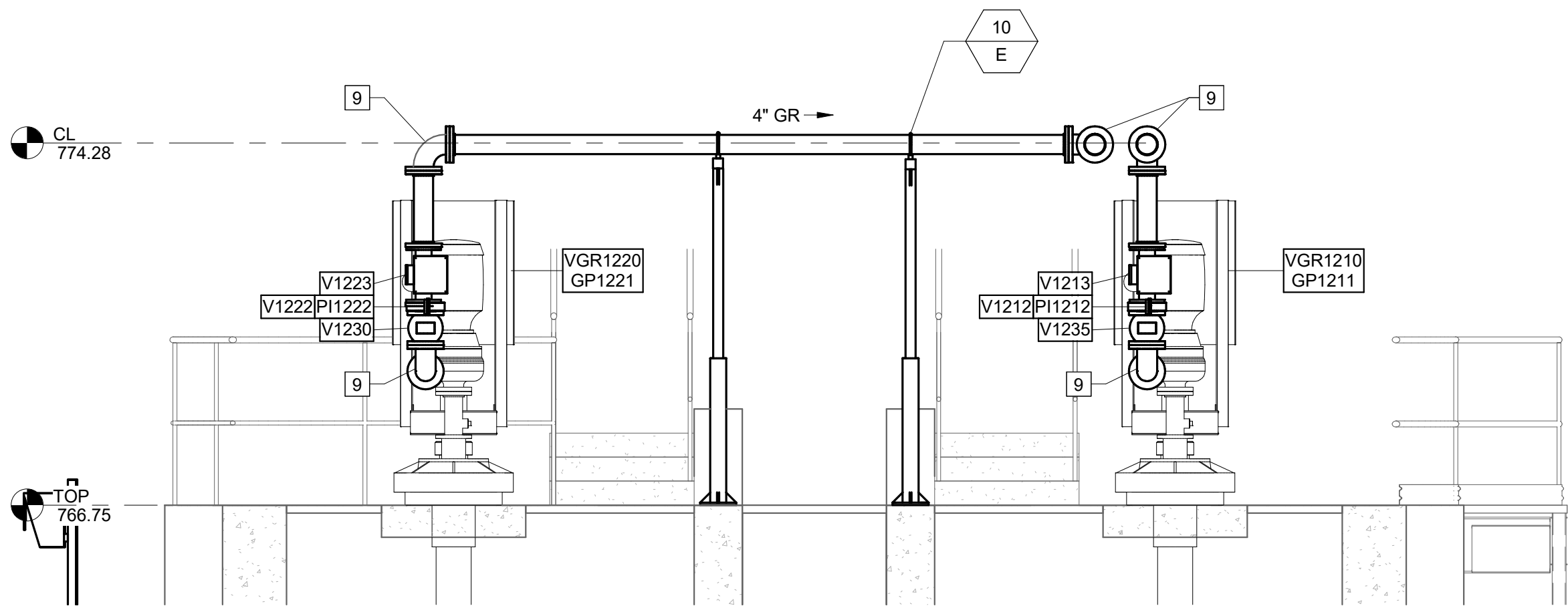
A SECTION
D-111 SCALE: 1/4" = 1'-0"



B SECTION
D-112 SCALE: 1/4" = 1'-0"

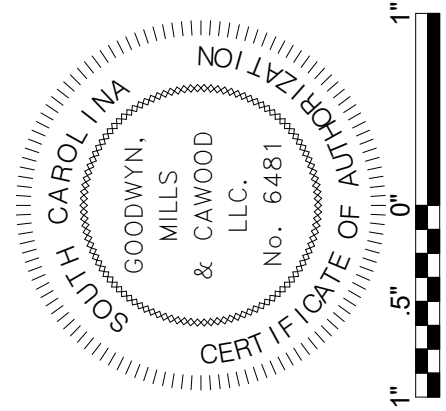


C SECTION
D-112 SCALE: 1/4" = 1'-0"



D SECTION
D-111 SCALE: 3/8" = 1'-0"

- KEY NOTES:** #
- 24" X 18" TEE
 - 16" FL 90° BEND
 - 18" FL 90° BEND
 - 18" X 24" FL REDUCER
 - 18" MJ 90° BEND
 - 18" X 24" MJ REDUCER
 - 24" X 18" MJ TEE
 - 24" MJ TEE
 - 4" FL 90° BEND
 - 4" BLIND FLANGE
 - PREFABRICATED STAINLESS STEEL CHUTE



ISSUE	DATE
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Project Manager:	WN
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Designer:	JX
Drawn By:	HKD

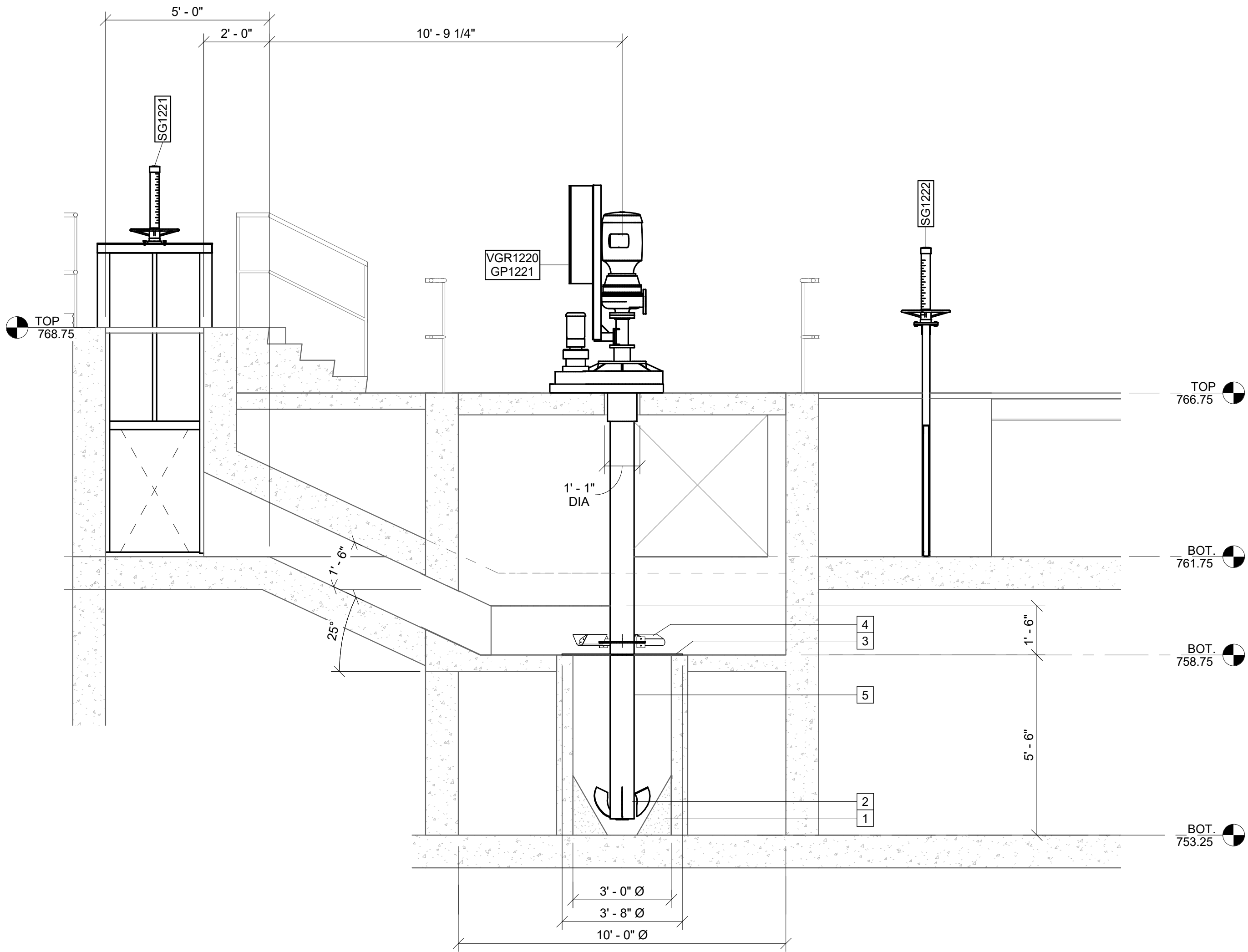
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Anderson County

GMC PROJECT #CGRE220027

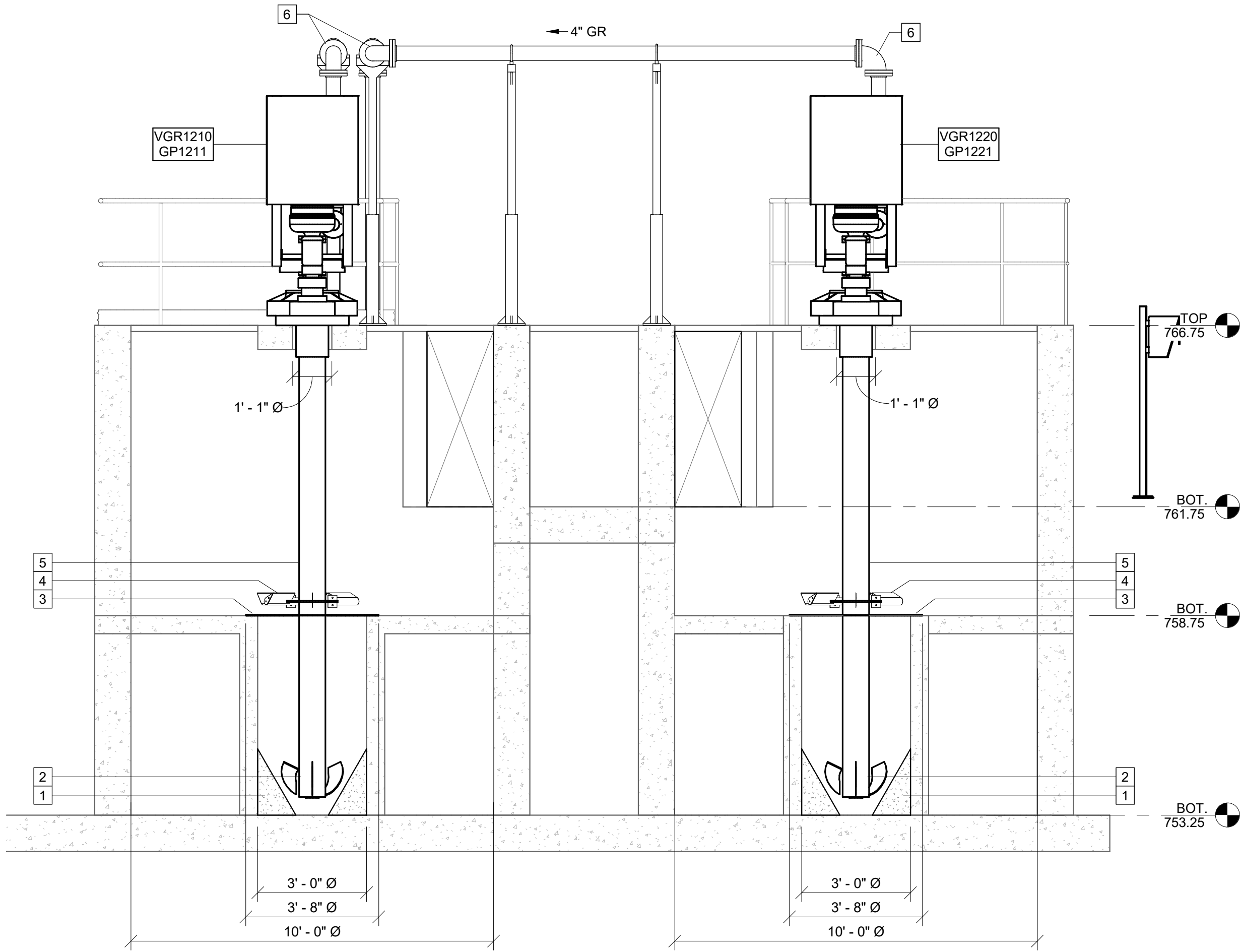
**HEADWORKS -
SECTIONS**

D-113

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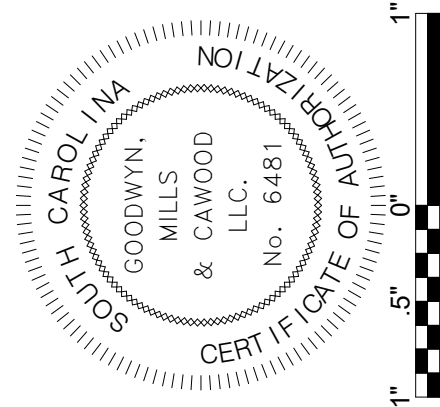
E SECTION
D-111 SCALE: 3/8" = 1'-0"



F SECTION
D-111 SCALE: 3/8" = 1'-0"

KEY NOTES: #

1. GROUTED FILL
2. GRIT FLUIDIZER
3. 2 PIECE STEEL FLOOR PLATE
4. PROPELLER BLADES
5. DRIVE TUBE
6. 4" FL 90° BEND



ISSUE	DATE
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Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

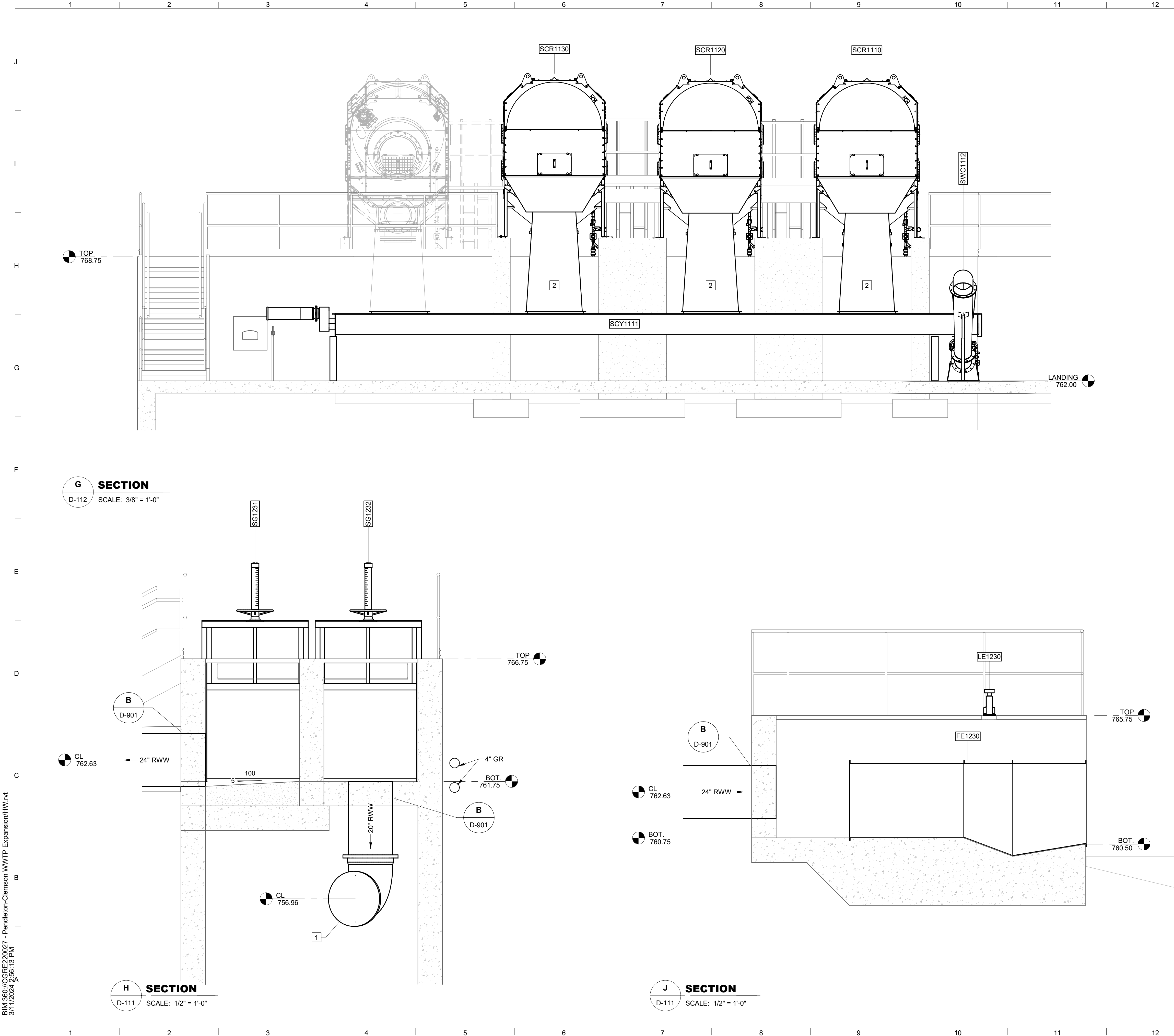
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**HEADWORKS -
SECTIONS**

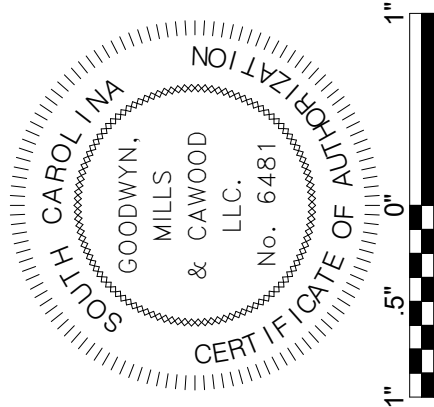
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BM 360\\CGRE220027 - Pendleton-Clemson WWTP Expansion\\HW.rvt
3/11/2024 2:56:13 PM



KEY NOTES: #

- 20" MJ 90° BEND
- PREFABRICATED STAINLESS STEEL CHUTE



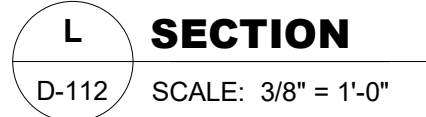
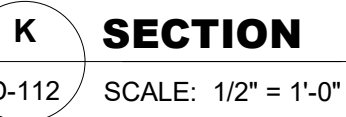
ISSUE	DATE
30% Submittal	01.18.2023
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Engineer:	TR
Designer:	JX
Drawn By:	HKD

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HEADWORKS -
SECTIONS

D-115



**PENDLETON - CLEMONSON
REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

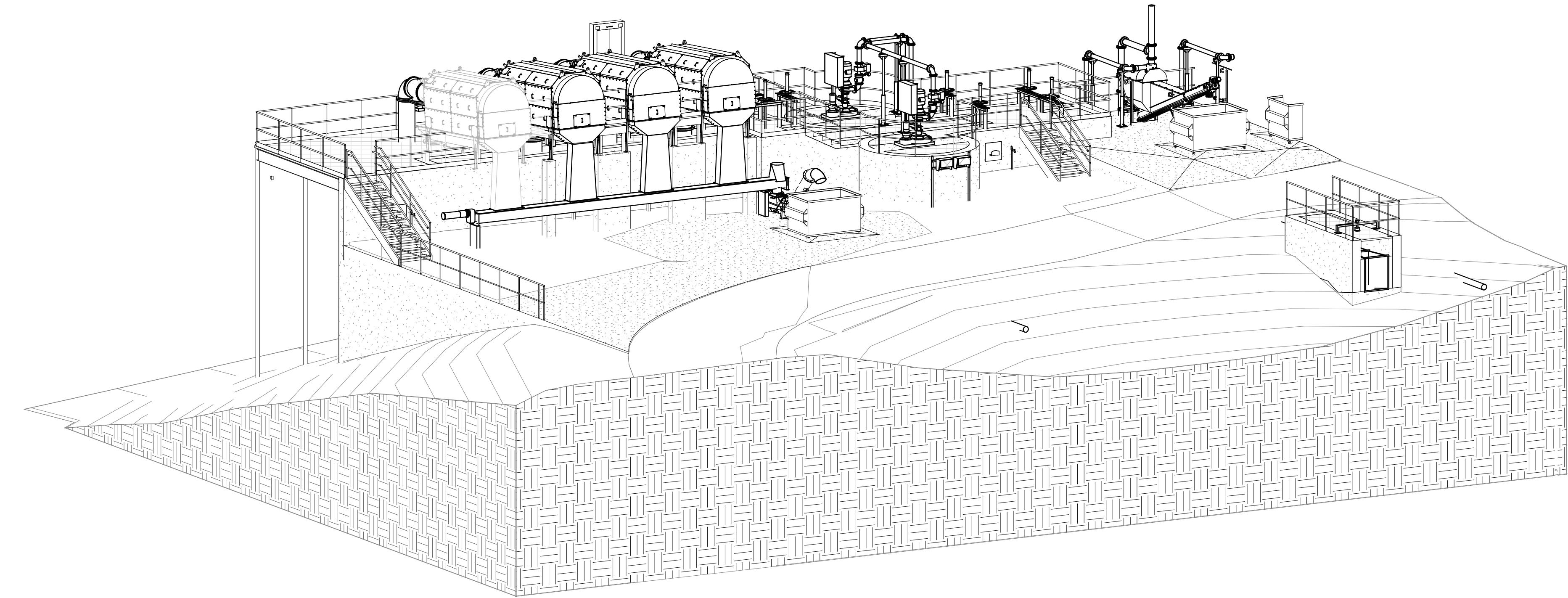
GMC PROJECT #CGRE220027

D-116

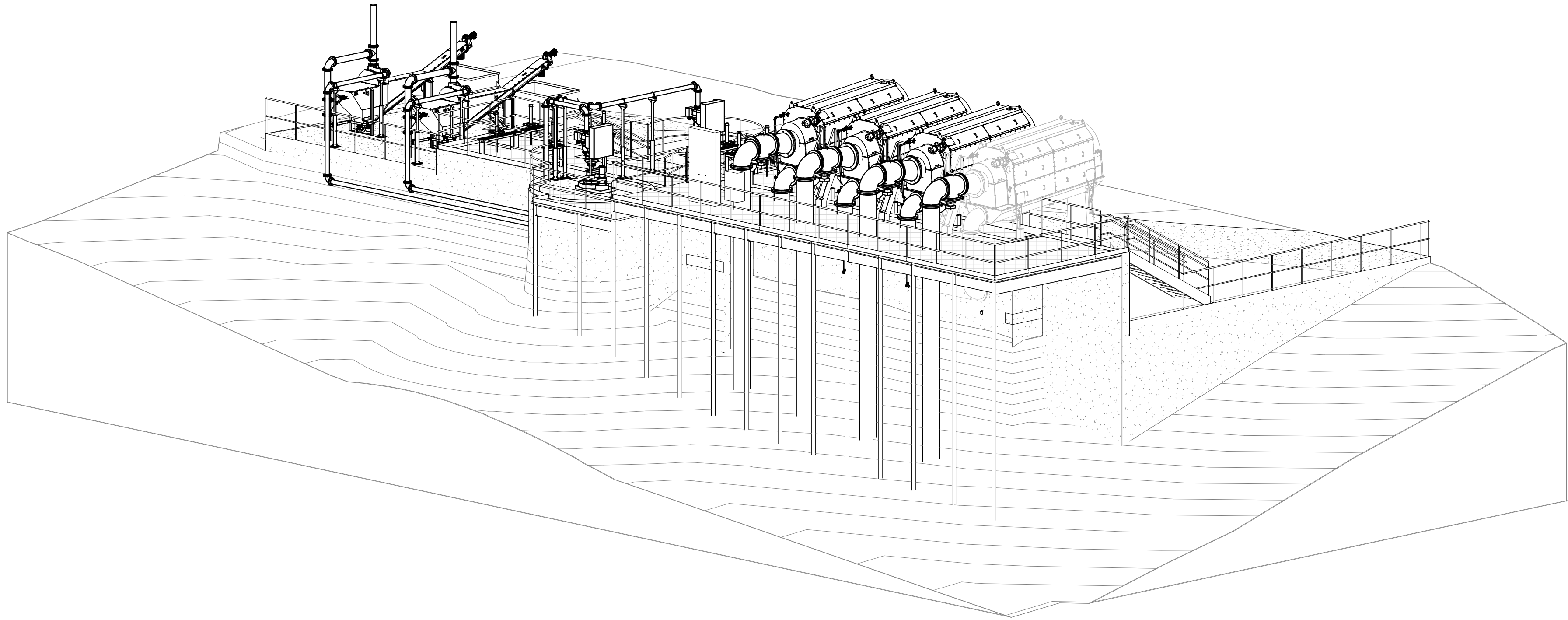


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N
ISOMETRIC
D-117 SCALE:



M
ISOMETRIC
D-117 SCALE:



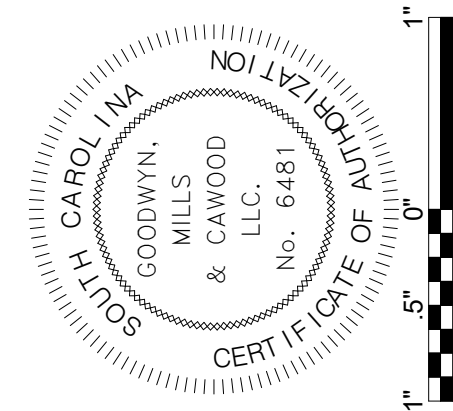
HEADWORKS -
ISOMETRICS

D-117

PENDLETON - CLEMSON
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Drawn By:	HKD



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DRAWING FILE: T:\1 Projects\SC\Pendleton, Town of\CGRE220027 - Pendleton-Clemson WWTP\DWG+CAD\01 BID DRAWINGS\10 PROCESS\D-121.dwg
PLOTTED: Mar 11, 2024 - 3:52pm

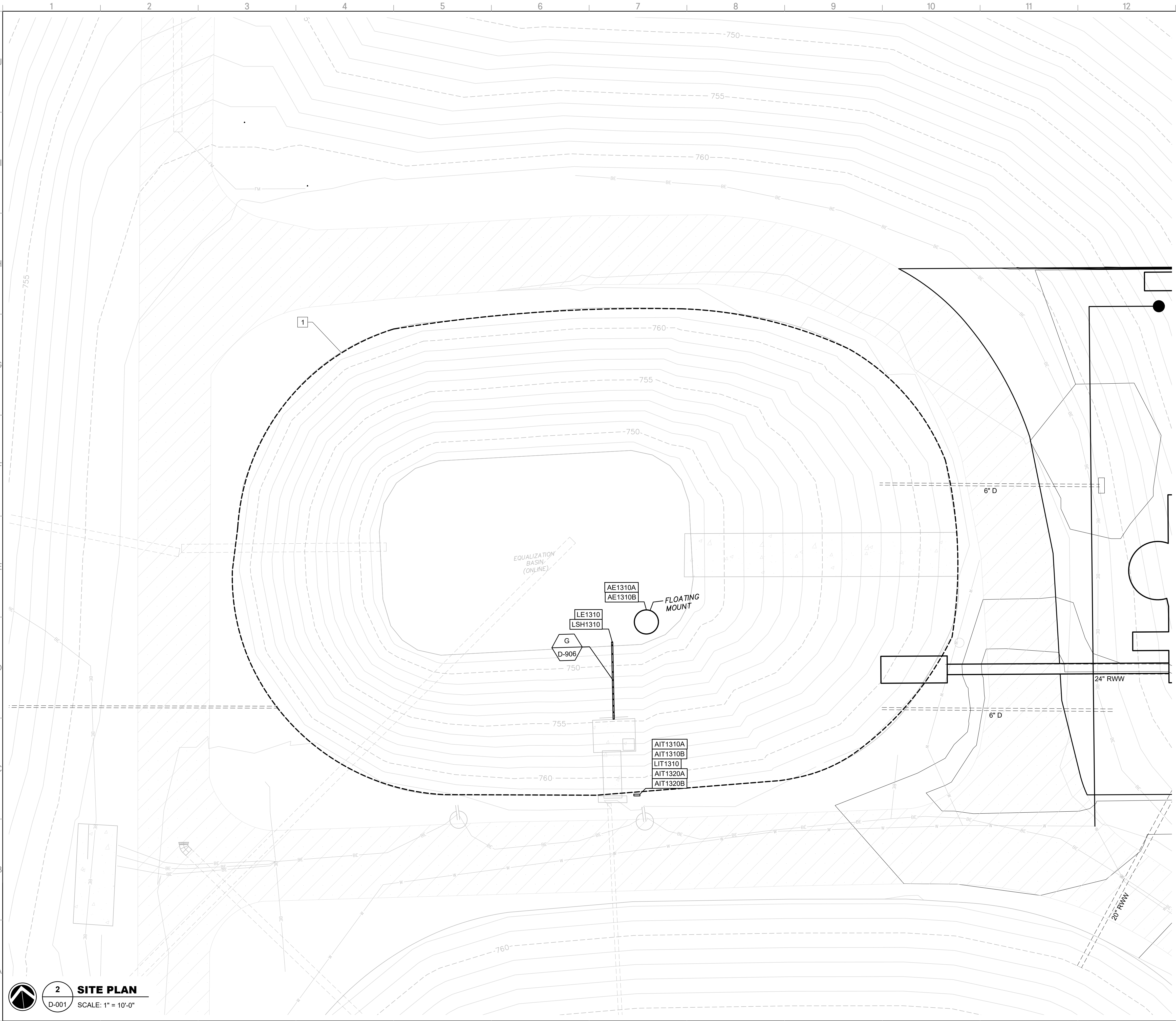


2

SITE PLAN

D-001

SCALE: 1" = 10'-0"



KEY NOTES: #

1. CONCRETE

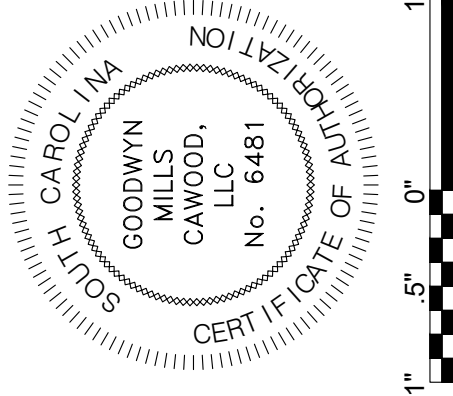
EQUALIZATION
BASIN - PLAN

D-121

PENDLETON - CLEMSON
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Drawn By:	HKD



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3/11/2024 3:03:20 PM

8
D-201

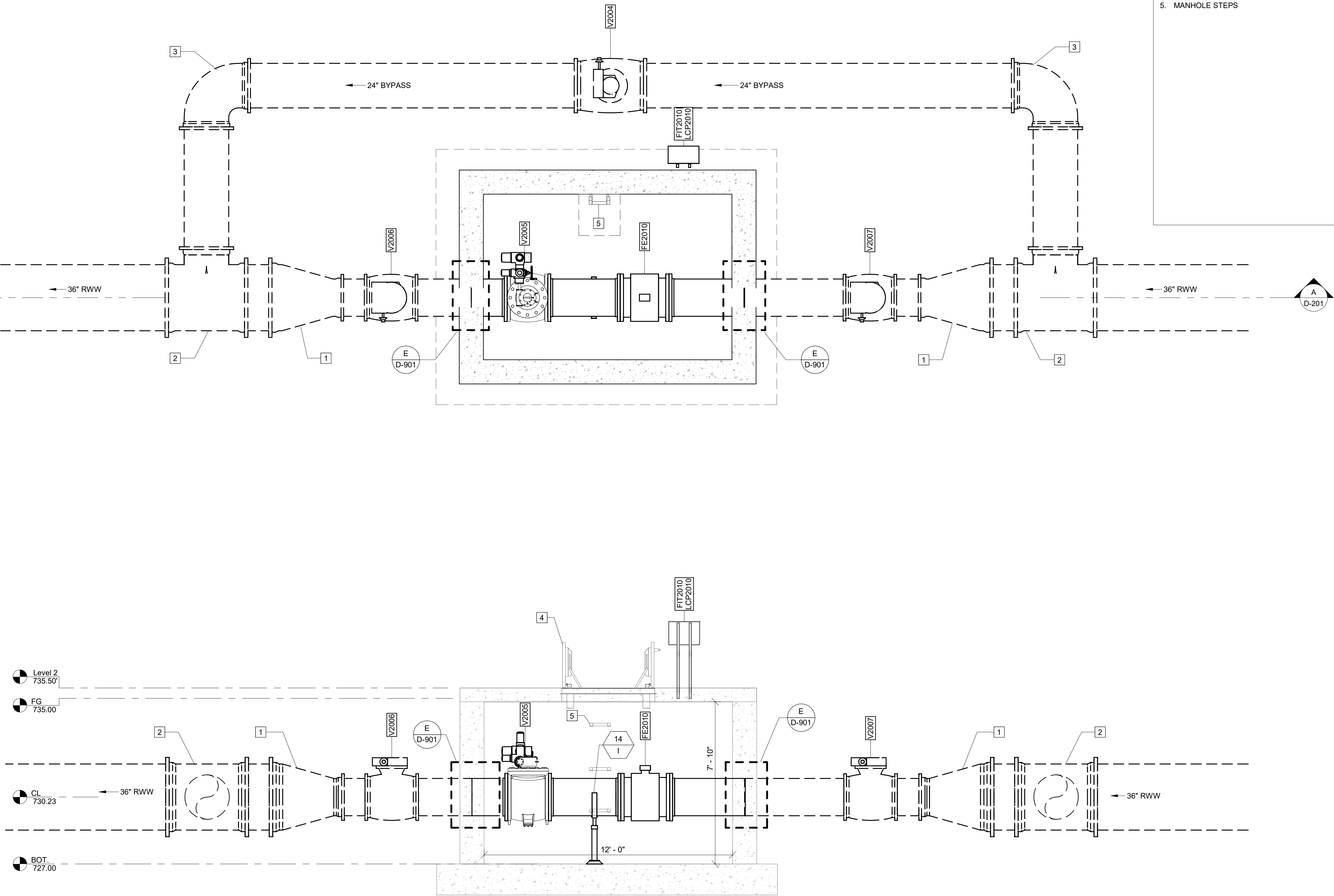
PLAN

SCALE: 3/8" = 1'-0"

A
D-201

SECTION

SCALE: 3/8" = 1'-0"



KEY NOTES: #

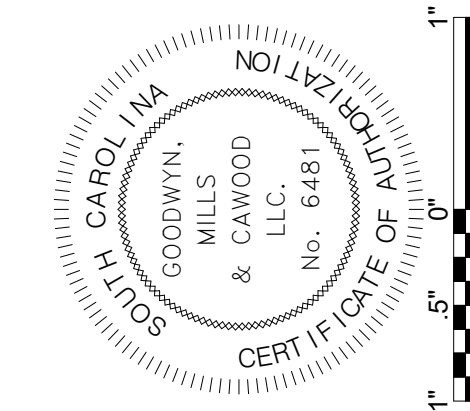
1. 36" X 20" MJ REDUCER
2. 36" X 24" MJ TEE
3. 24" 90 MJ BEND
4. 4" X 4" HATCH
5. MANHOLE STEPS

PENDLETON - CLEMSON
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PENDLETON, SOUTH CAROLINA
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**BNR FLOW CONTROL
VALVE PLAN AND
SECTION**

D-201



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3/11/2024 3:09:35 PM



3A

PLAN

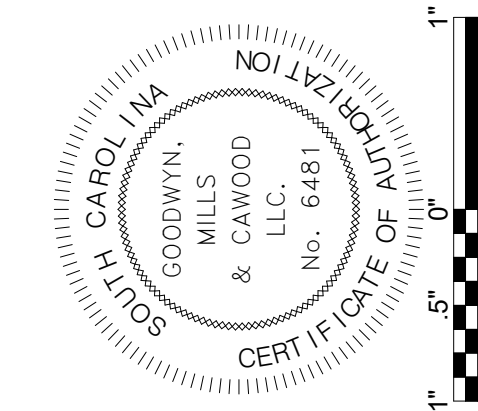
D-301

SCALE: 3/32" = 1'-0"

This drawing is and shall remain the property of Goodwyn, Mills and Cawood, Inc. (GMC) and Goodwyn Mills Cawood LLC (GMC). Unauthorized use of any kind including use on other projects is prohibited. In the event that a conflict arises between the sealed drawings and the electronic files, the sealed drawings will govern.

KEY NOTES: #

1. 24" MJ 90° BEND
2. DIFFUSER SYSTEM
3. 24" MJ 90 BEND
4. 24" MJ 135 TEE
5. 24" MJ TEE
6. 20" MJ 90 BEND
7. 20" MJ TEE



ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
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GMC PROJECT #CGRE220027

BIOLOGICAL
NUTRIENT
BIOREACTOR - LOWER
PLAN

D-301

PLAN

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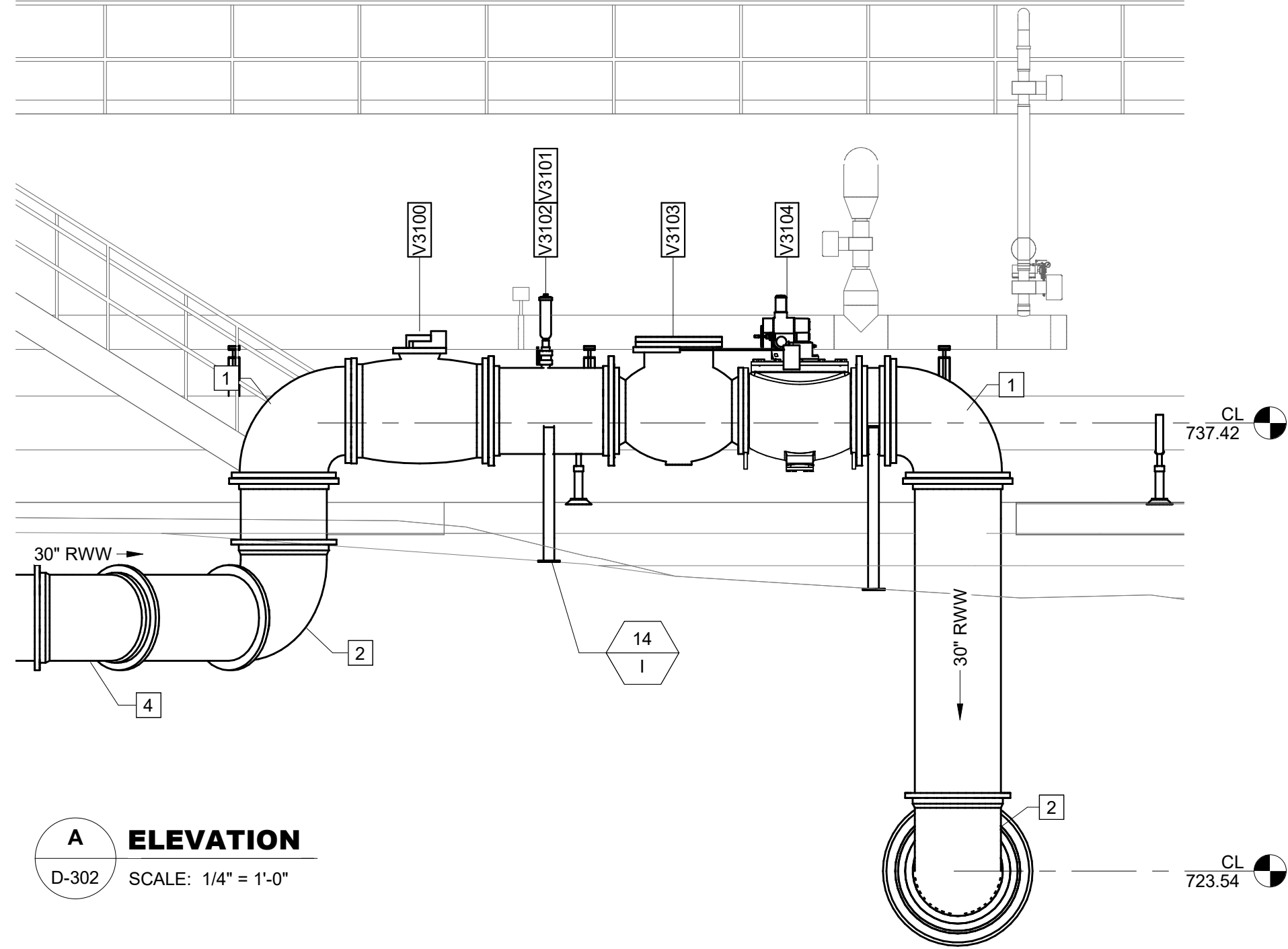
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ISSUE	DATE
30% Submittal	01/18/2023
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100% submittal	03/08/2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

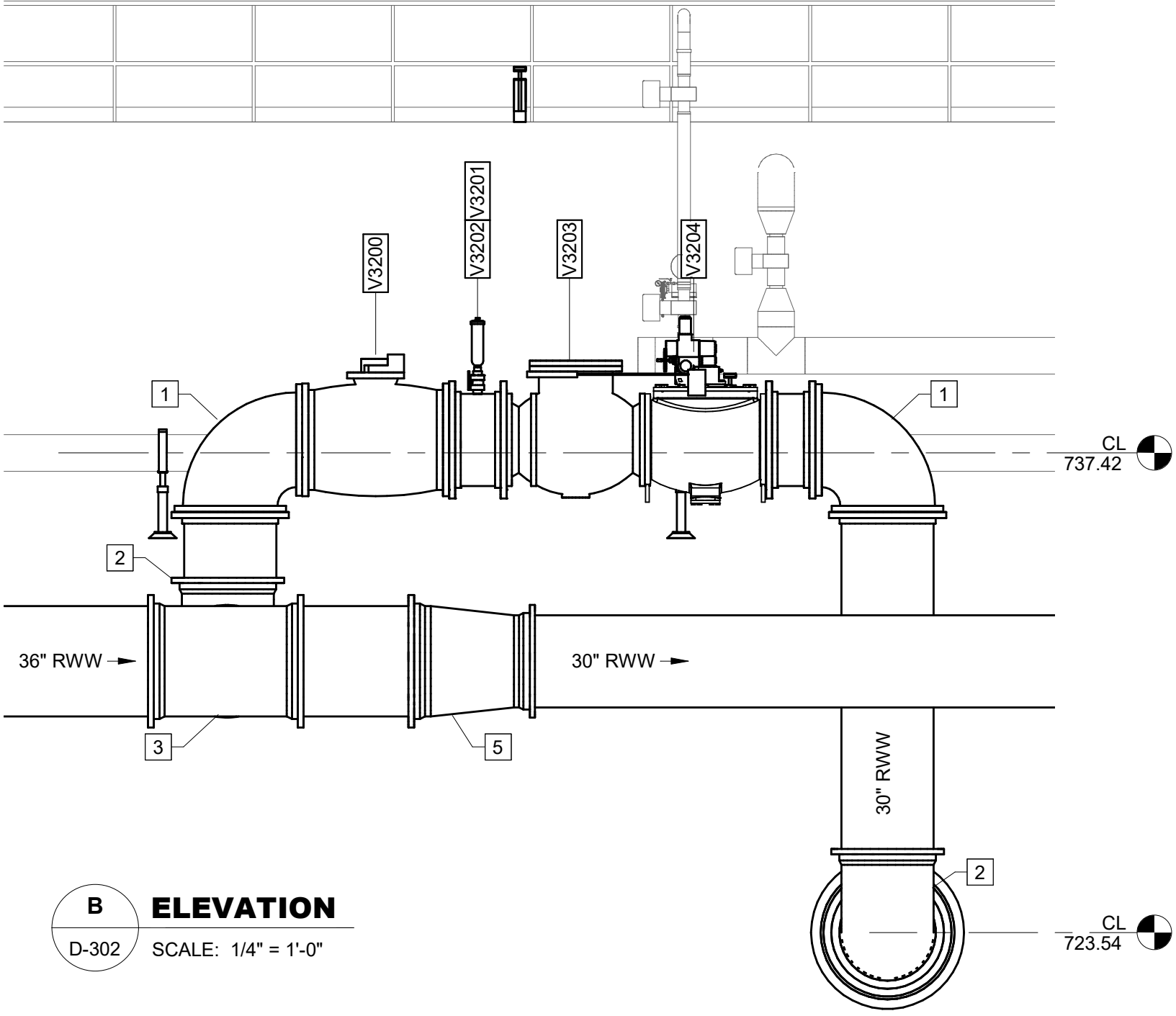
BIOLOGICAL NUTRIENT BIOREACTOR - UPPER PLAN

D-302

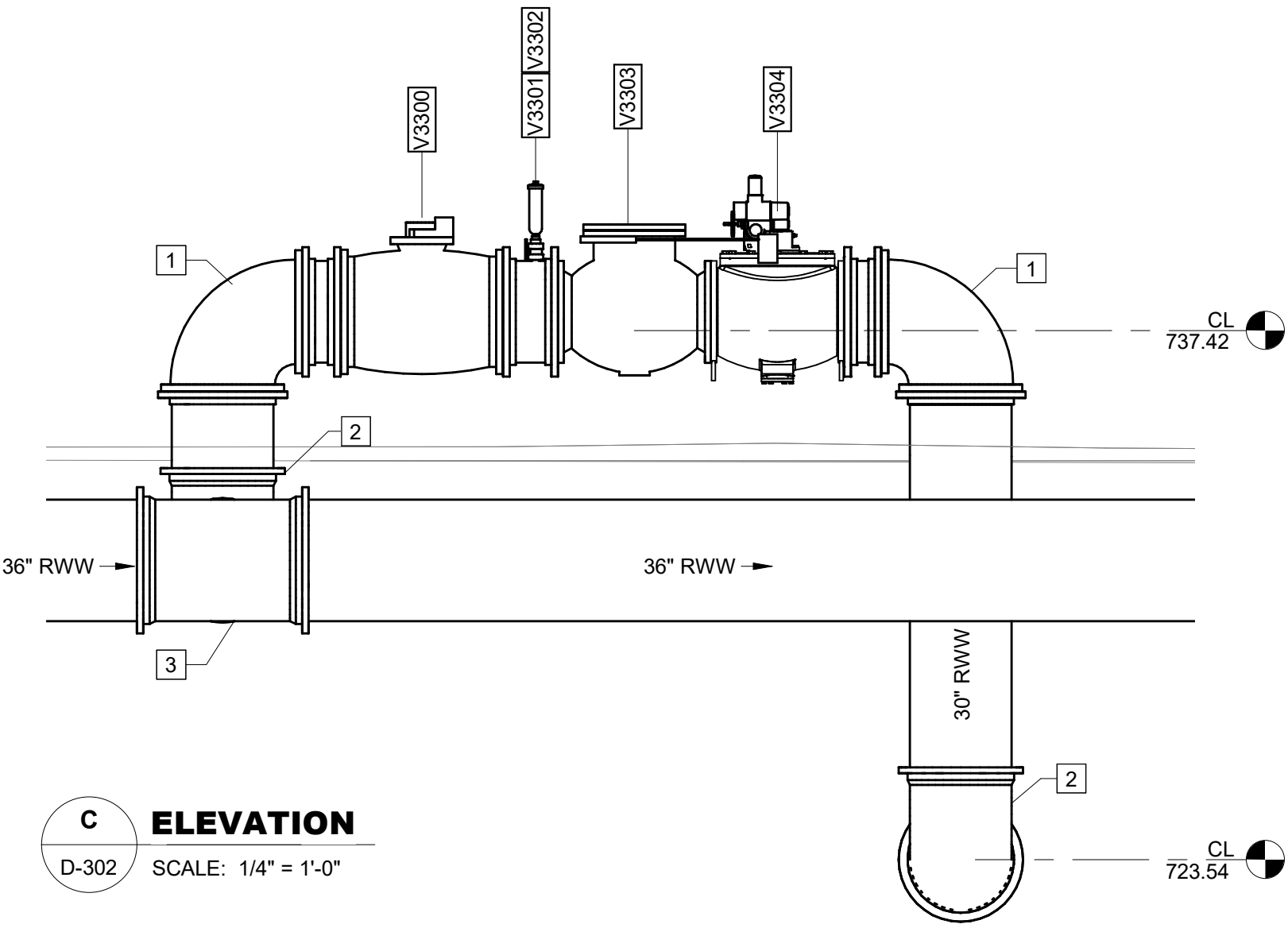
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3/11/2024 3:09:52 PM



A ELEVATION
D-302 SCALE: 1/4" = 1'-0"



B ELEVATION
D-302 SCALE: 1/4" = 1'-0"



C ELEVATION
D-302 SCALE: 1/4" = 1'-0"

KEY NOTES: #

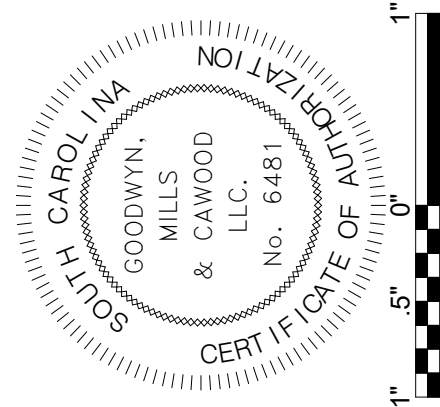
1. 30° 90° FL BEND
2. 30° 90° MJ BEND
3. 36" x 30" MJ TEE
4. 30° 45° MJ BEND
5. 36" X 30" REDUCER

PENDLETON - CLEMSON
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Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

BIOLOGICAL
NUTRIENT
BIOREACTOR -
ELEVATIONS

D-303

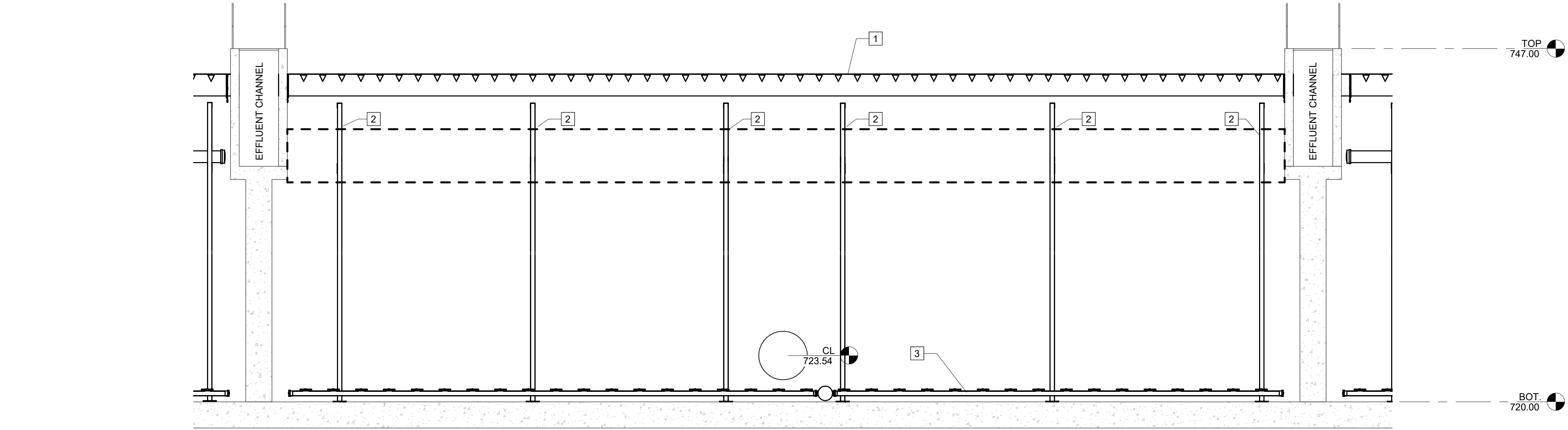


ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

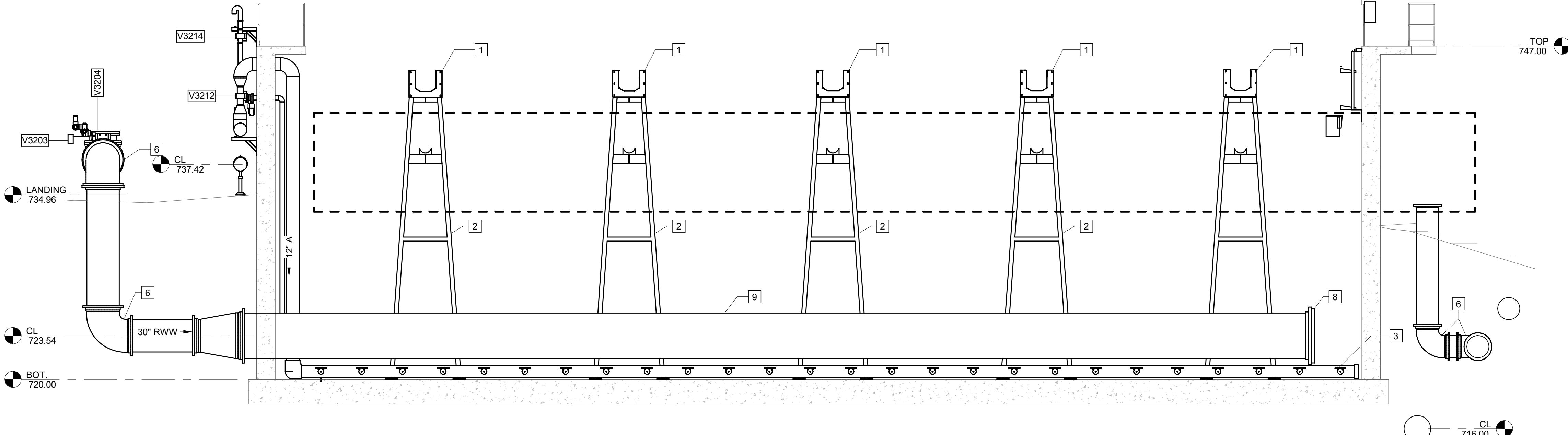
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3/11/2024 3:10:08 PM

D SECTION
D-301 SCALE: 3/16" = 1'-0"



E SECTION
D-301 SCALE: 3/16" = 1'-0"



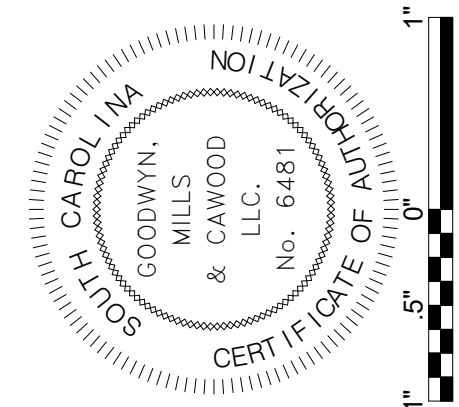
- NOTES:**
CONTRACTOR SHALL INSTALL SLUDGE REMOVAL PIPING IN ACCORDANCE WITH INSTRUCTIONS AND DRAWINGS FROM MANUFACTURER
- KEY NOTES:** #
1. EFFLUENT V-NOTCHED WEIR ASSEMBLY IN EFFLUENT LATERAL
 2. LATERAL SUPPORT
 3. FIXED FINE BUBBLE DIFFUSER
 4. 8" 90° MJ BEND
 5. 30" FL TEE
 6. 30" 90° FL BEND
 7. 20" 90° MJ BEND
 8. 42" BLIND CAP
 9. INFLUENT HEADER

**BIOLOGICAL
NUTRIENT
BIOREACTOR -
SECTIONS
D-304**

**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

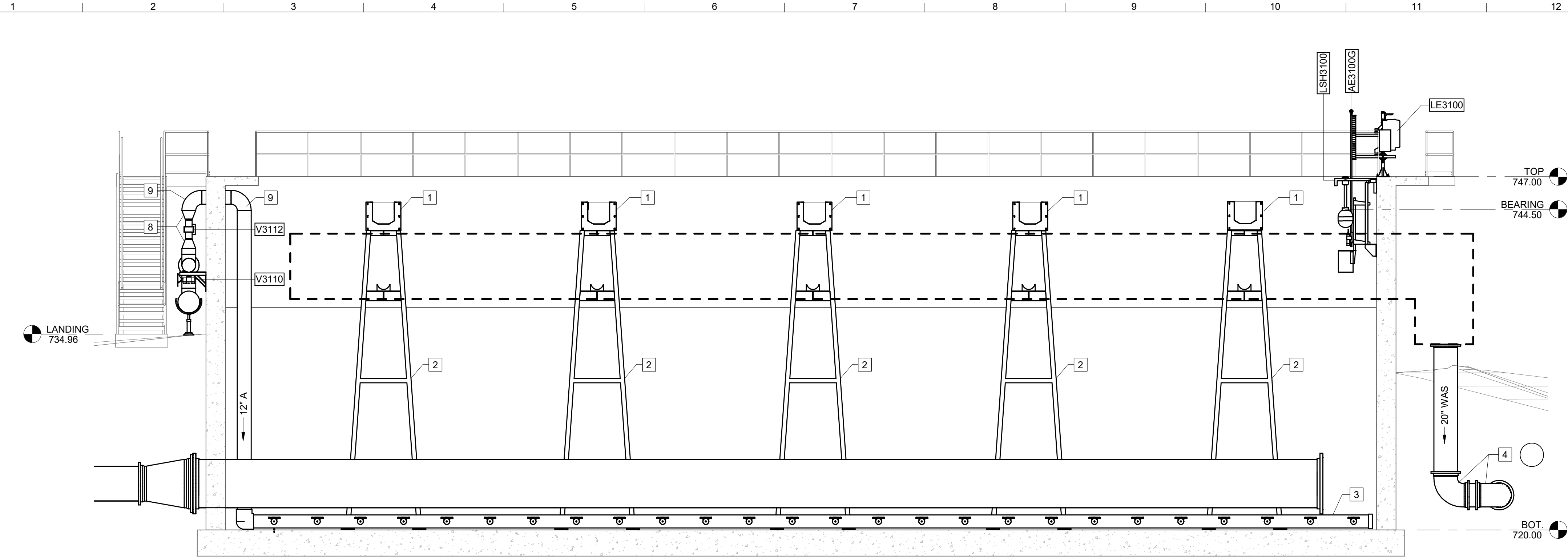
GMC PROJECT #CGRE220027

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30% Submittal	01.18.2023
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90% Submittal	12.04.2023
100% submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

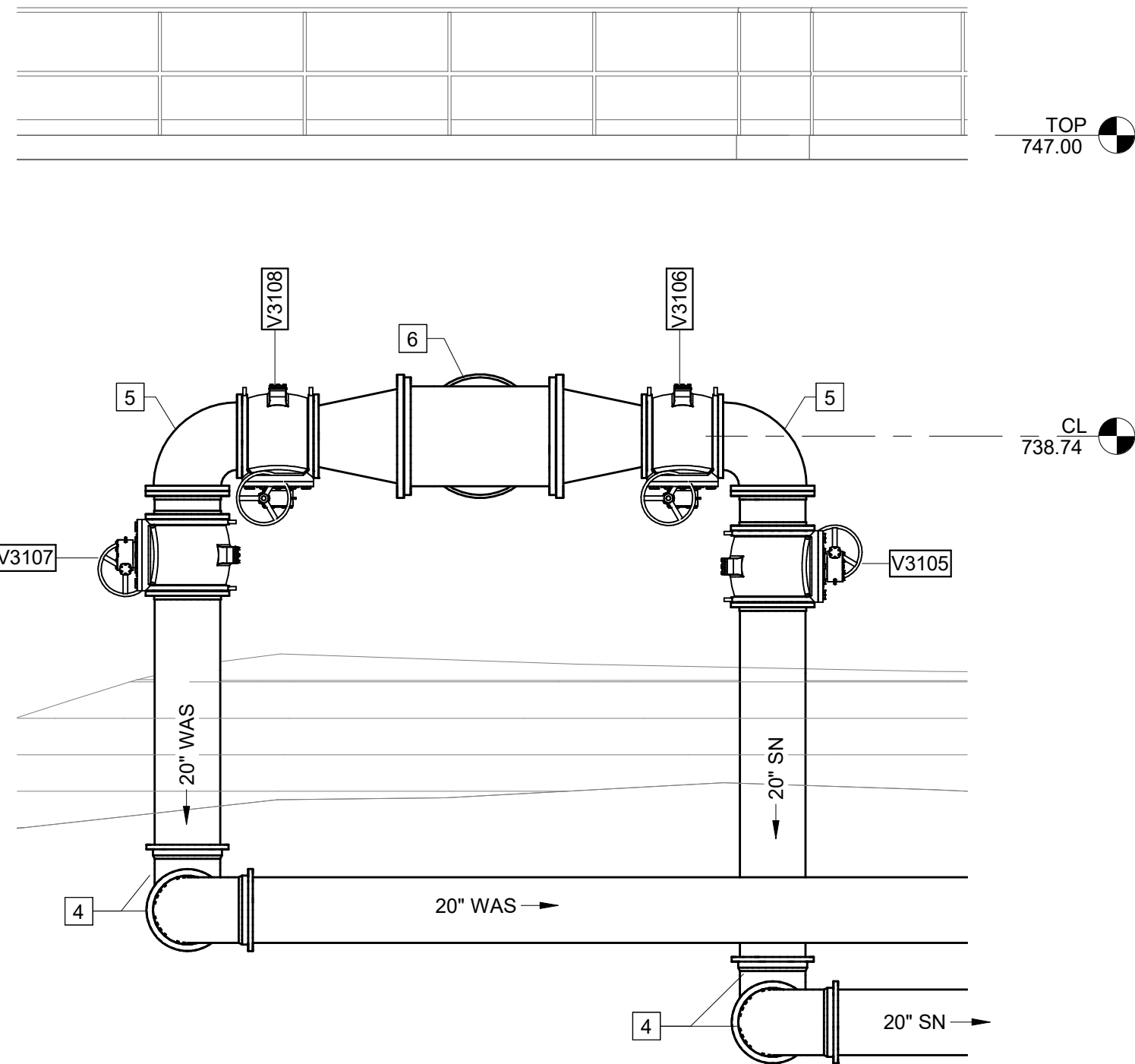


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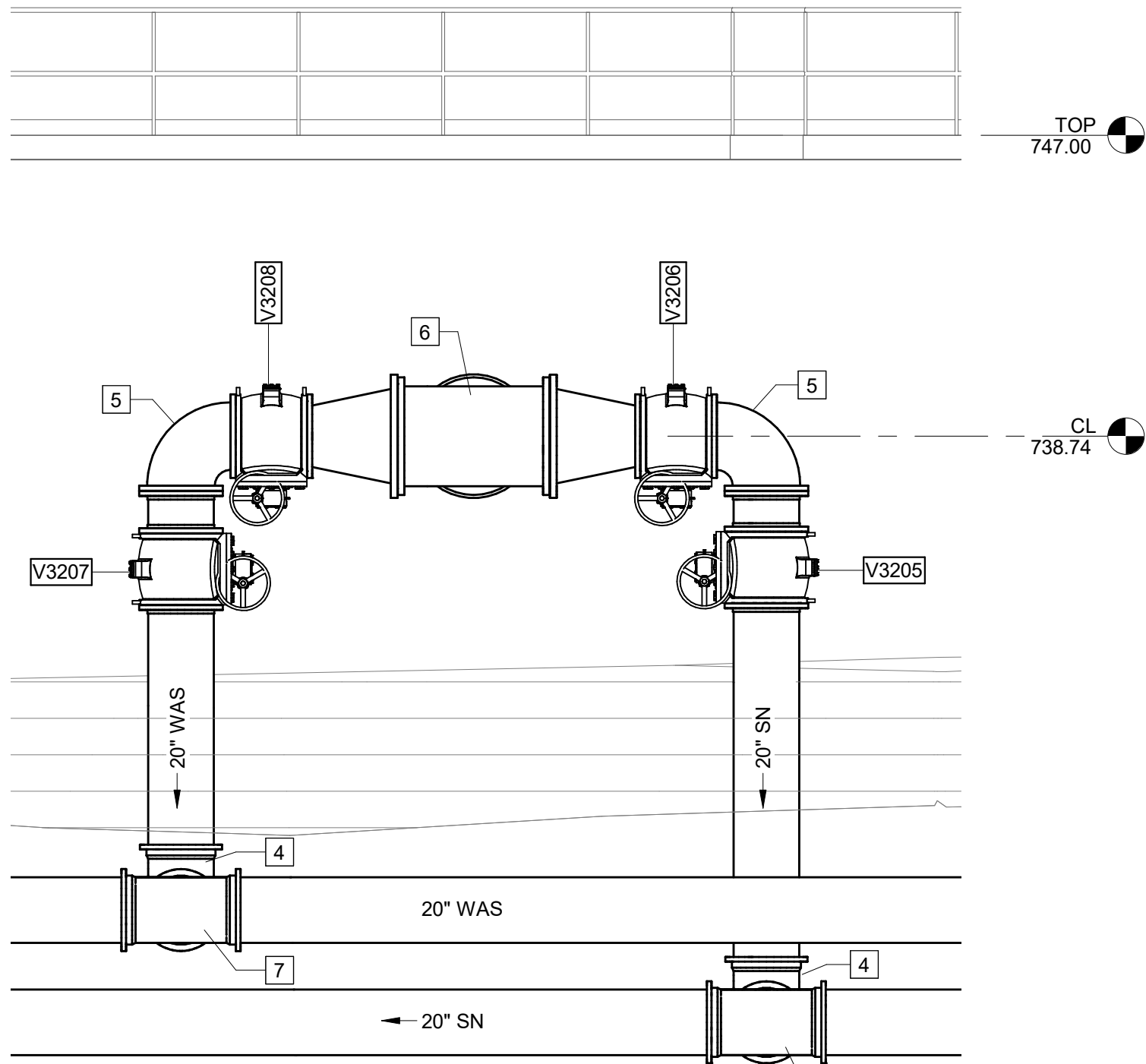
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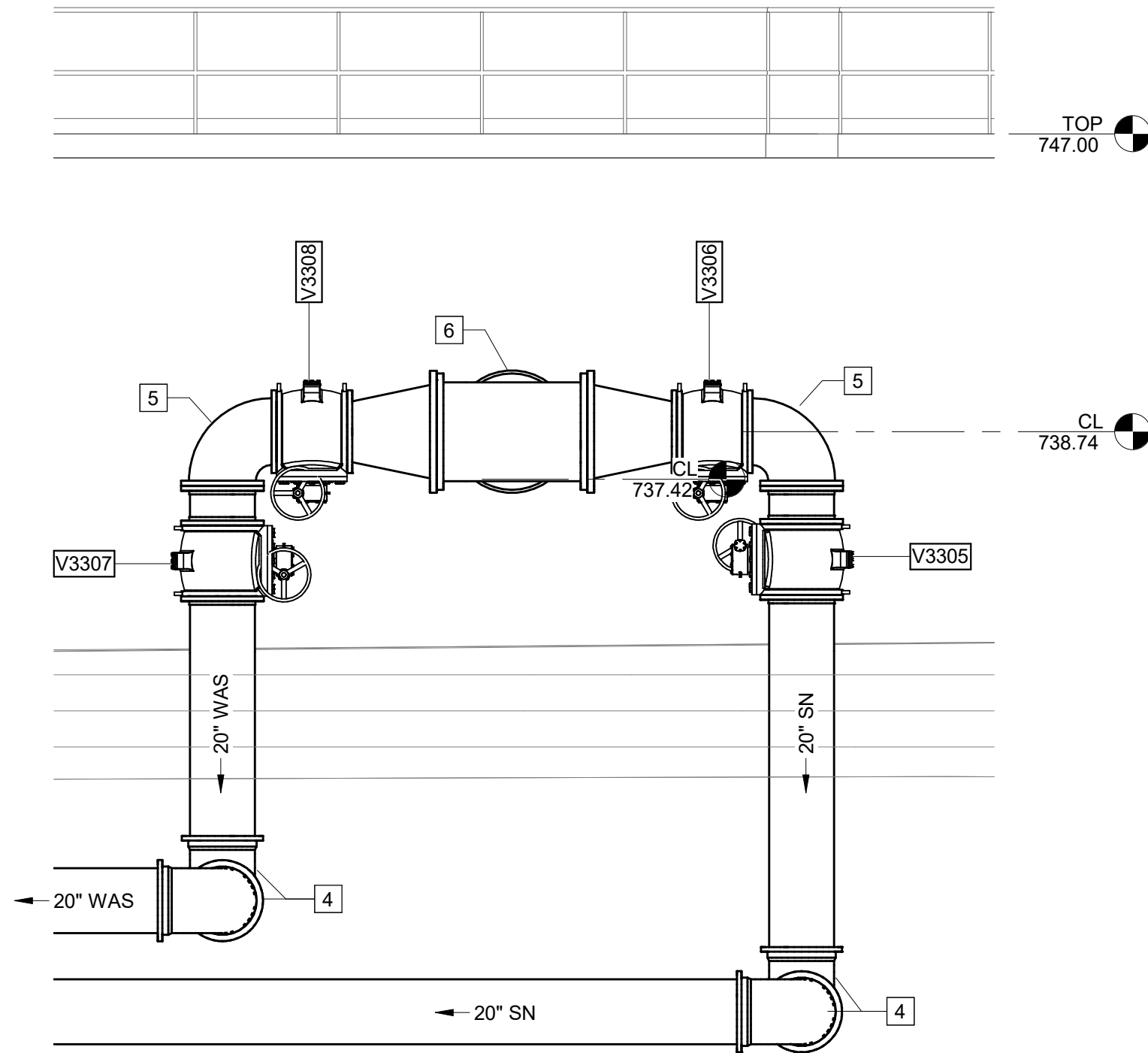
D SECTION
D-301 SCALE: 3/16" = 1'-0"



G ELEVATION
D-302 SCALE: 1/4" = 1'-0"

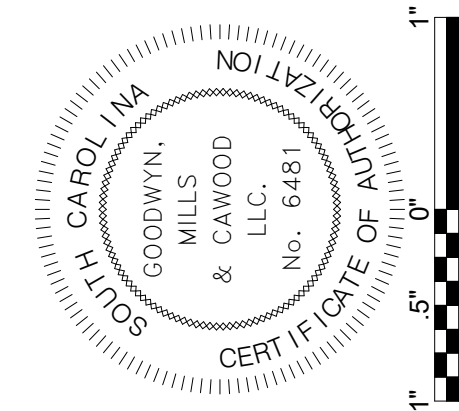


H ELEVATION
D-302 SCALE: 1/4" = 1'-0"



J ELEVATION
D-302 SCALE: 1/4" = 1'-0"

- NOTES:**
CONTRACTOR SHALL INSTALL SLUDGE REMOVAL PIPING IN ACCORDANCE WITH INSTRUCTIONS AND DRAWINGS FROM MANUFACTURER
1. V-NOTCH WEIR ELEVATION IS 744.17
- KEY NOTES:** #
- EFFLUENT V-NOTCHED WEIRD ASSEMBLY IN EFFLUENT LATERAL
 - LATERAL SUPPORT
 - FIXED FINE BUBBLE DIFFUSER
 - 20" MJ 90° BEND
 - 20" FL 90° BEND
 - 30" FL TEE
 - 20" MJ TEE
 - 12"x6" REDUCER
 - 12" 90° BEND



ISSUE	DATE
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Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

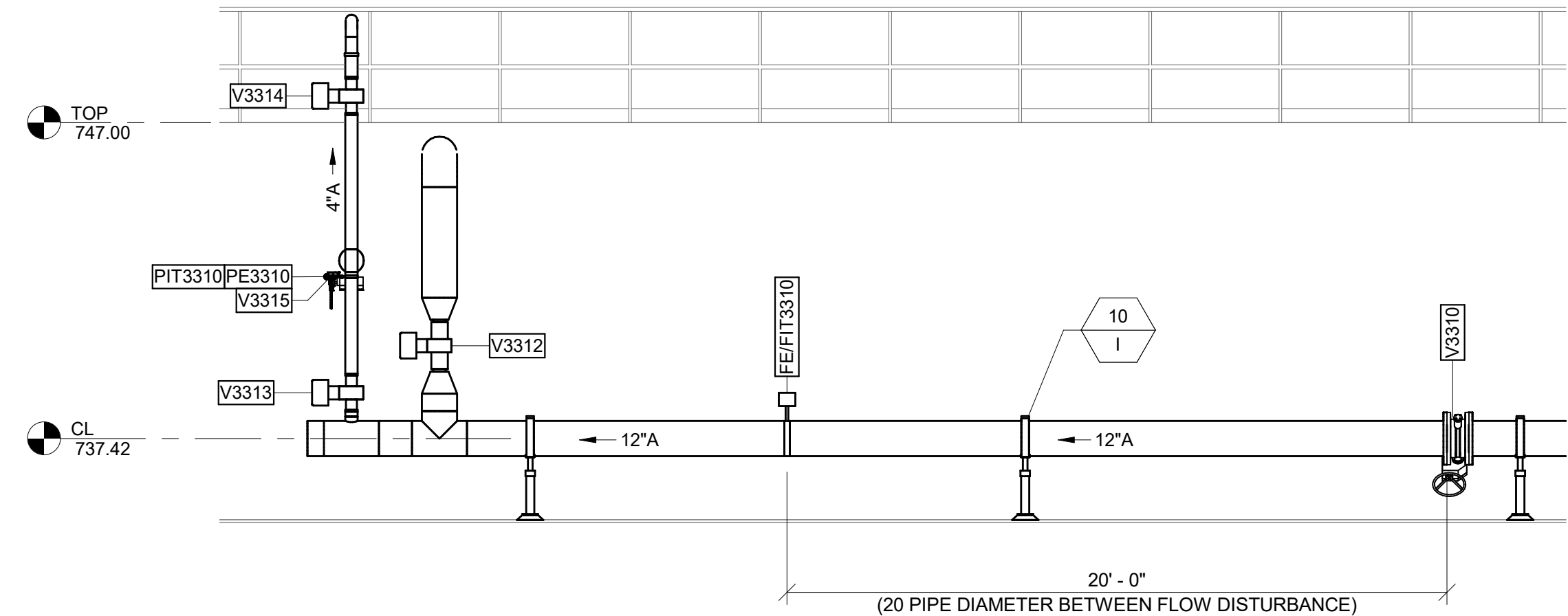
PENDLETON - CLEMSON
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City of Clemson
Anderson County

GMC PROJECT #CGRE220027

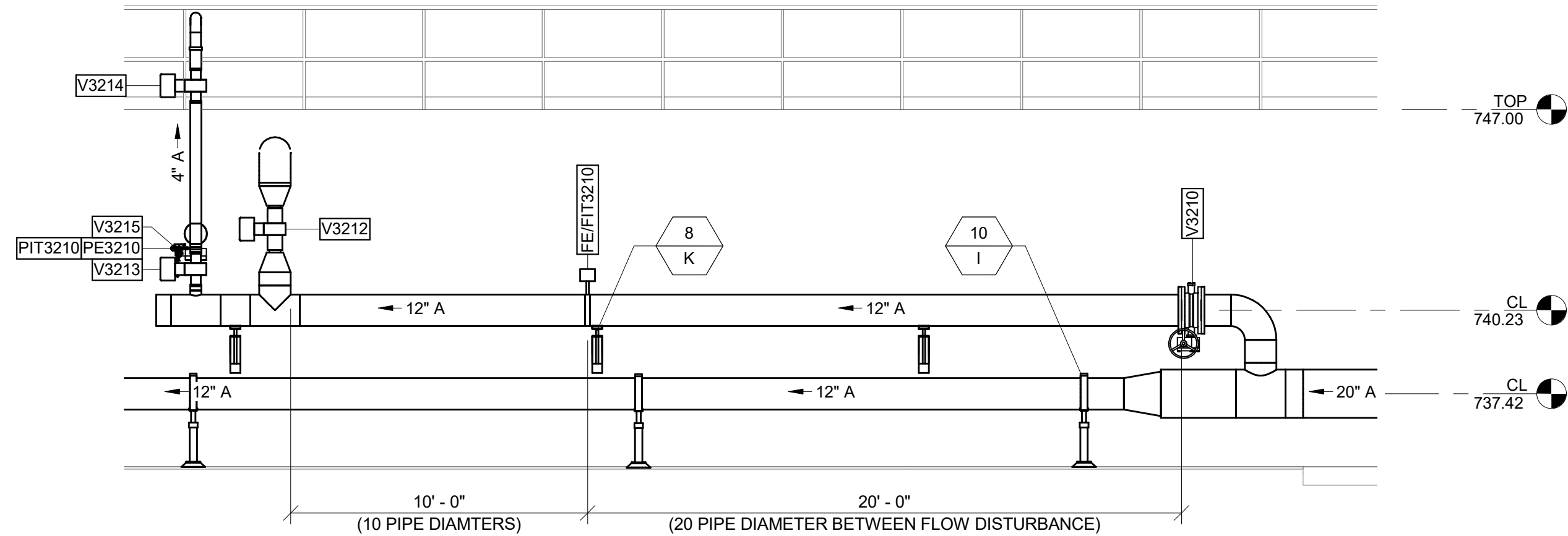
BIOLOGICAL NUTRIENT
BIOREACTOR-
SECTION &
ELEVATION

D-305

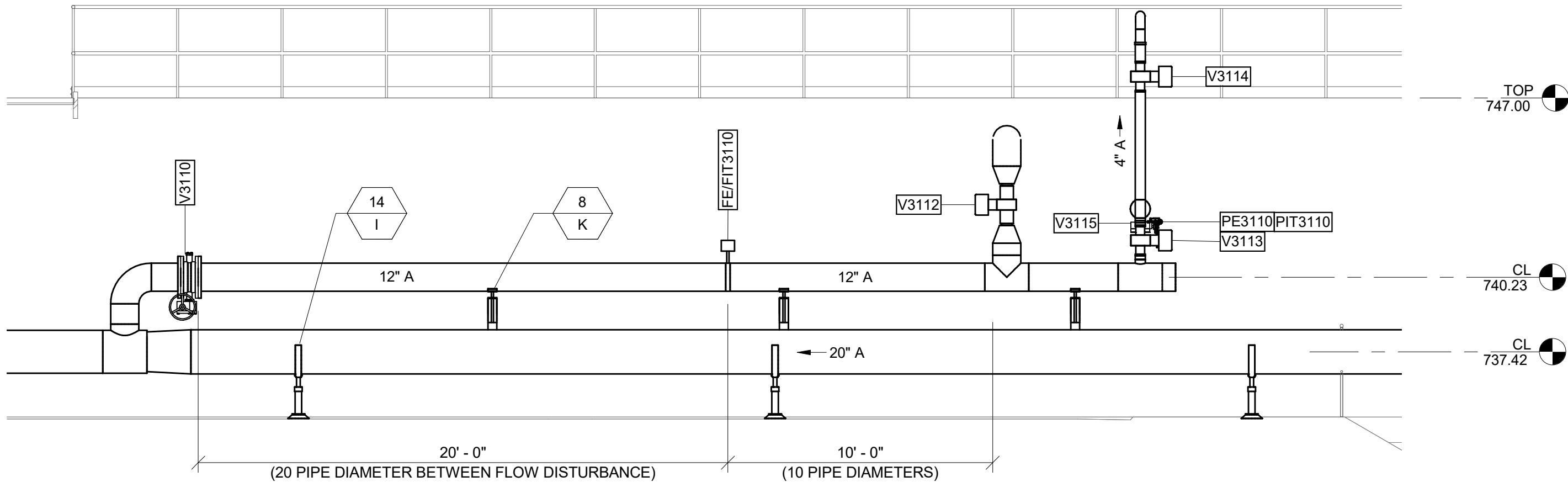
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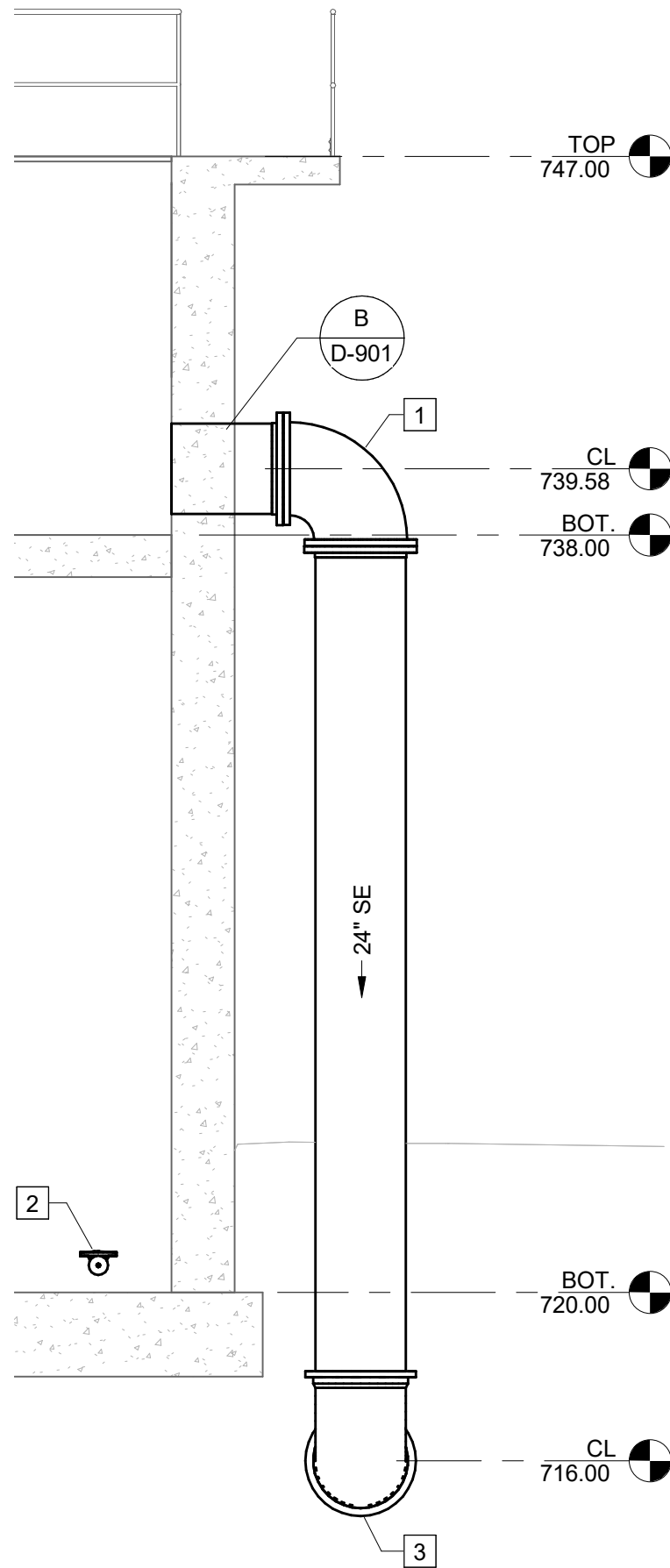
K ELEVATION
D-302 SCALE: 1/4" = 1'-0"



L ELEVATION
D-302 SCALE: 1/4" = 1'-0"



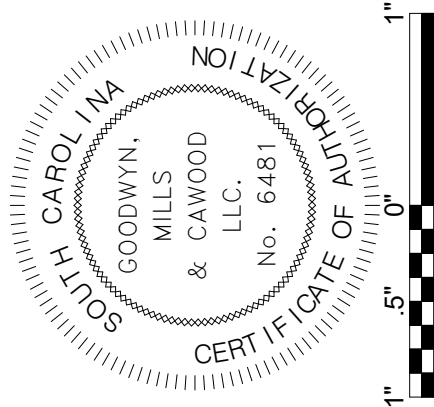
M ELEVATION
D-302 SCALE: 1/4" = 1'-0"



N SECTION
D-302 SCALE: 1/4" = 1'-0"

KEY NOTES: #

- 24" 90° FL BEND
- DIFFUSER SYSTEM
- 24" 90° MJ BEND



ISSUE	DATE
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100% submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

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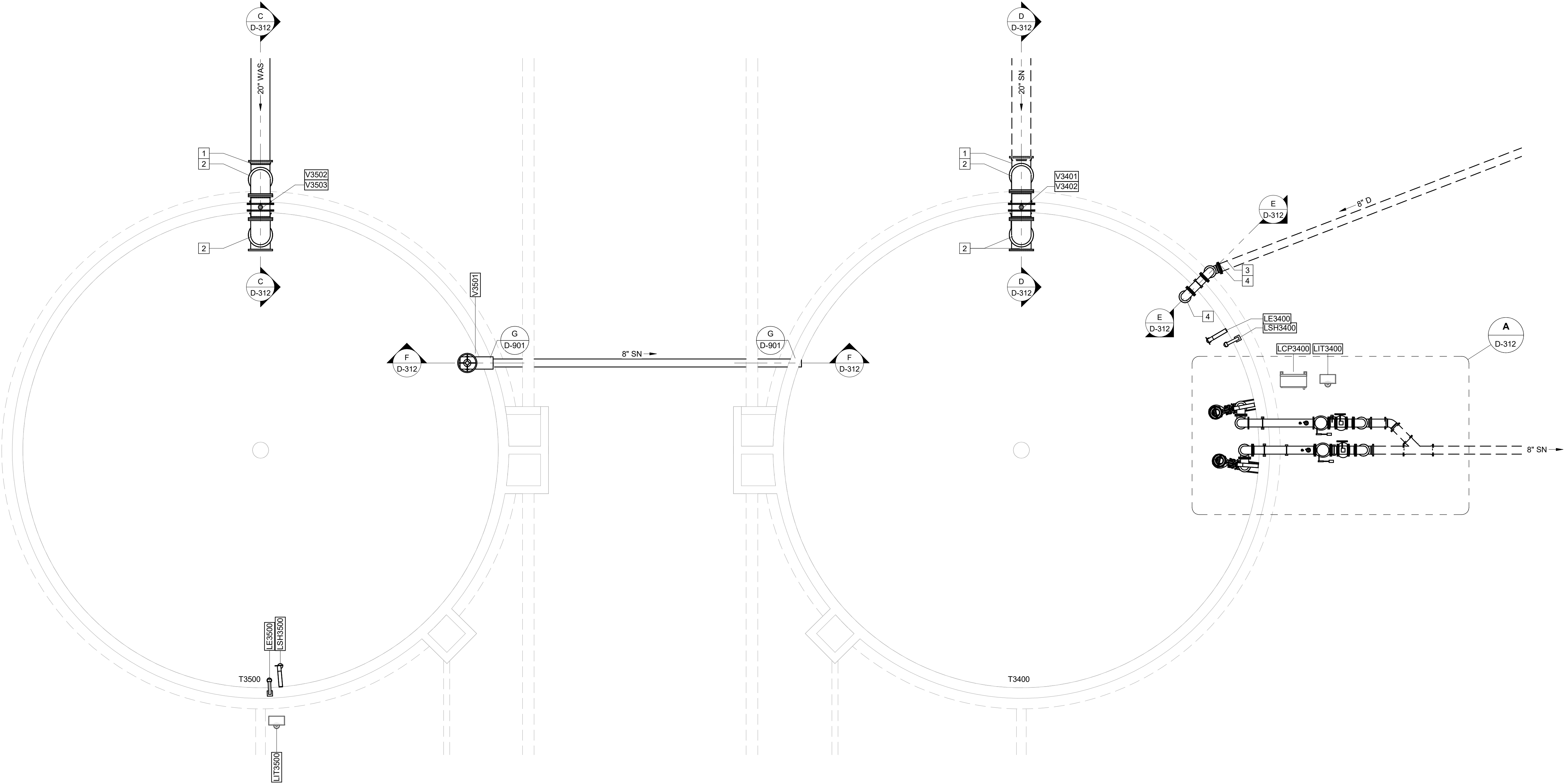
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BIOLOGICAL
NUTRIENT
BIOREACTOR -
ELEVATIONS
D-306

BM 360\\CCBRE220027 - Pendleton-Clemson WWTP Expansion\\level correction.rvt
3/11/2024 3:12:33 PM

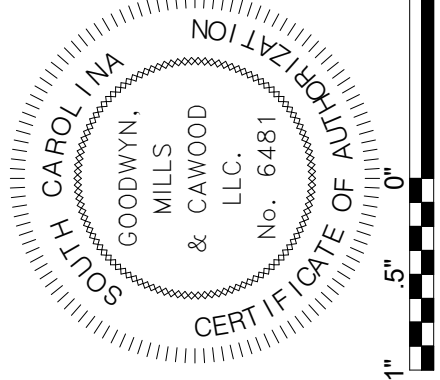


3C
D-001
PLAN
SCALE: 3/16" = 1'-0"



KEY NOTES: #

1. 20" 90° MJ BEND
2. 20" 90° FL BEND
3. 8" 90° MJ BEND
4. 8" 90° FL BEND



ISSUE	DATE
30% Submittal	01.18.2023
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100% Submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

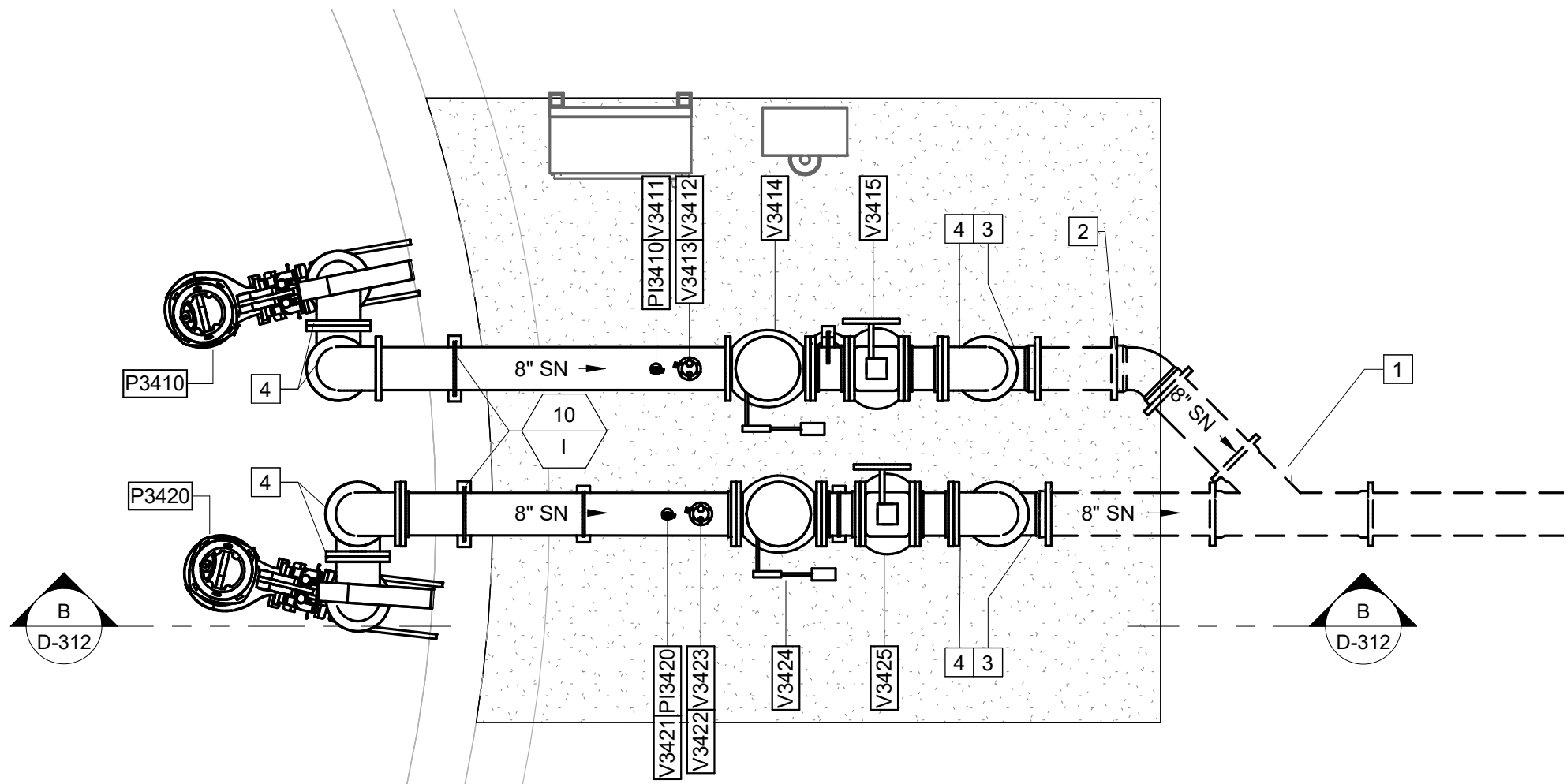
GMC PROJECT #CGRE220027

SLUDGE BUFFER &
LEVEL CORRECTION
TANKS - PLAN

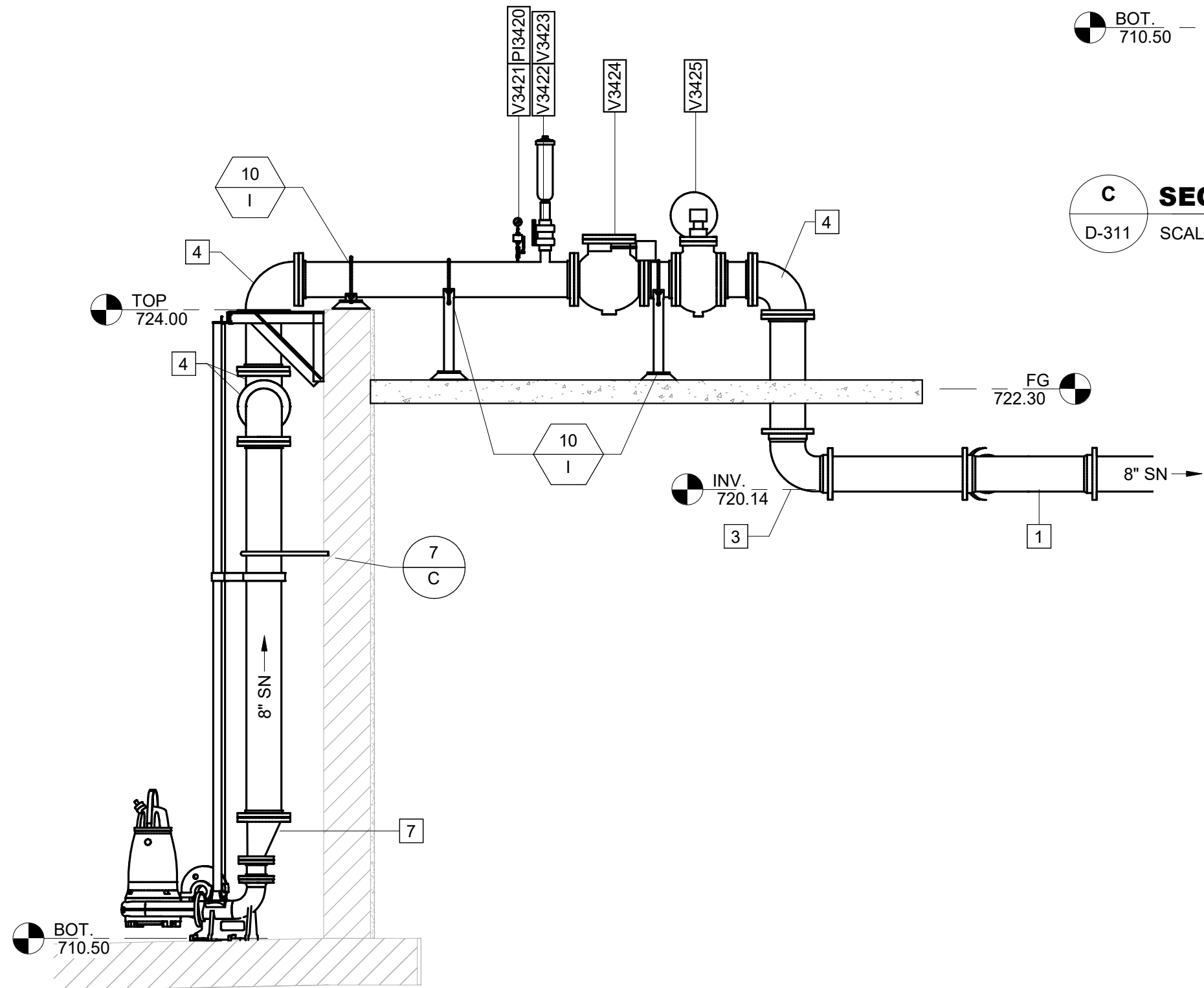
D-311

BM 360/CCRE220027 - Pendleton-Clemson WWTP Expansion/level correction.rvt
3/11/2024 4:00:06 PM

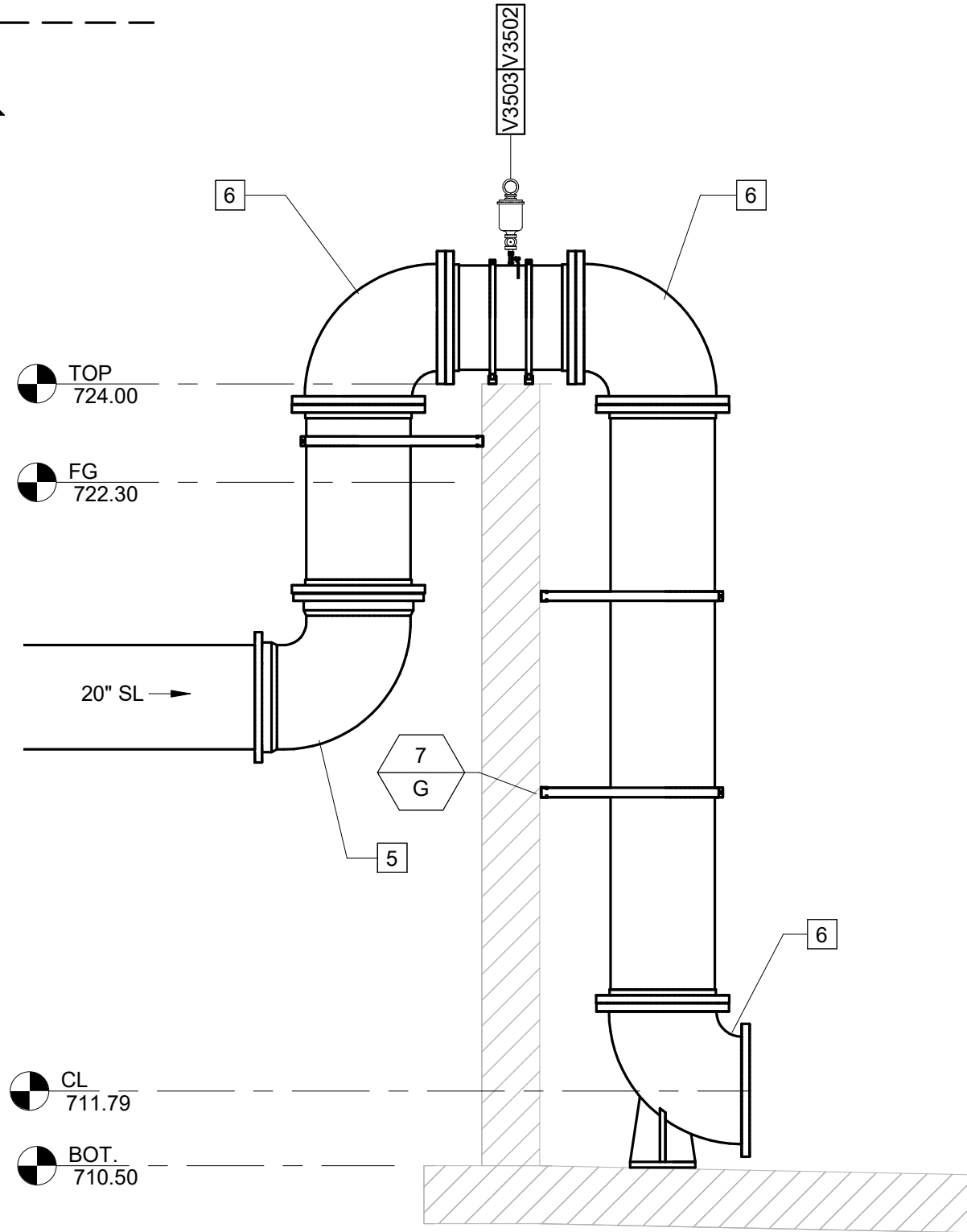
A ENLARGED PLAN
D-311 SCALE: 3/8" = 1'-0"



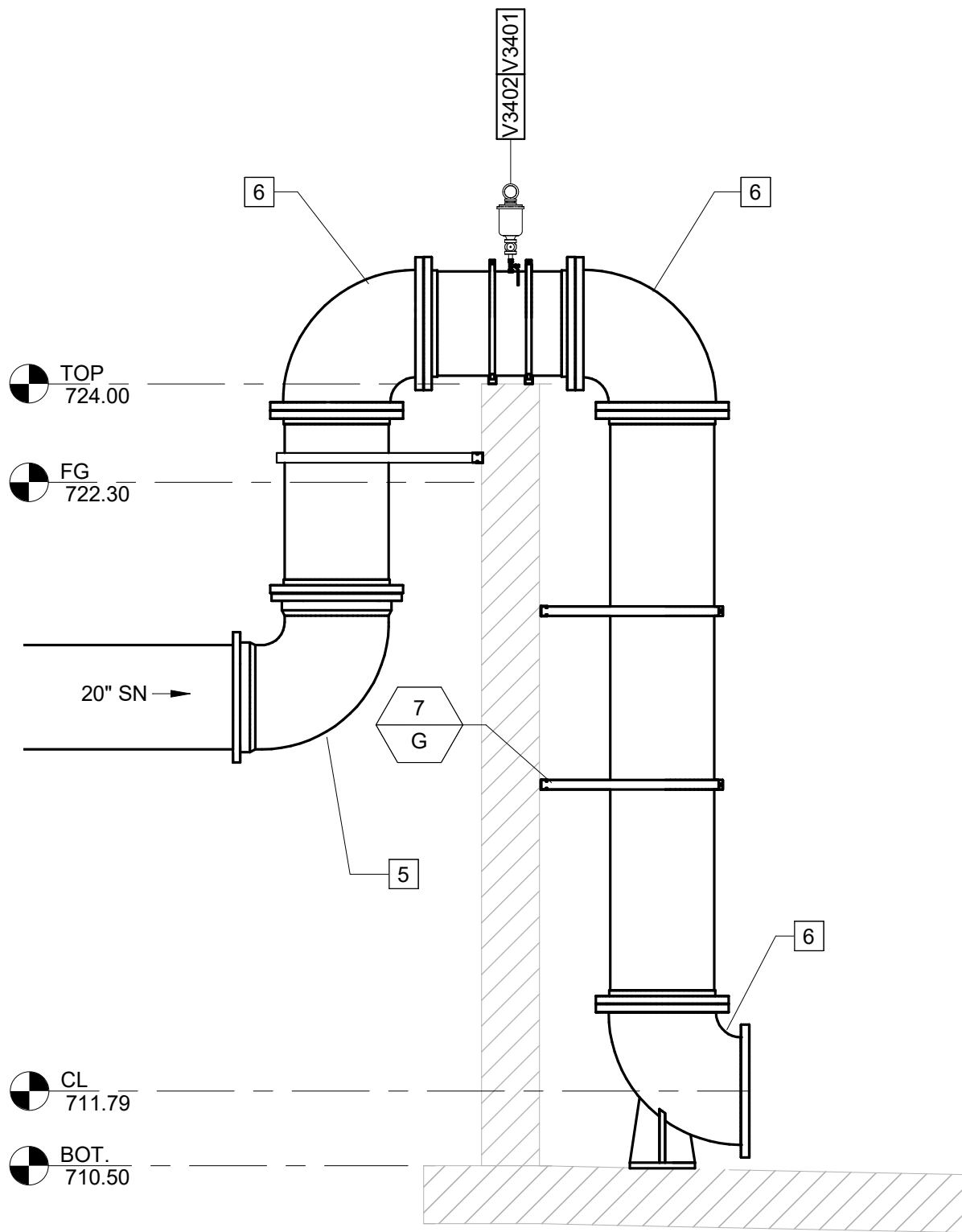
B SECTION
D-312 SCALE: 3/8" = 1'-0"



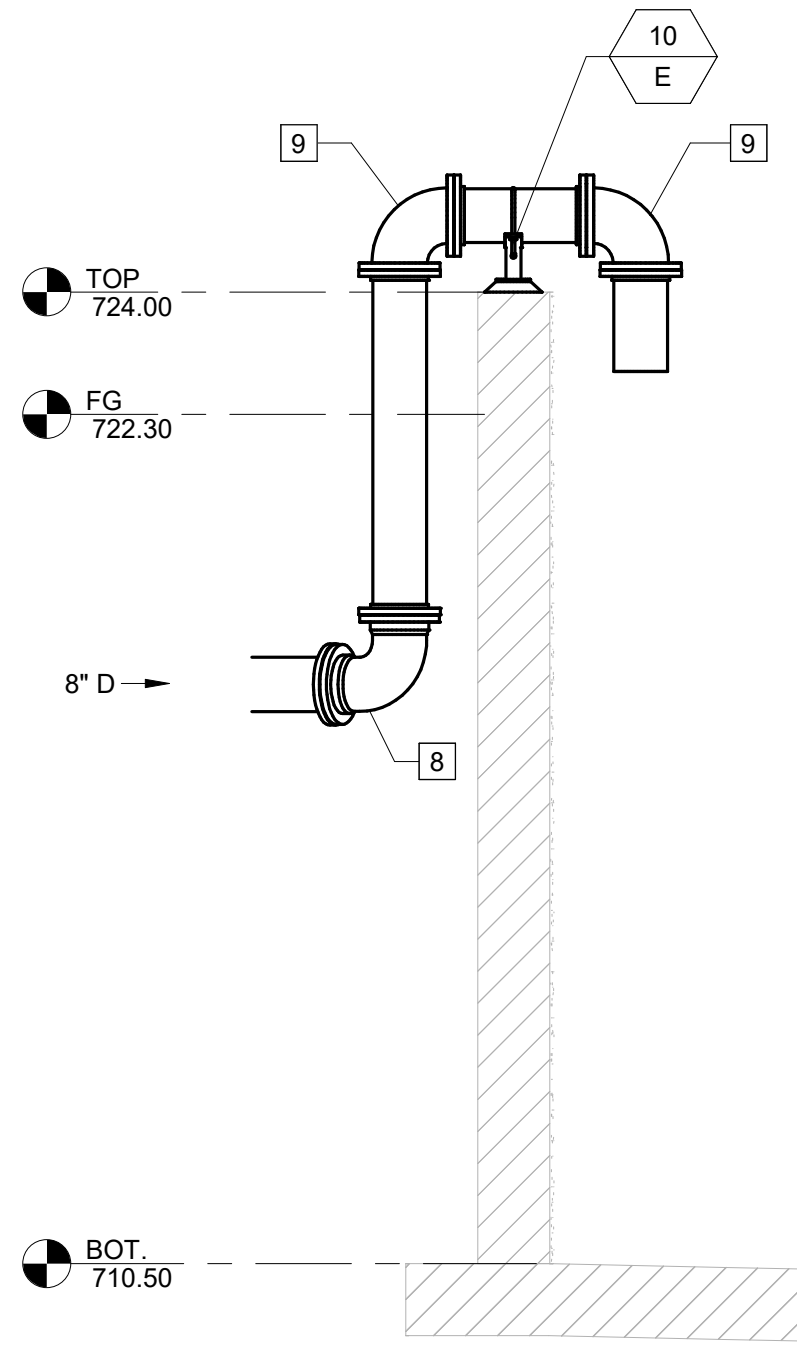
C SECTION
D-311 SCALE: 3/8" = 1'-0"



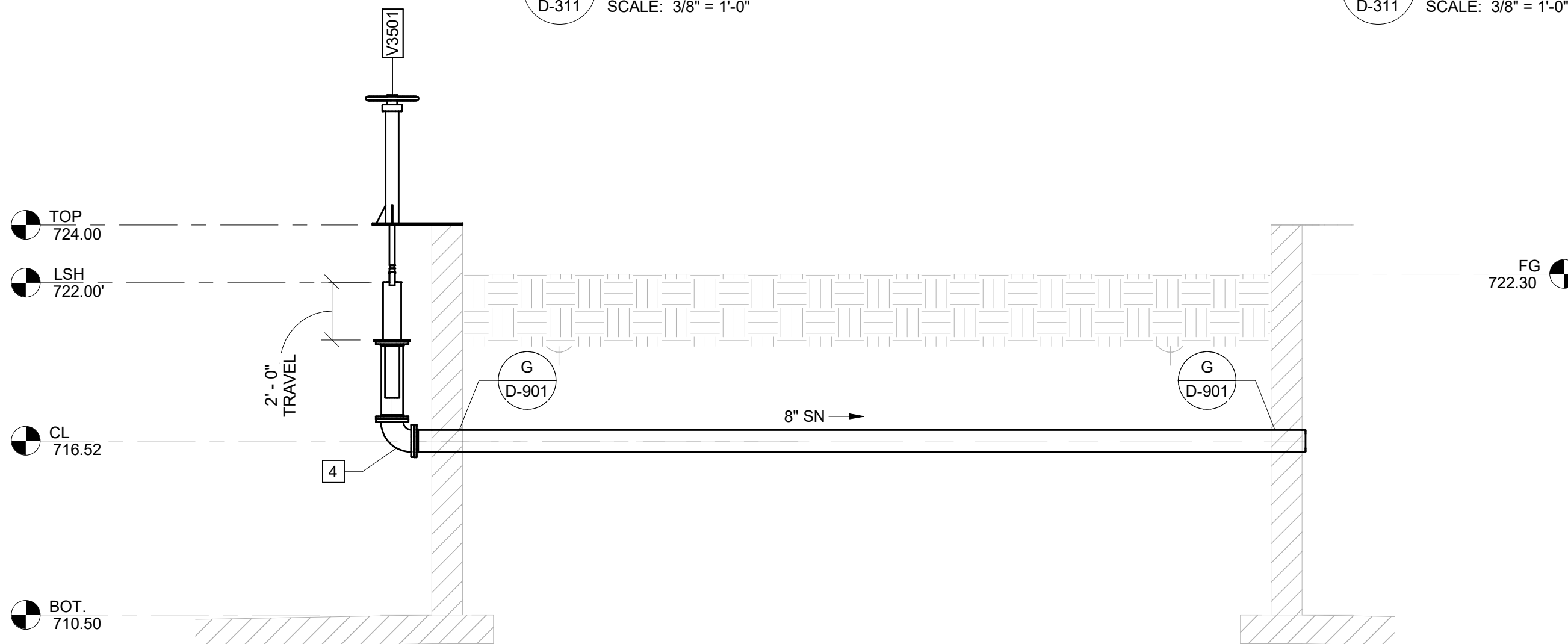
D SECTION
D-311 SCALE: 3/8" = 1'-0"



E Section 9
D-311 SCALE: 3/8" = 1'-0"



F SECTION
D-311 SCALE: 1/4" = 1'-0"



KEY NOTES: #

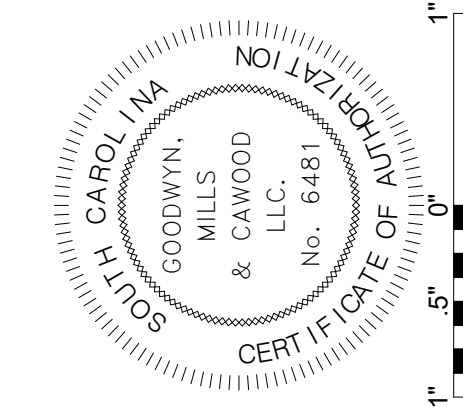
1. 8" MJ WYES
2. 8" 45° MJ BEND
3. 8" 90° MJ BEND
4. 8" 90° FL BEND
5. 20" 90° MJ BEND
6. 20" 90° FL BASE BEND
7. 8" X 4" REDUCER
8. 8" 90° MJ BEND
9. 8" 90° FL BEND

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SLUDGE BUFFER &
LEVEL CORRECTION
TANKS - ENLARGED
PLAN & SECTIONS

D-312



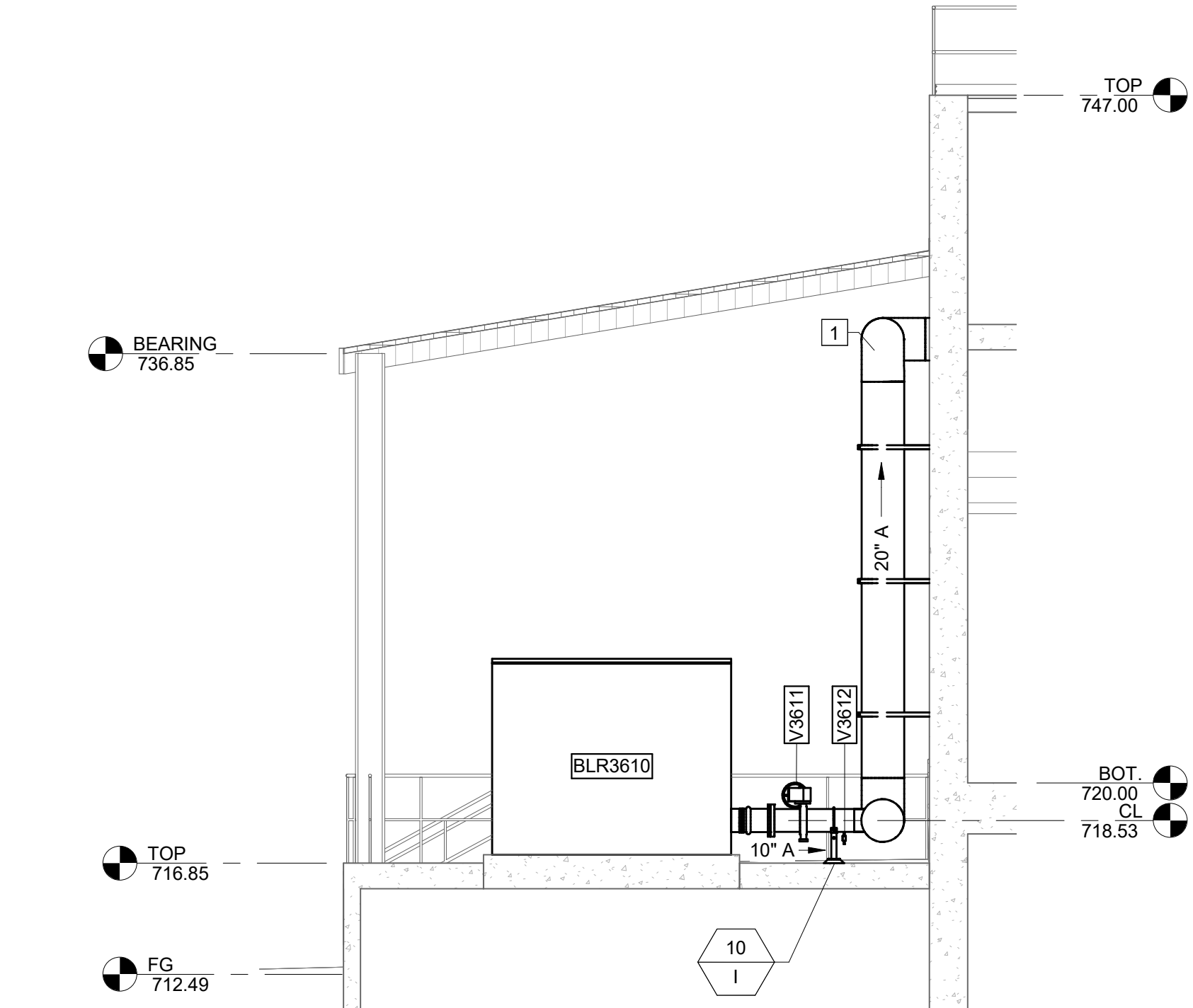
ISSUE	DATE
30% Submittal	01.18.2023
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Drawn By:	HKD

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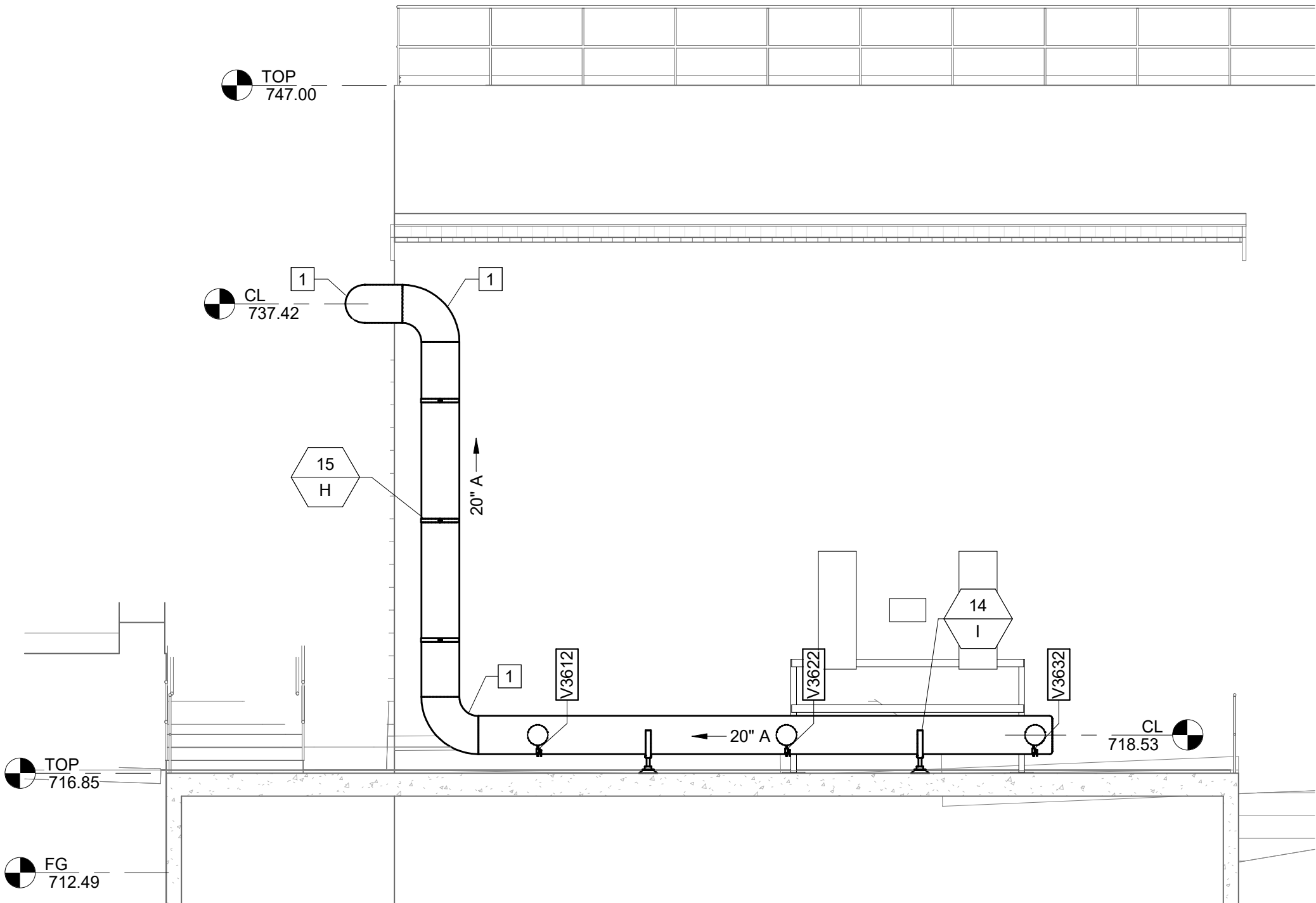
BM 360\\CGRE220027 - Pendleton-Clemson WWTP Expansion\\BNR.rvt
3/11/2024 3:10:35 PM



3D PLAN
D-301 SCALE: 3/16" = 1'-0"



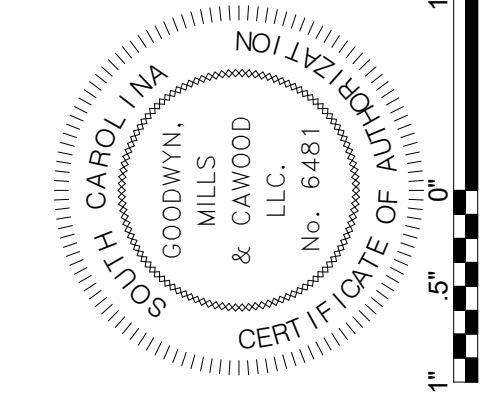
A SECTION
D-321 SCALE: 3/16" = 1'-0"



B SECTION
D-321 SCALE: 3/16" = 1'-0"

KEY NOTES: #

- 20" 90° BEND
- FABRICATED STAINLESS STEEL



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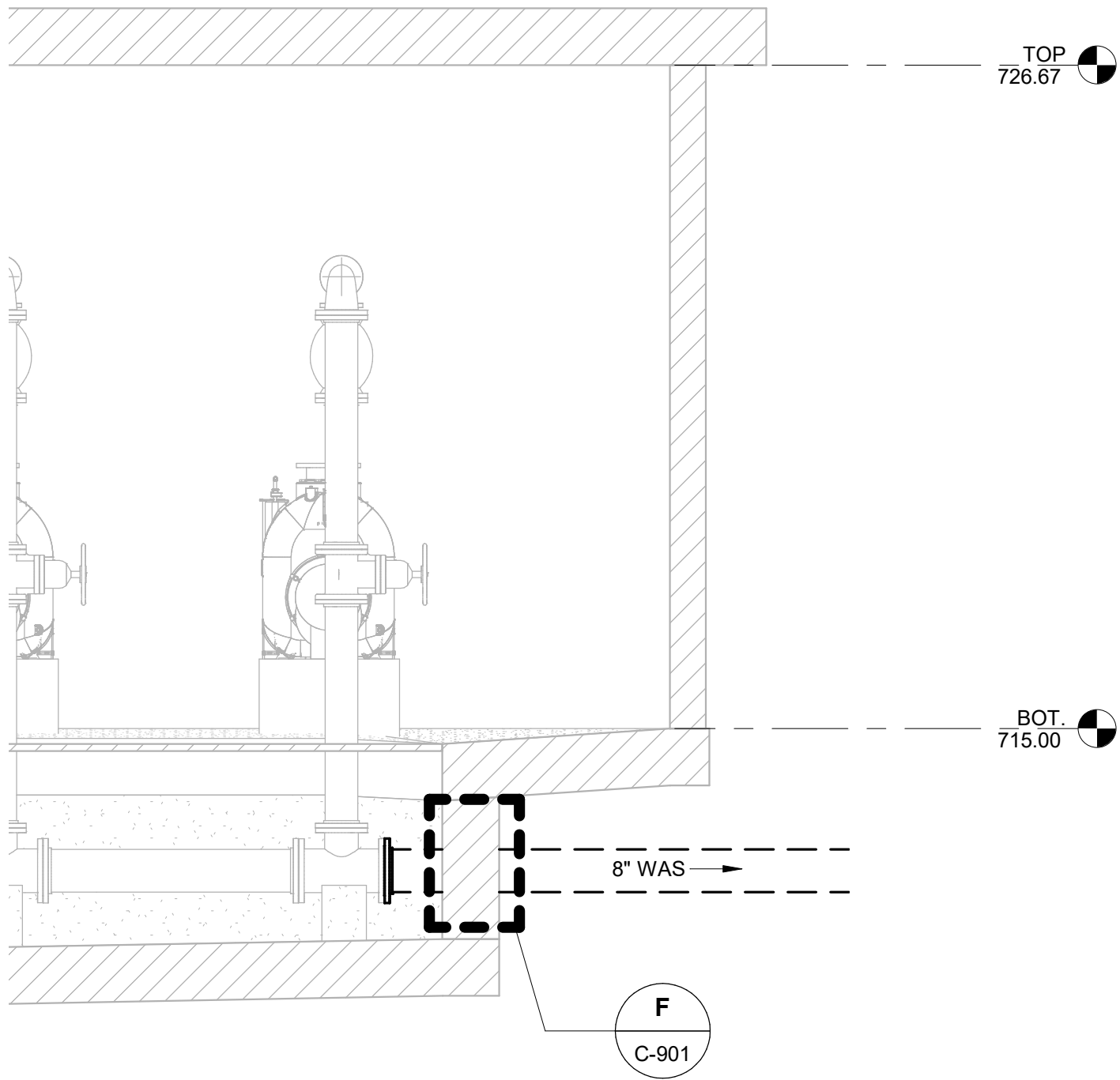
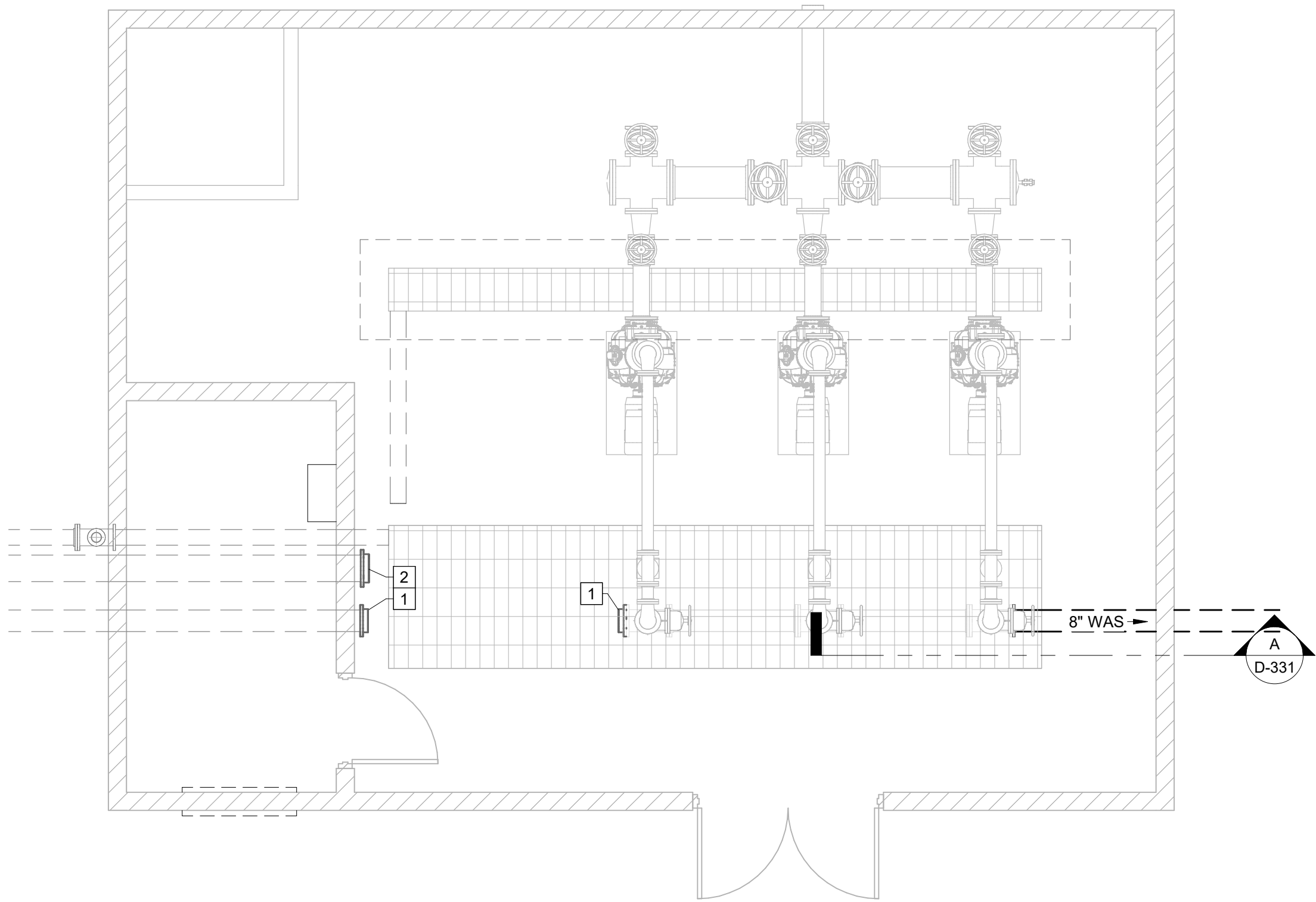
BIOLOGICAL NUTRIENT
BIOREACTORS
BLOWERS- PLAN &
SECTIONS

D-321

BM 4 360\\CGRE220027 - Pendleton-Clemson WWTp Expansion\\RAS.rvt
3/11/2024 3:23:09 PM



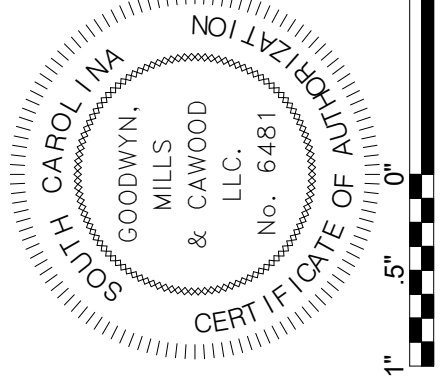
4E PLAN
D-001 SCALE: 1/4" = 1'-0"



A SECTION
D-331 SCALE: 3/8" = 1'-0"

KEY NOTES: #

1. 8" CAP DISHED
2. 10" CAP DISHED



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Designer:	JX
Drawn By:	HKD

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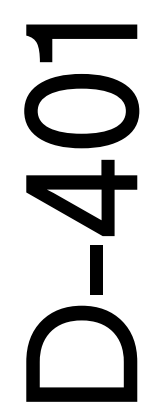
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**RAS/WAS PUMP
BUILDING - PLAN &
SECTION**

D-331

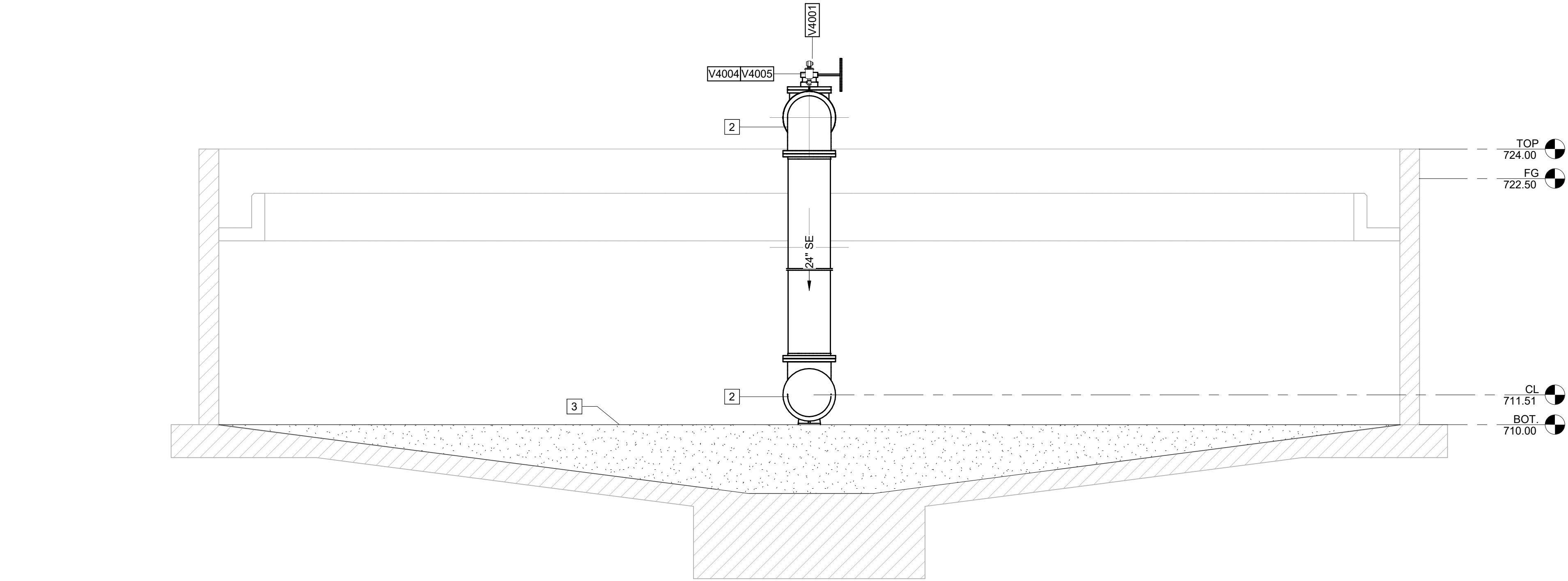
PLAN

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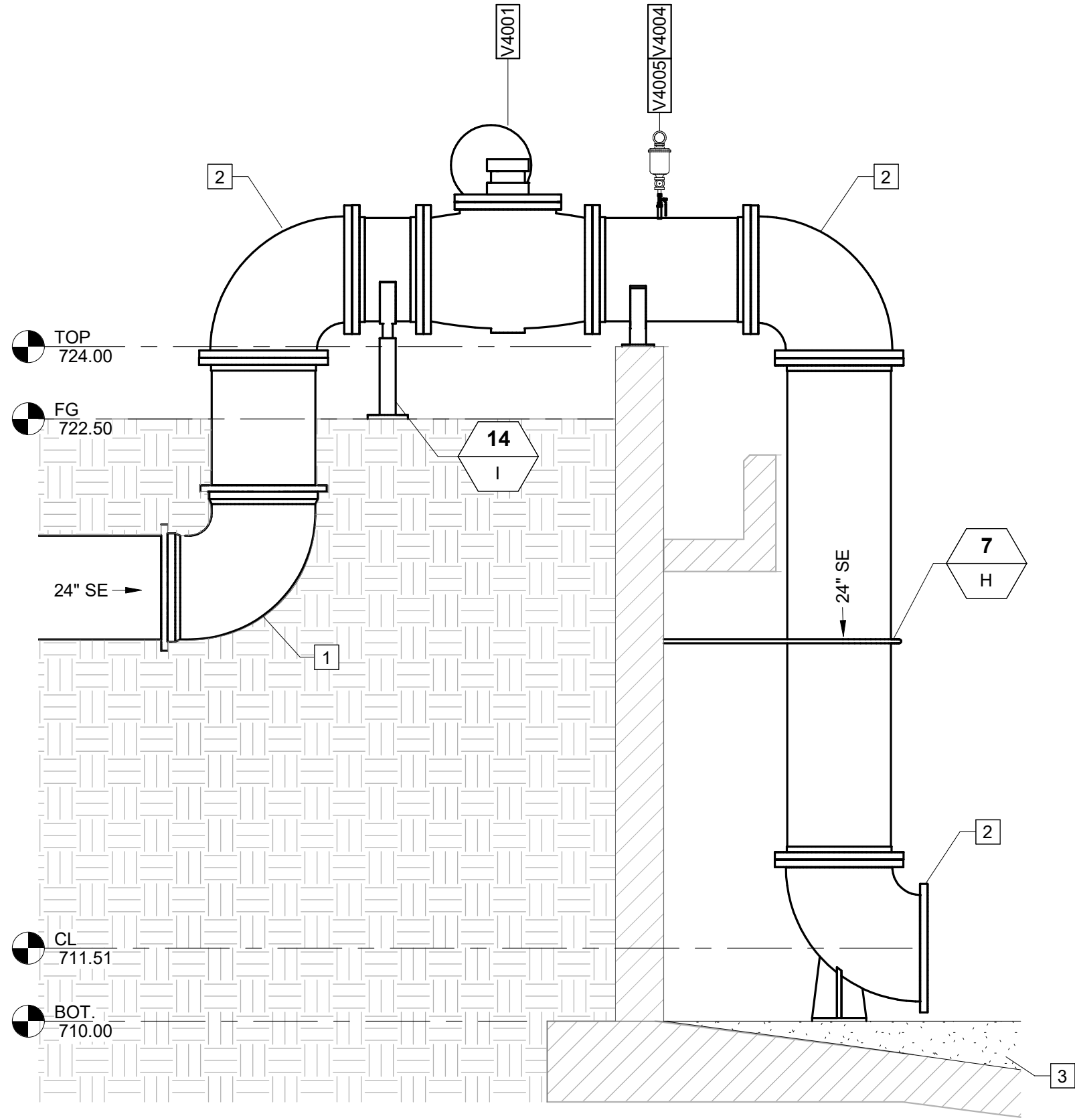


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3/11/2024 3:27:07 PM

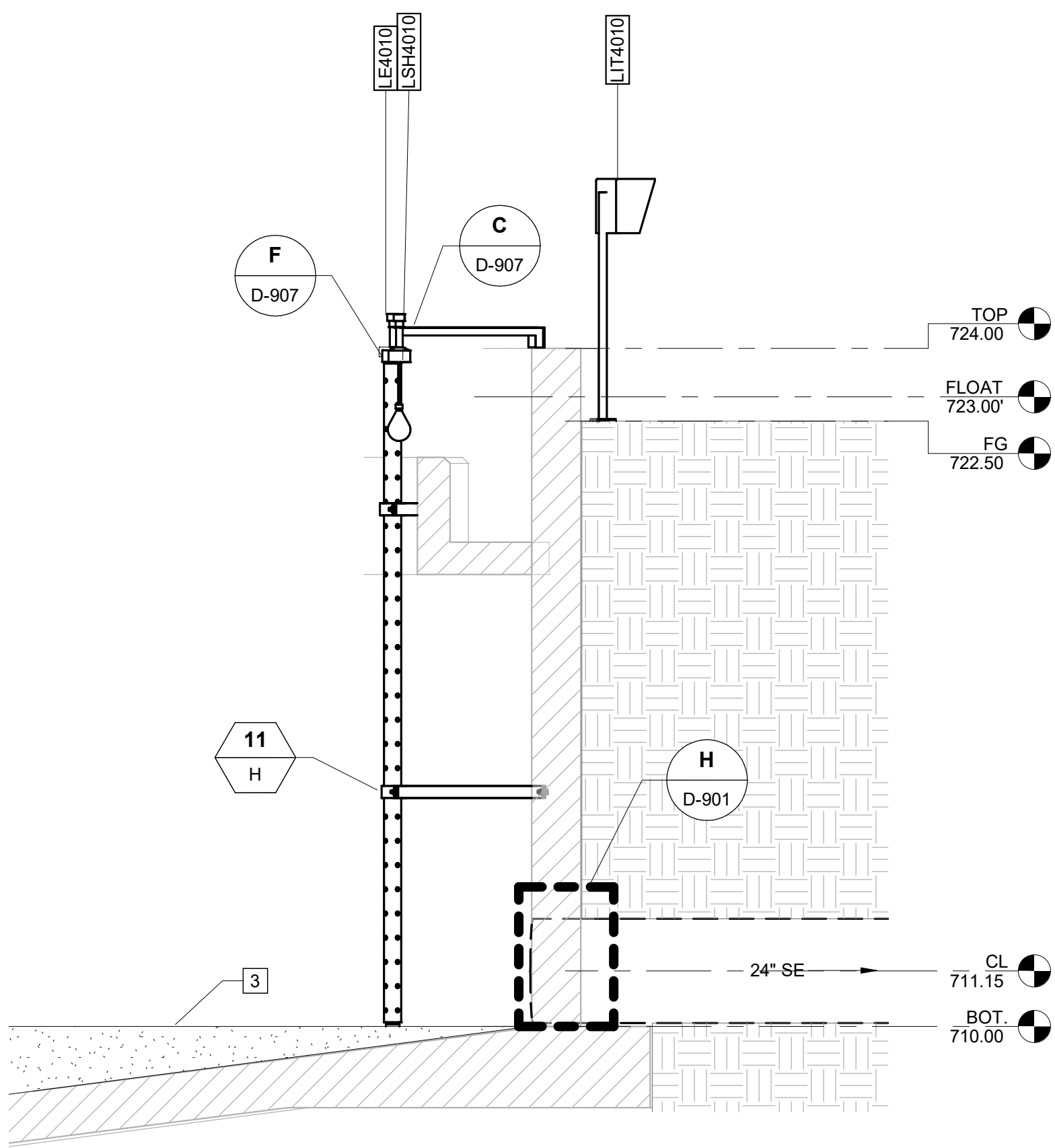
A SECTION
D-401 SCALE: 1/4" = 1'-0"



B SECTION
D-401 SCALE: 3/8" = 1'-0"

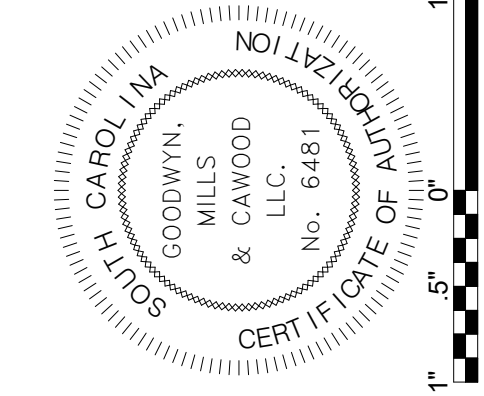


C SECTION
D-401 SCALE: 3/8" = 1'-0"



KEY NOTES: #

1. 24" 90° MJ BEND
2. 24" 90° FL BASE BEND
3. GROUT FILL



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Project Manager:	WN
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Designer:	JX
Drawn By:	HKD

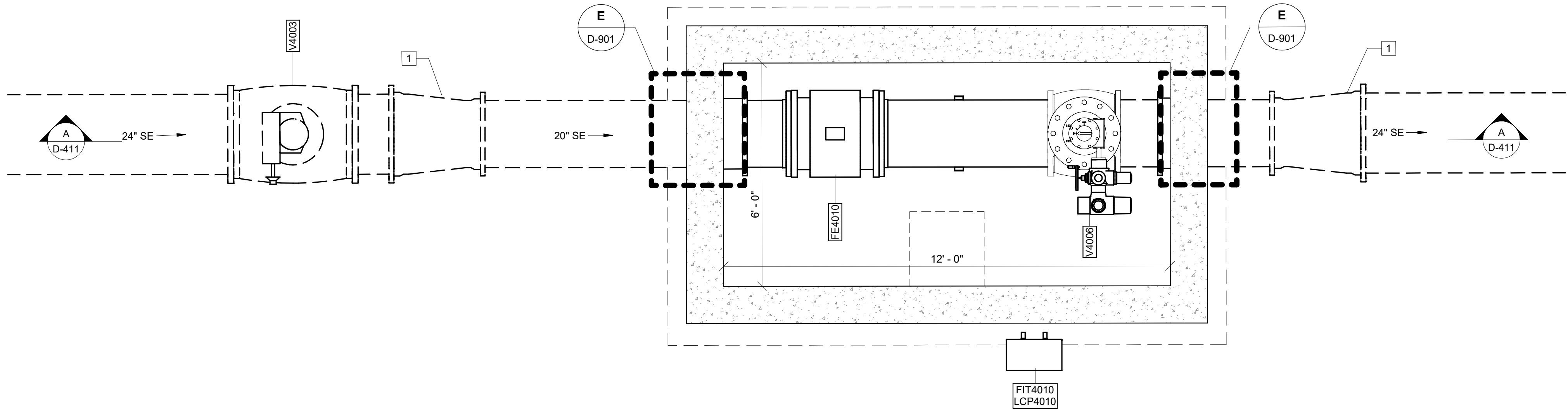
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City of Clemson
Anderson County

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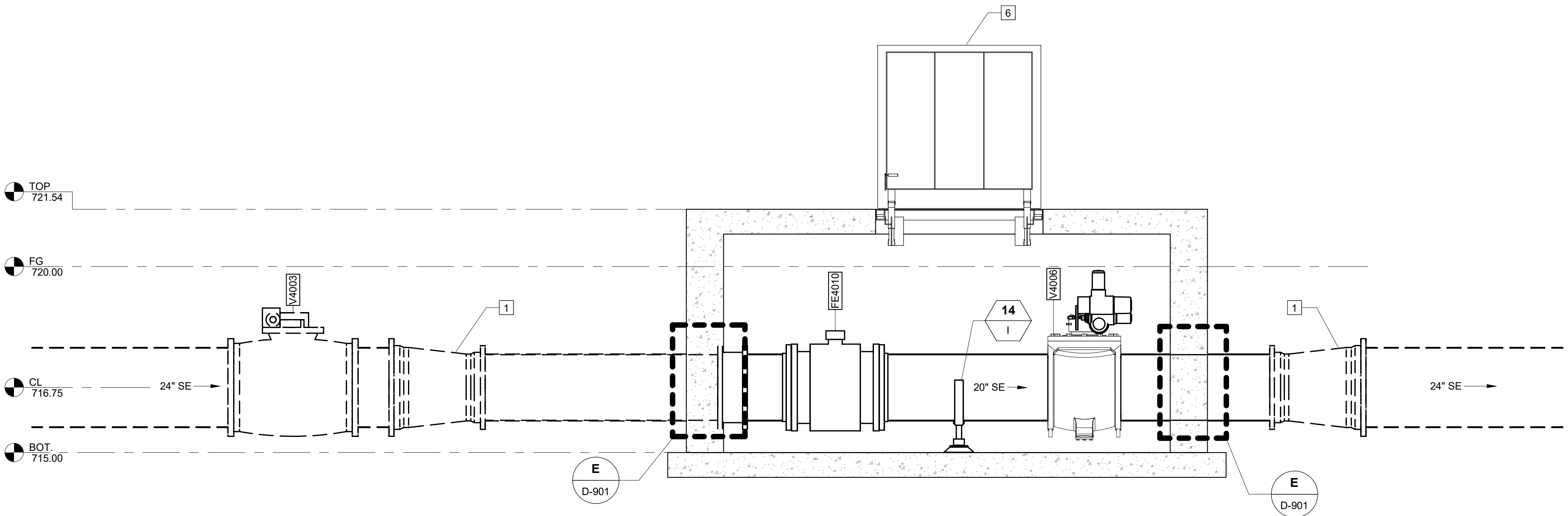
**POST EQUALIZATION
BASIN SECTION**

D-402

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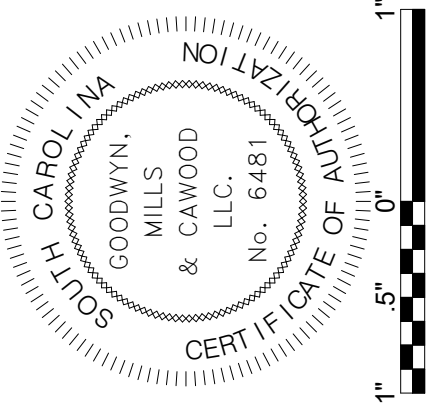
4B PLAN
D-411 SCALE: 1/2" = 1'-0"



A SECTION
D-411 SCALE: 1/2" = 1'-0"

KEY NOTES: #

- 18" FL 90° BEND
- 18" BLIND FLANGE
- 18" X 24" FL REDUCER
- 4" FL 90° BEND
- 6" FL 90° BEND
- 4' X 4' HATCH



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POST EQUALIZATION
FLOW CONTROL
VAULT

D-411



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3/11/2024 3:31:51 PM



5

PLAN

D-501

SCALE: 3/16" = 1'-0"

KEY NOTES: #

1. 16" FL 90° BEND
2. 16" FL COUPLING ADAPTERS
3. 16" MJ 90° BEND
4. 24" X 16" MJ CROSS
5. 24" MJ 90 BEND
6. 24" FL TEE
7. BLIND FLANGE
8. WEIR GATE
9. 24" FL 90° BEND
10. 24" X 16" FL TEE

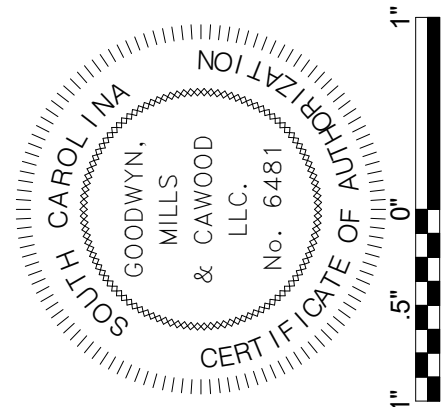
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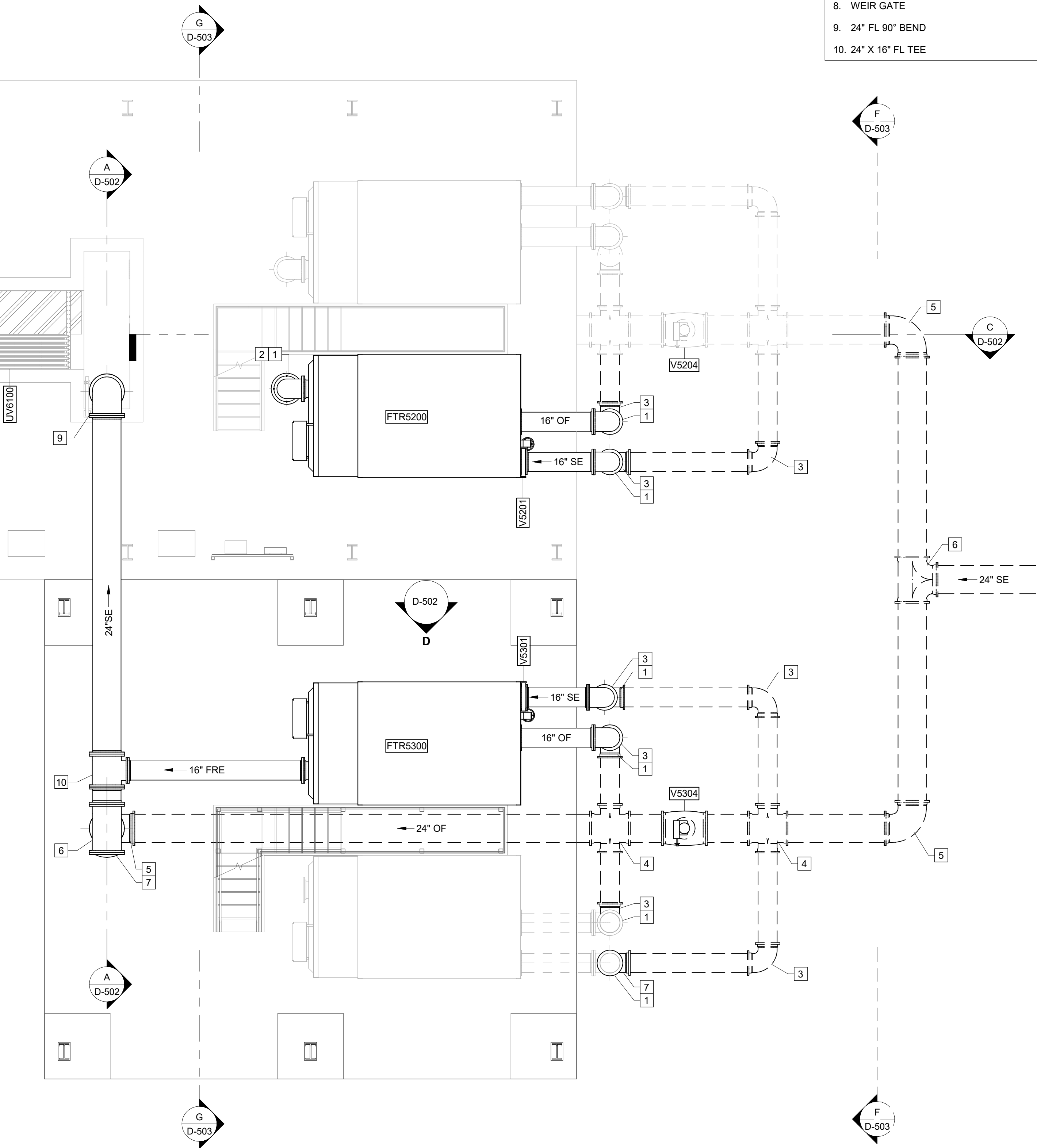
ISSUE	DATE
30% Submittal	01.18.2023
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100% submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

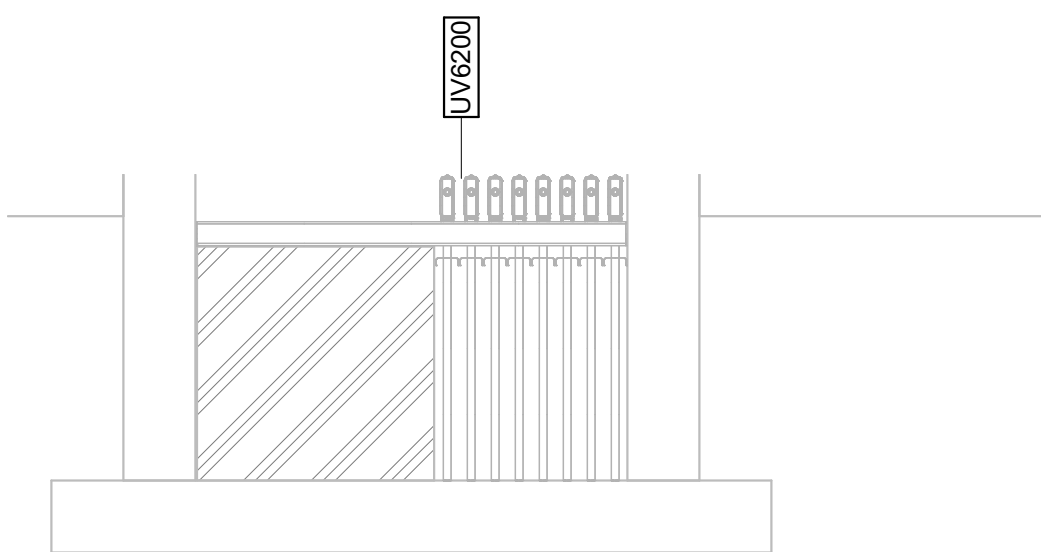
FILTERS - PLAN

D-501

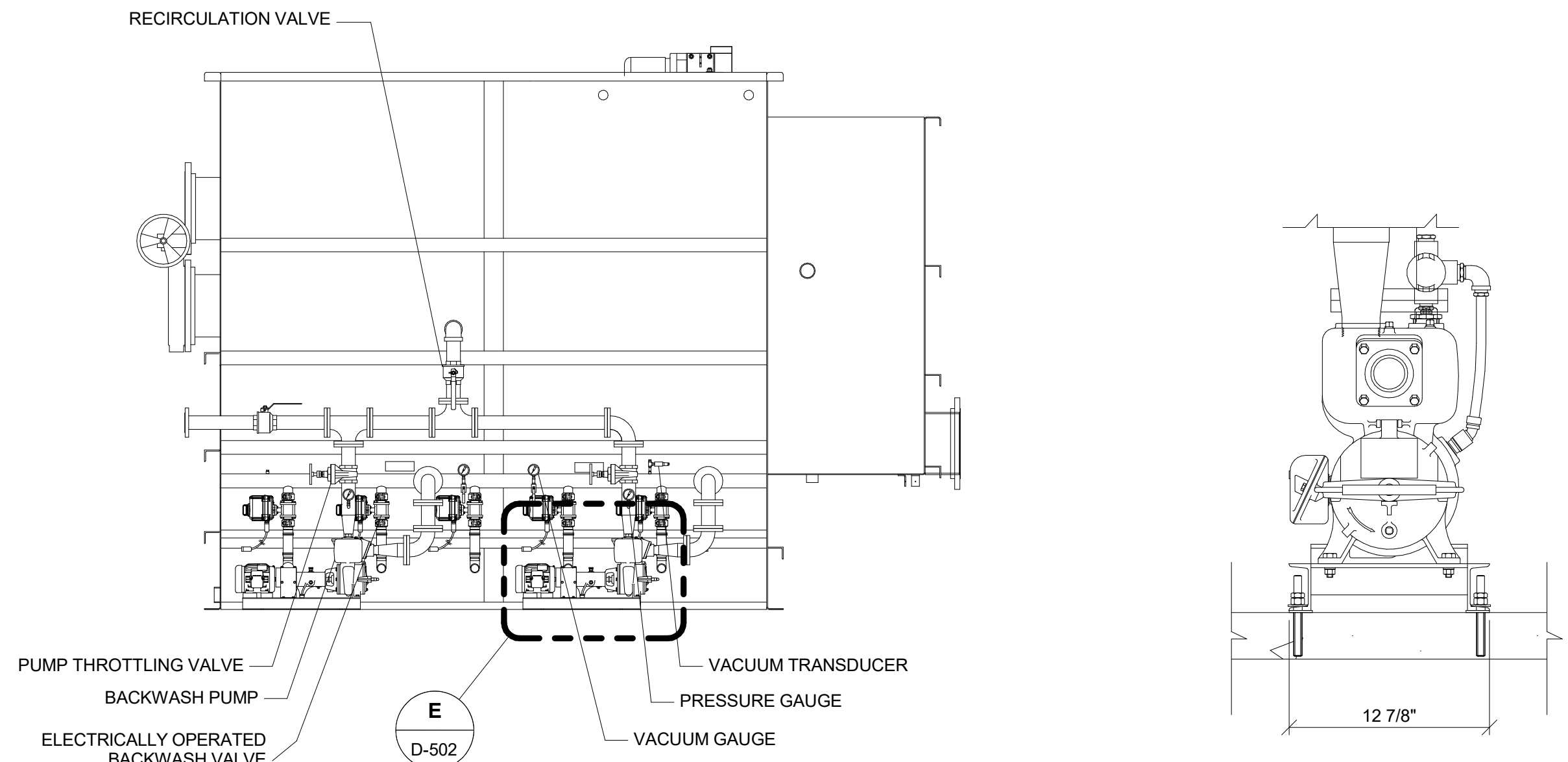
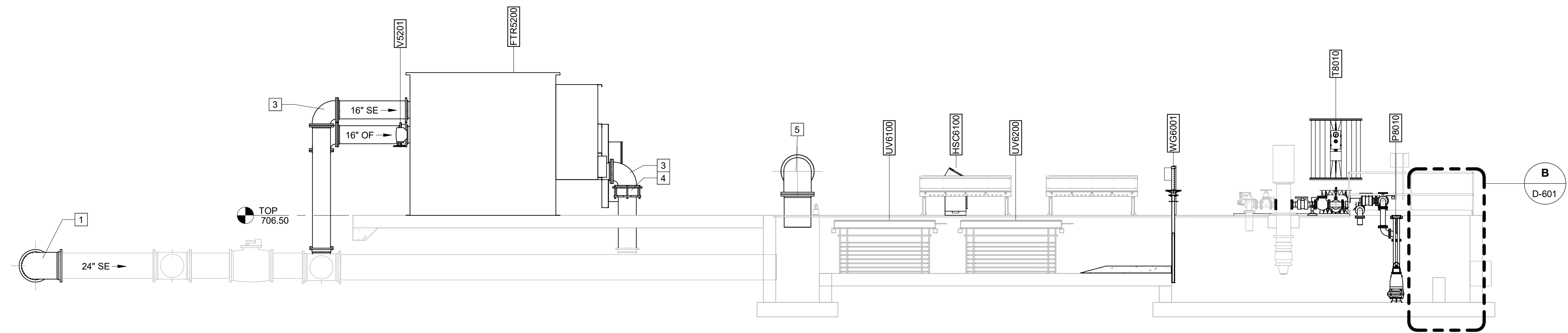


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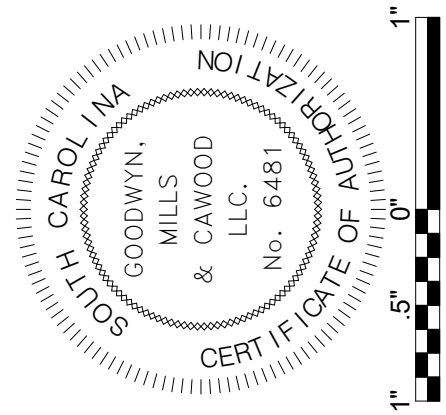


B **SECTION**
D-501 SCALE: 3/8" = 1'-0"



E ELEVATION
D-502 SCALE: NOT TO SCALE

1. 24" MJ 90° BEND
2. 16" MJ 90° BEND
3. 16" FL 90° BEND
4. 16" FL COUPLING ADAPT
5. 24" FL 90° BEND
6. 24" X 16" FL TEE
7. 24" FL TEE
8. BLIND FLANGE



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Project Manager:	WN
Engineer:	TR
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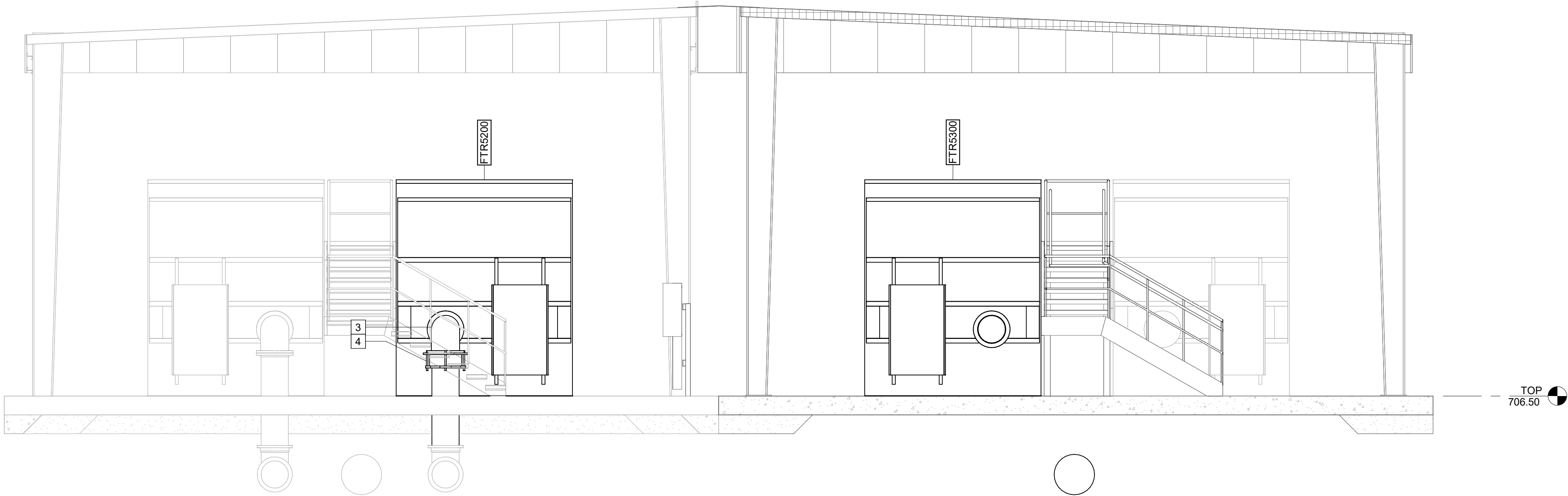
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D-502

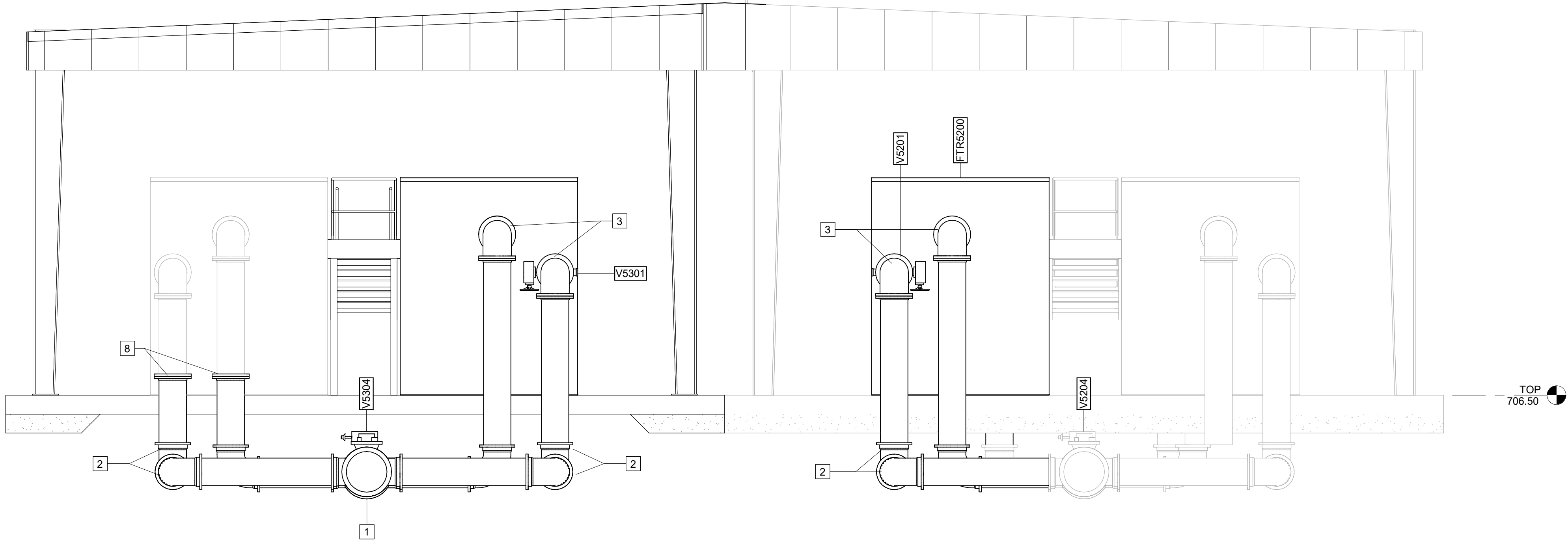


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3/11/2024 3:31:59 PM

G SECTION
D-501 SCALE: 1/4" = 1'-0"



F SECTION
D-501 SCALE: 1/4" = 1'-0"



KEY NOTES: #

1. 24" X 16" MJ CROSS
2. 16" MJ 90° BEND
3. 16" FL 90° BEND
4. 16" FL COUPLING ADAPT
5. 24" FL 90° BEND
6. 24" X 16" FL TEE
7. 24" FL TEE
8. BLIND FLANGE

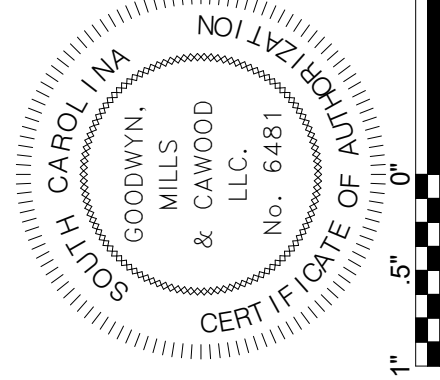
FILTERS - SECTIONS

D-503

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REGIONAL WWTP EXPANSION**
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Town of Pendleton
City of Clemson
Anderson County

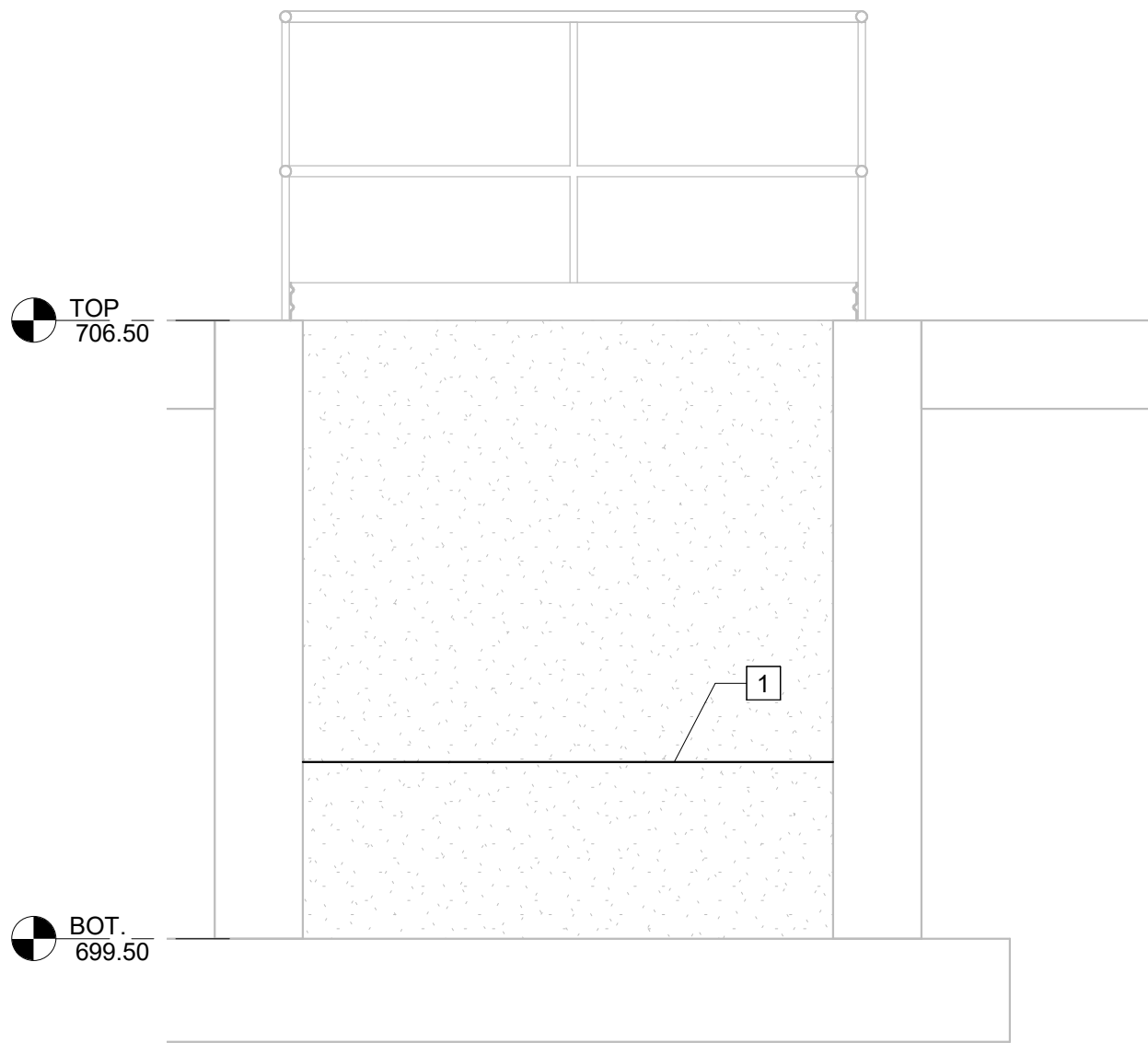
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Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

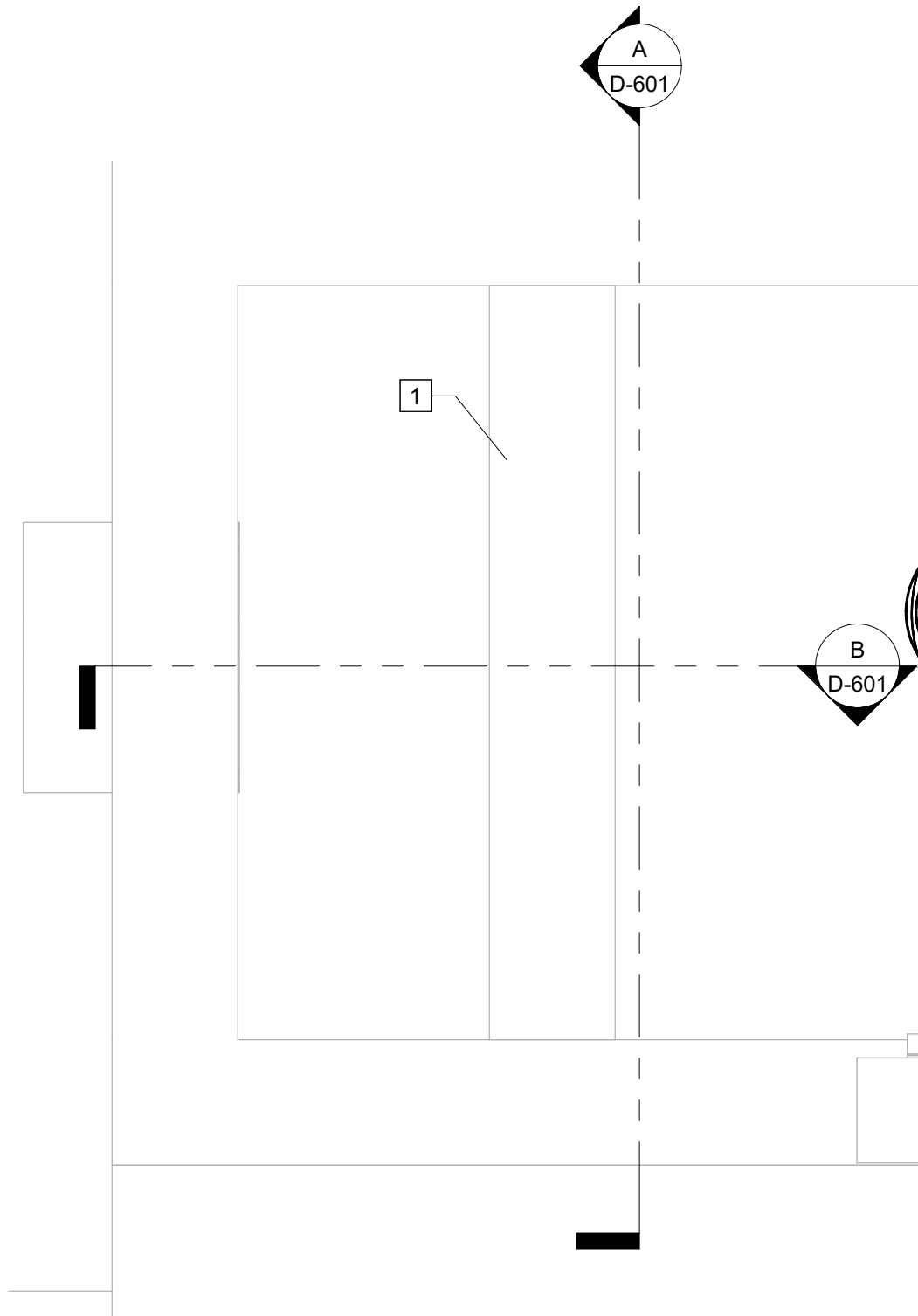


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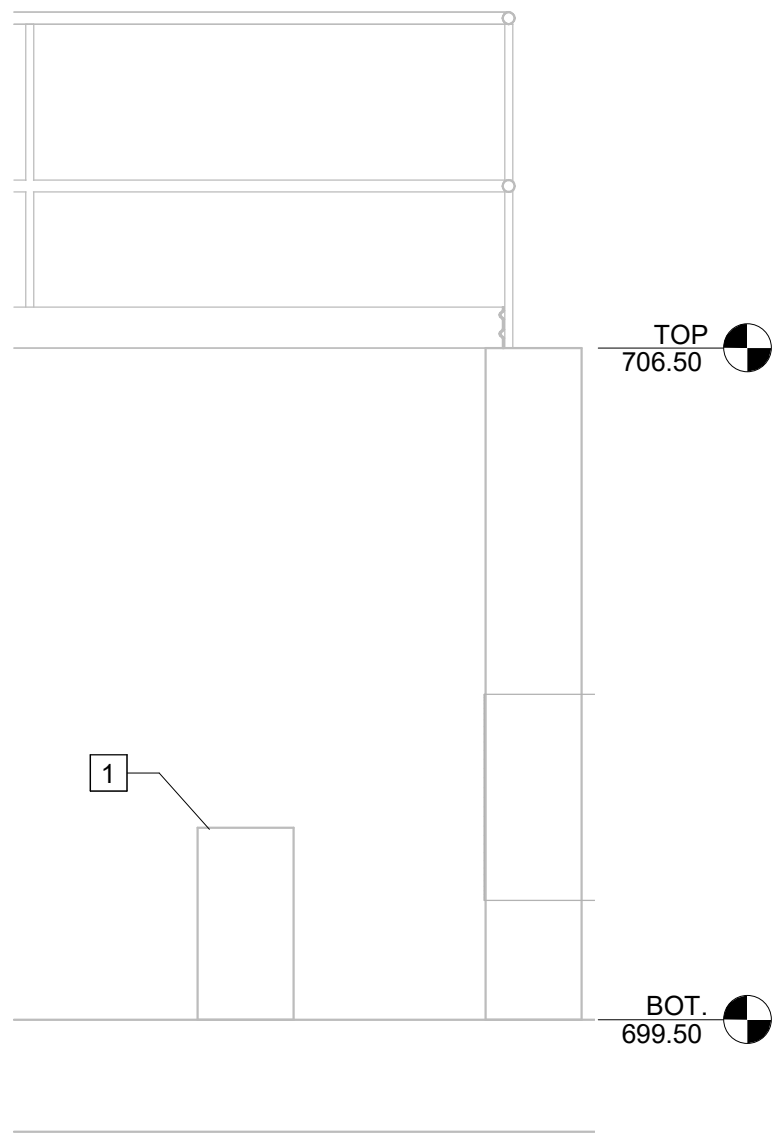
BM 360\\CGRE220027 - Pendleton-Clemson WWTP Expansion\\FTR.rvt
3/11/2024 3:31:59 PM



A SECTION
D-501 SCALE: 1/2" = 1'-0"



6A PLAN
SCALE: 3/4" = 1'-0"



B SECTION
D-501 SCALE: 1/2" = 1'-0"

KEY NOTES: #

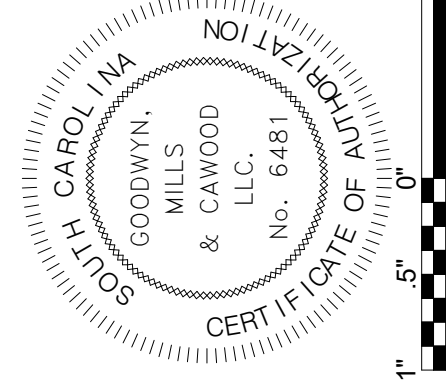
1. 2' CONCRETE

**WEIR GATE PLAN &
SECTIONS**

D-601

**PENDLETON - CLEMSON
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PENDLETON, SOUTH CAROLINA
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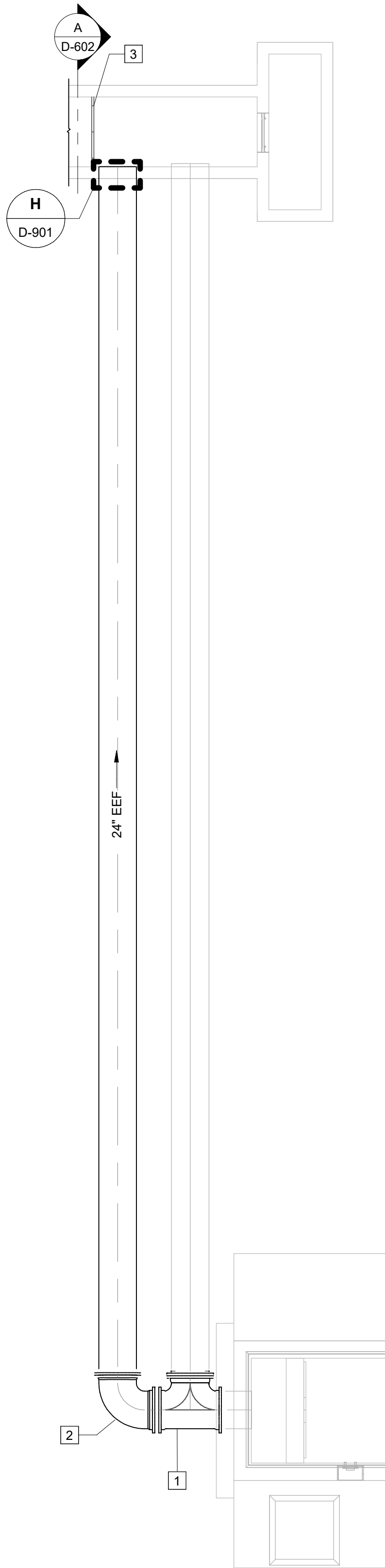
GMC PROJECT #CGRE220027



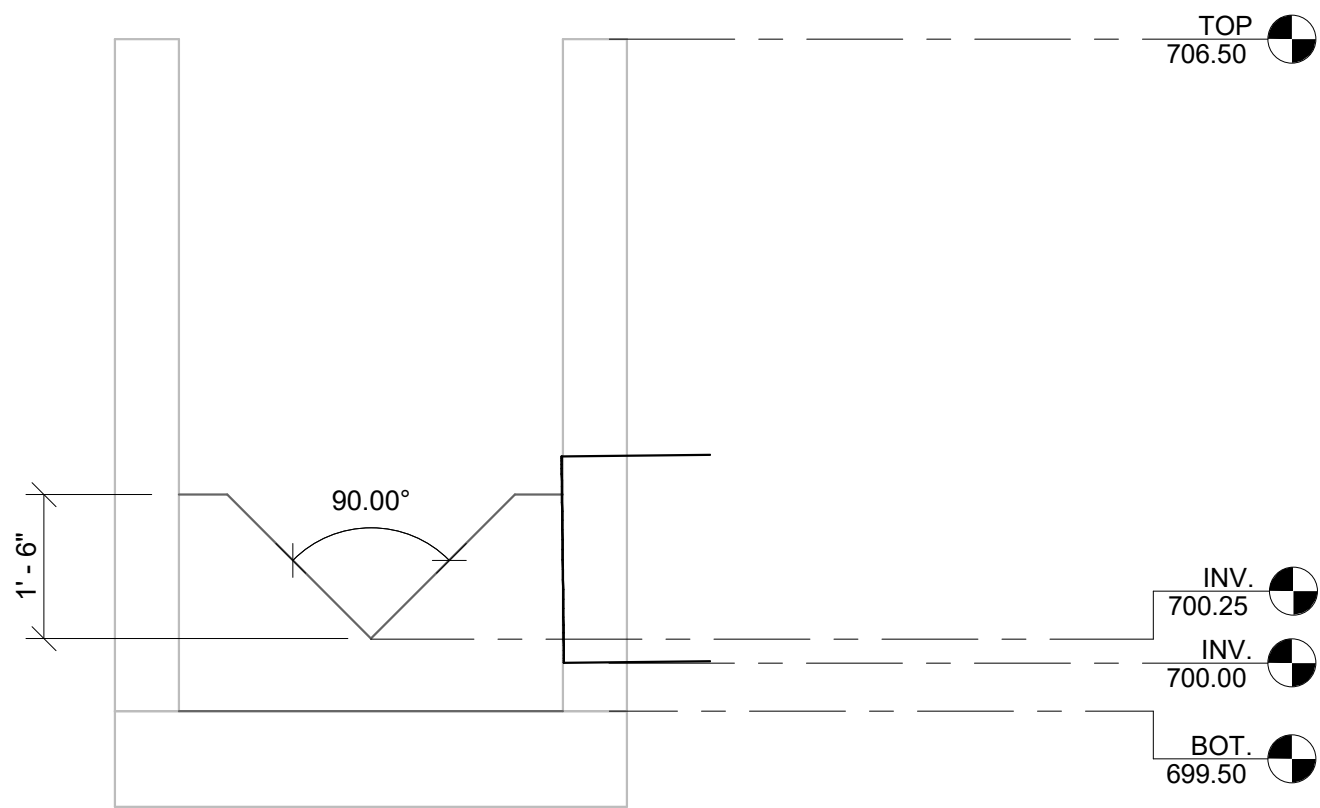
ISSUE	DATE
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6B PLAN
D-602 SCALE: 3/16" = 1'-0"



A SECTION
D-602 SCALE: 1/2" = 1'-0"

KEY NOTES:

- 24" MJ TEE
- 24" MJ 90° BEND
- 90° V-NOTCH WEIR

NOTES:

- MODIFY EXISTING BAFFLE INTO 90° V-NOTCH WEIR

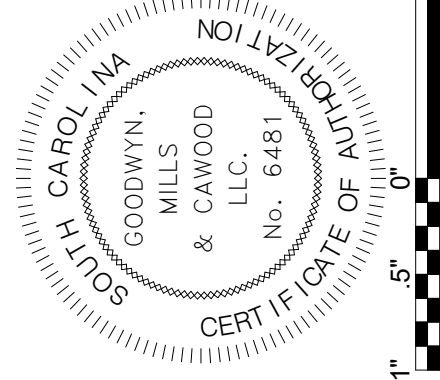
AERATION BASIN
CASCADE PLAN

D-602

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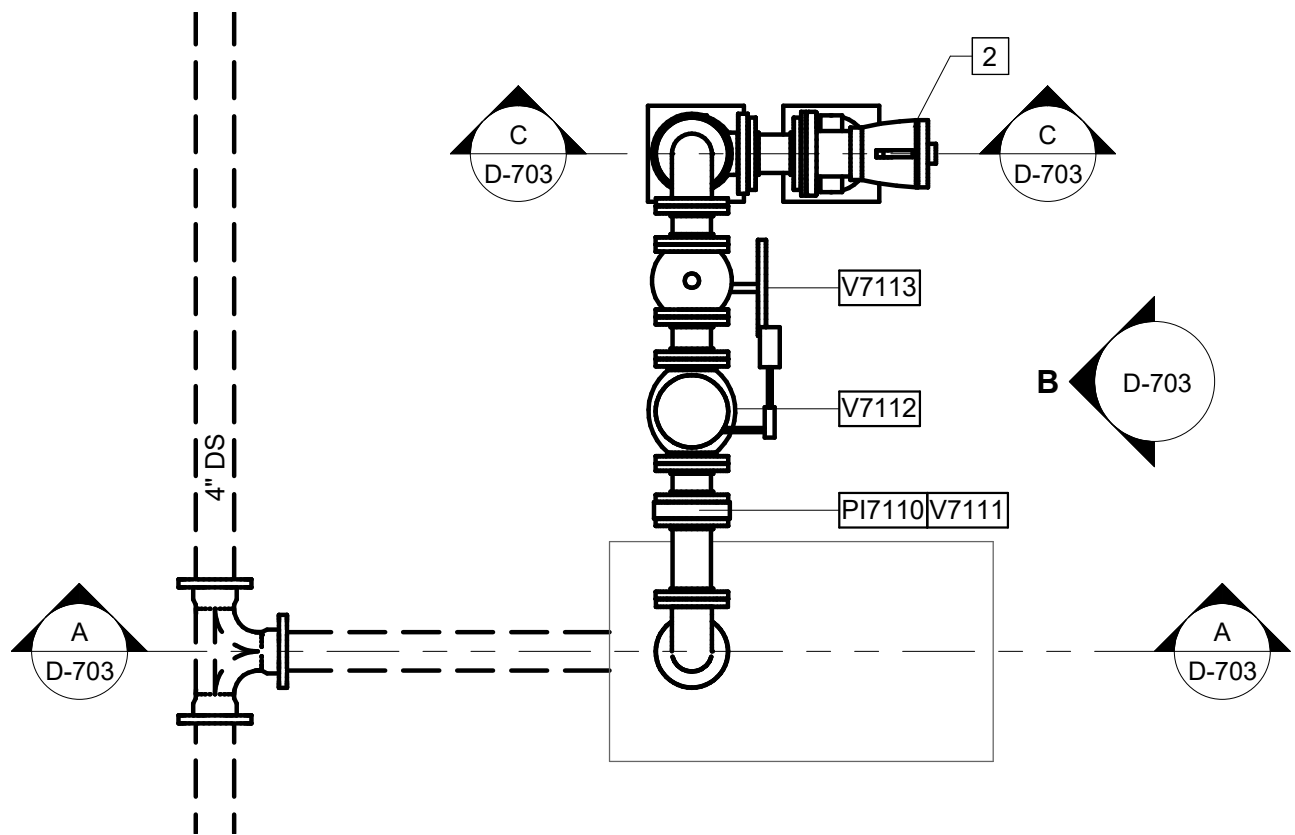
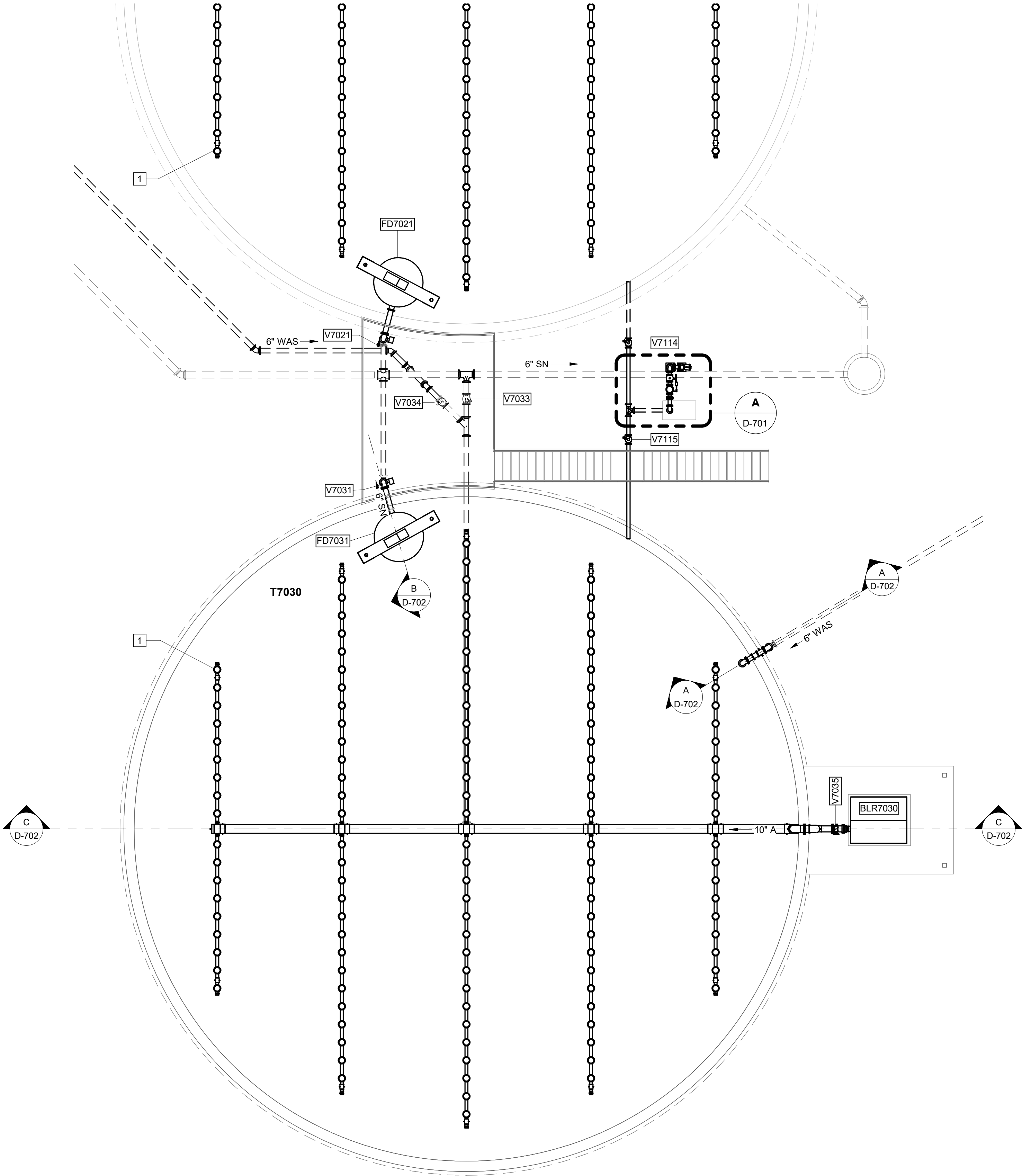


7A

PLAN

D-701

SCALE: 1/8" = 1'-0"



A

ENLARGED PLAN

D-701

SCALE: 1/2" = 1'-0"

KEY NOTES: #

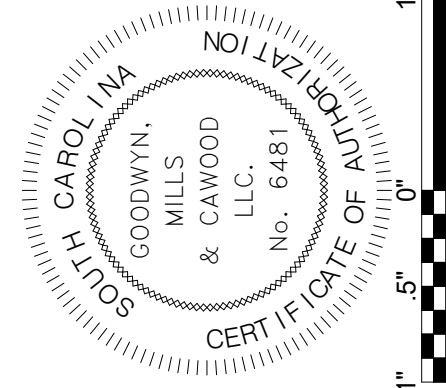
1. FIXED COARSE BUBBLE DIFFUSER
2. QUICK DISCONNECT W/ DUST COVER

AEROBIC DIGESTER -
PLAN

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REGIONAL WWTTP EXPANSION
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D-701

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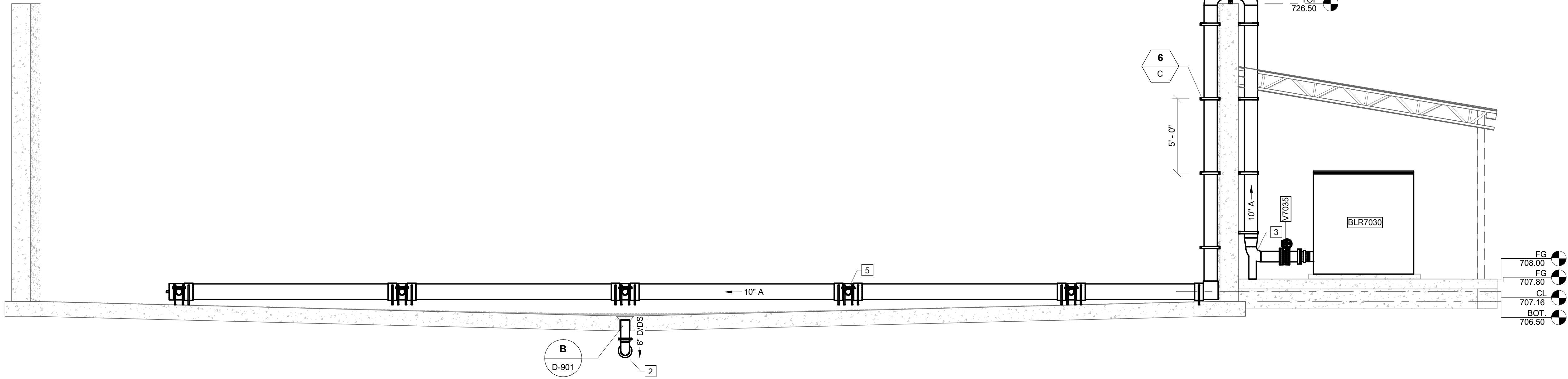


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Project Manager:	WN
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Designer:	JX
Drawn By:	HKD

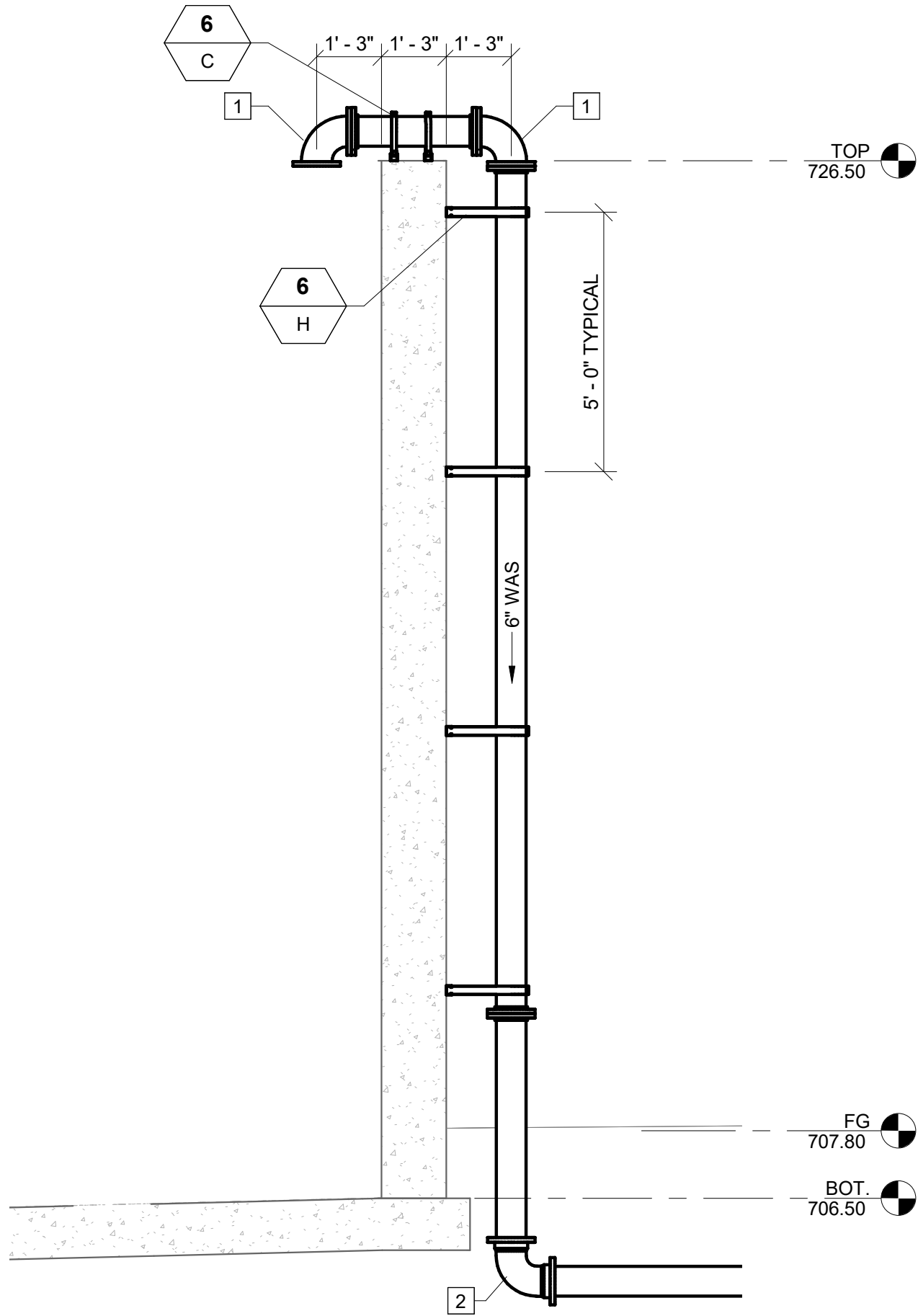
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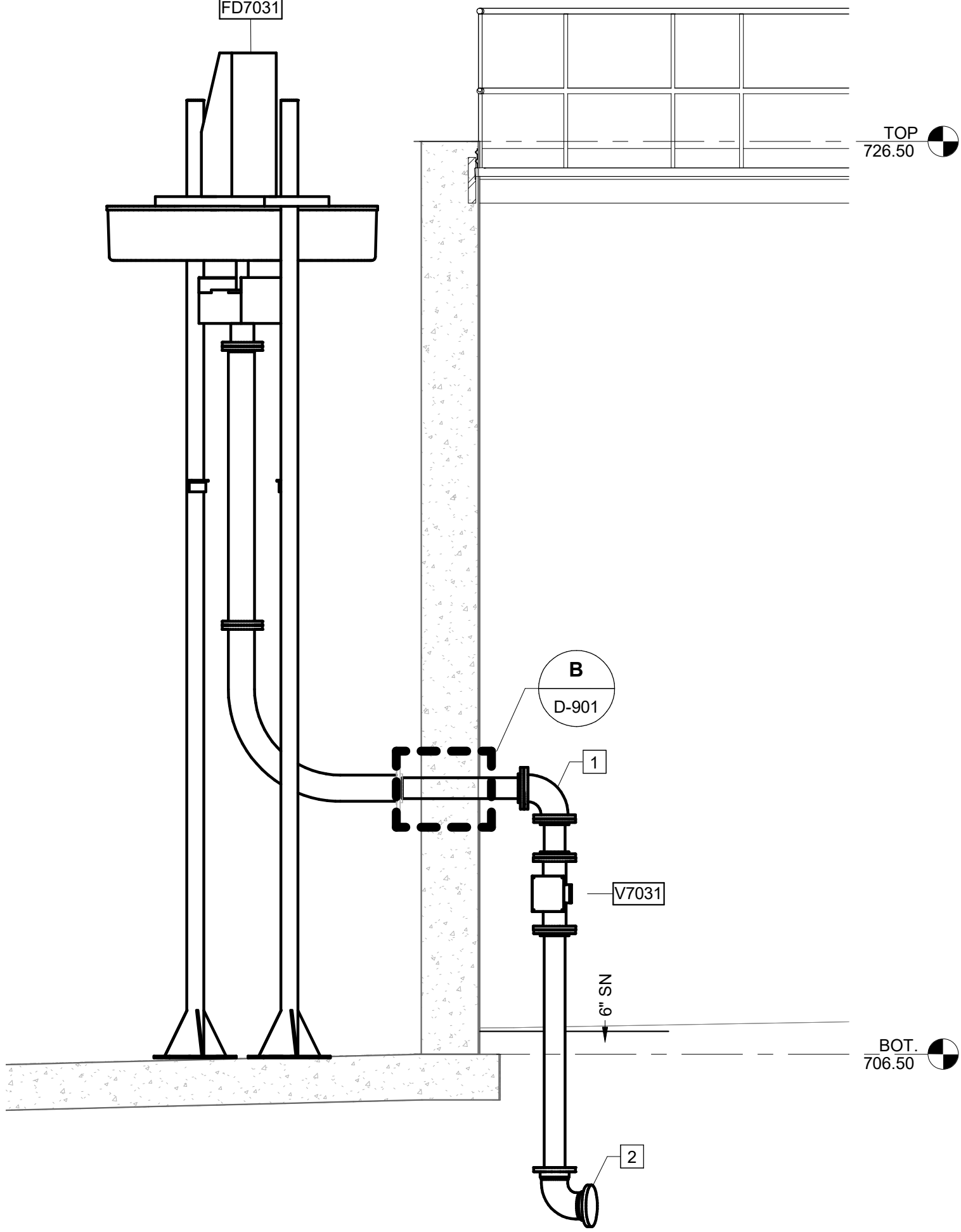
C SECTION
D-701 SCALE: 1/4" = 1'-0"



A SECTION
D-701 SCALE: 3/8" = 1'-0"



B SECTION
D-701 SCALE: 3/8" = 1'-0"



KEY NOTES: #

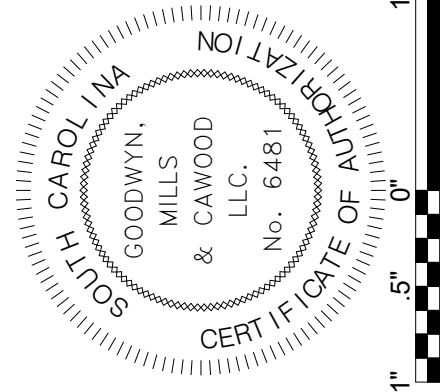
1. 6" 90° FL BEND
2. 6" 90° MJ BEND
3. 8" 90° WELD BEND
4. 10" 90° WELD BEND
5. DIFFUSER SYSTEM

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AEROBIC DIGESTER -
SECTIONS

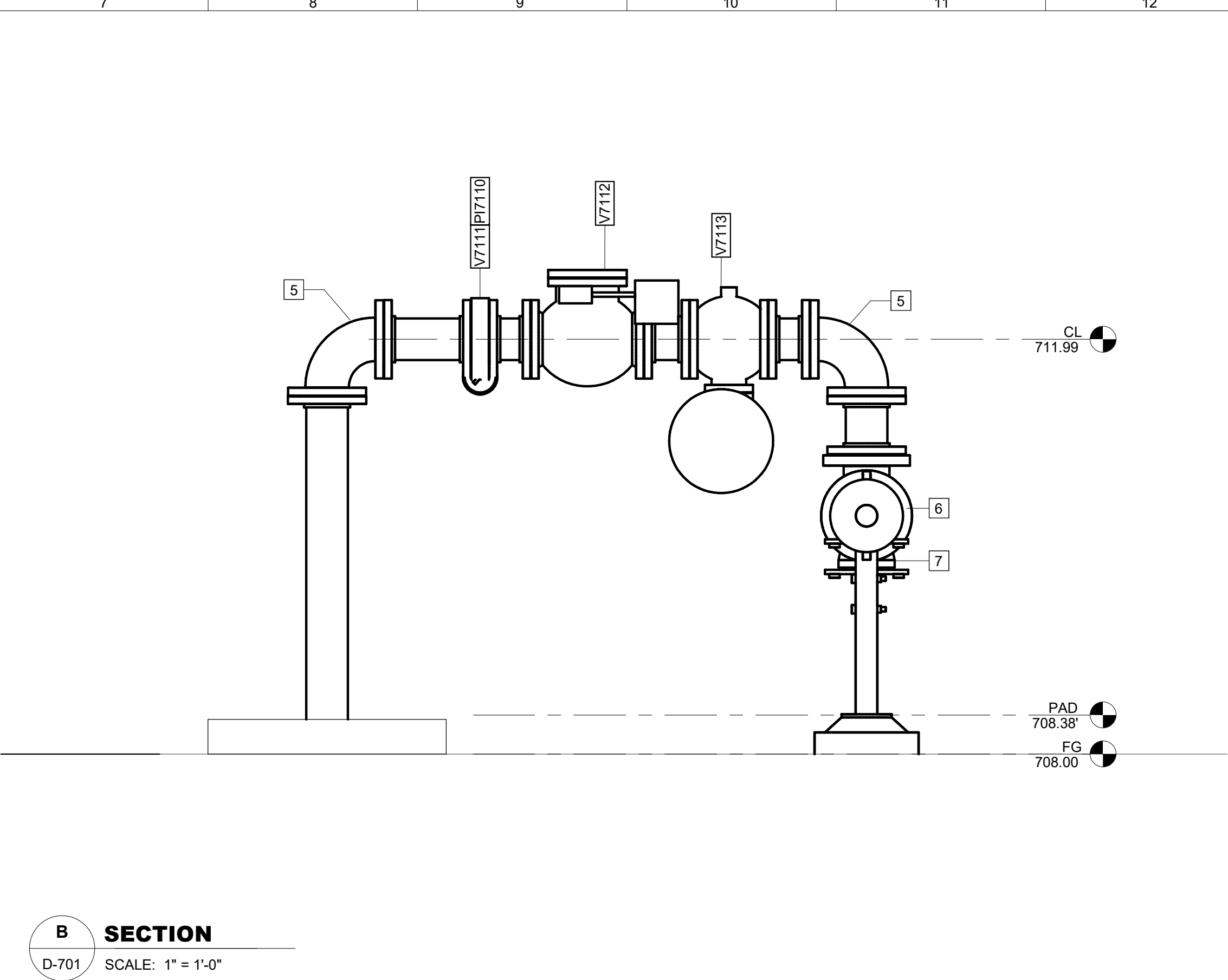
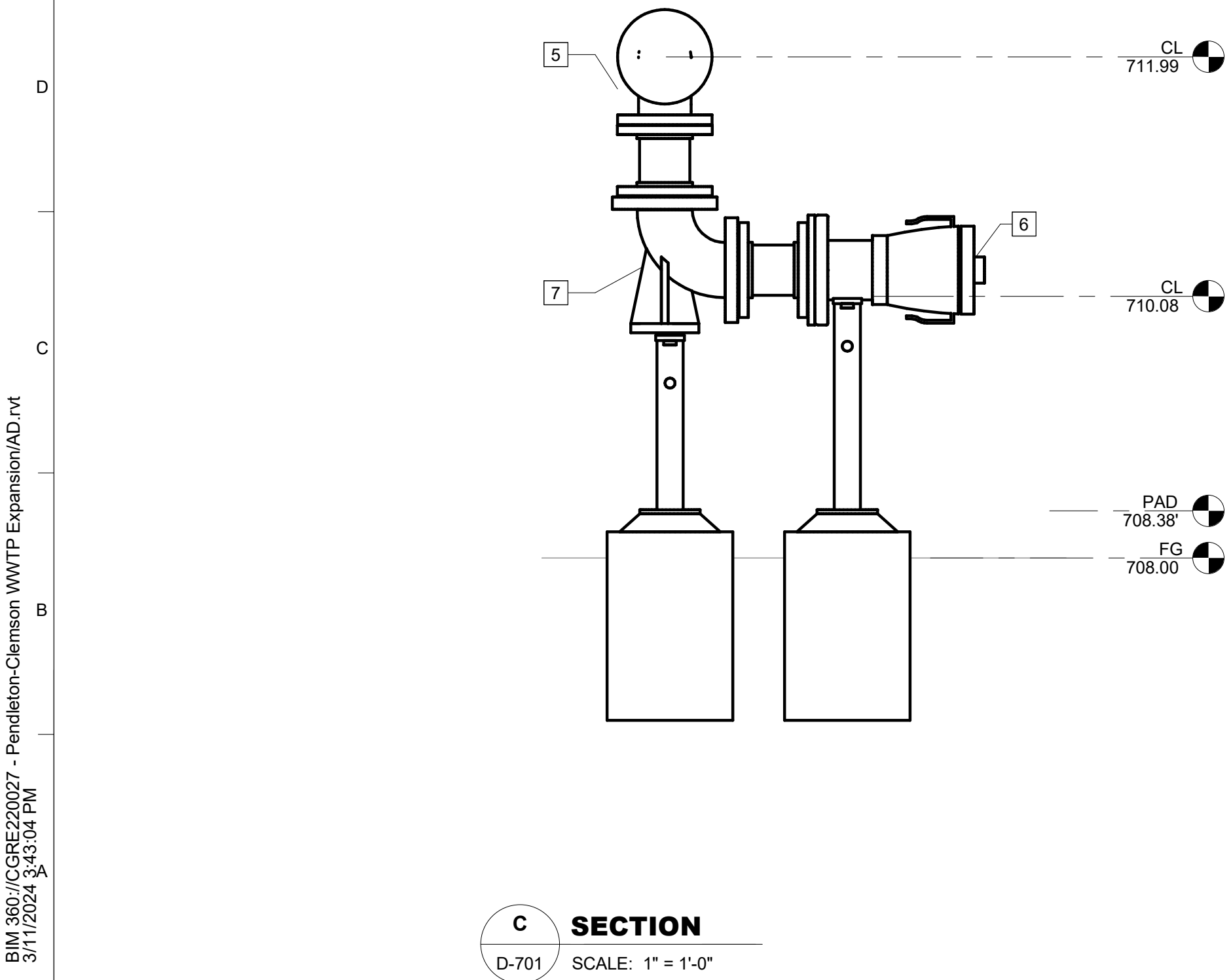
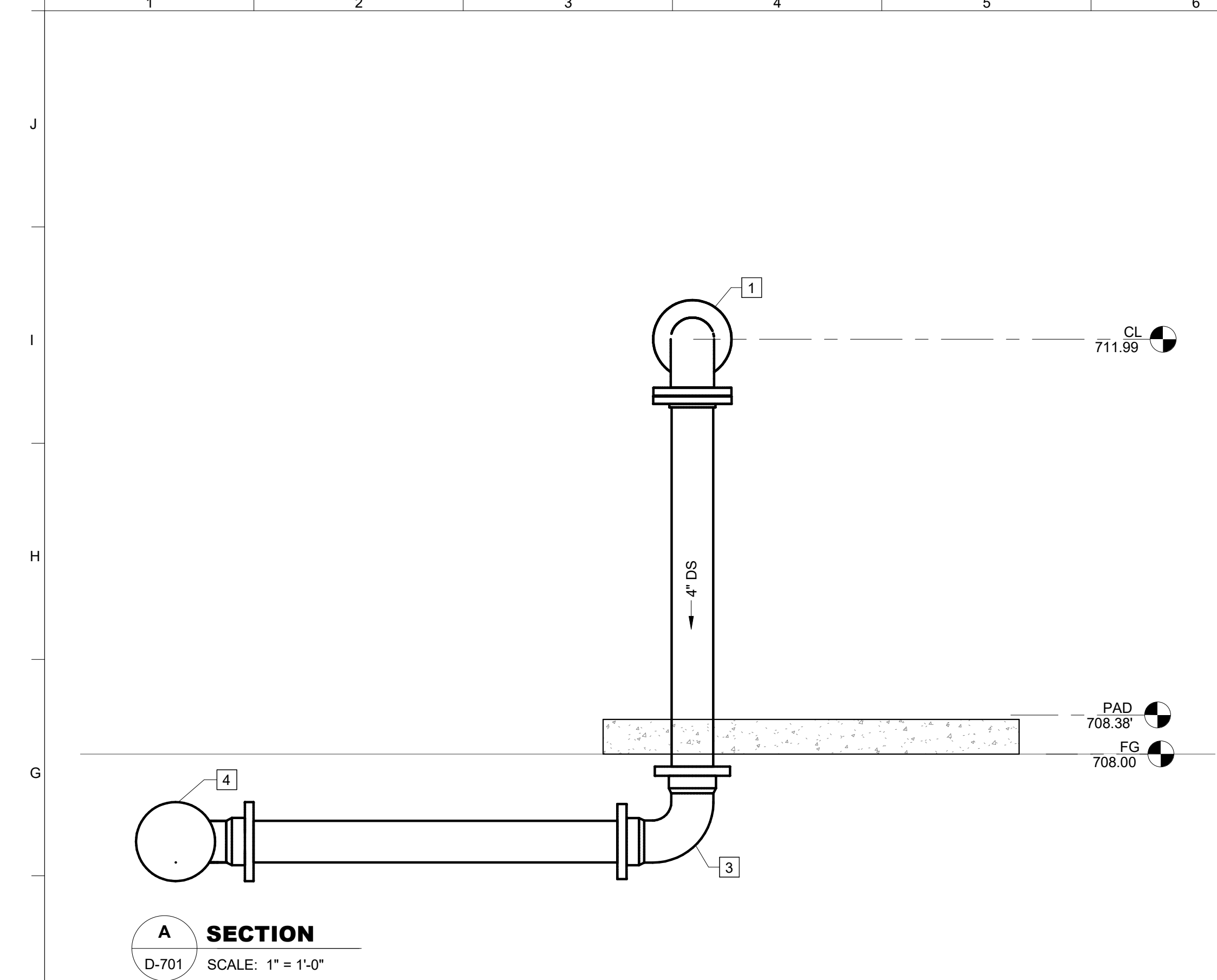
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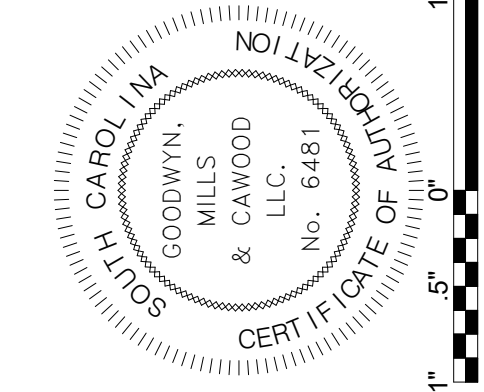
ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

GMC
117 Welborn St.
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BM 360\\CGRE220027 - Pendleton-Clemson WWTP Expansion\\AD.rvt
3/11/2024 3:43:04 PM



- KEY NOTES:** #
- 4" X 6" 90° REDUCER
 - 6" X 4" 90° REDUCER
 - 4" 90° MJ BEND
 - 4" MJ TEE
 - 4" 90° FL BEND
 - QUICK DISCONNECT W/ DUST COVER
 - 4" REDUCING SQUARE FL



ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
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PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

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**AEROBIC DIGESTER -
SECTIONS**

D-703



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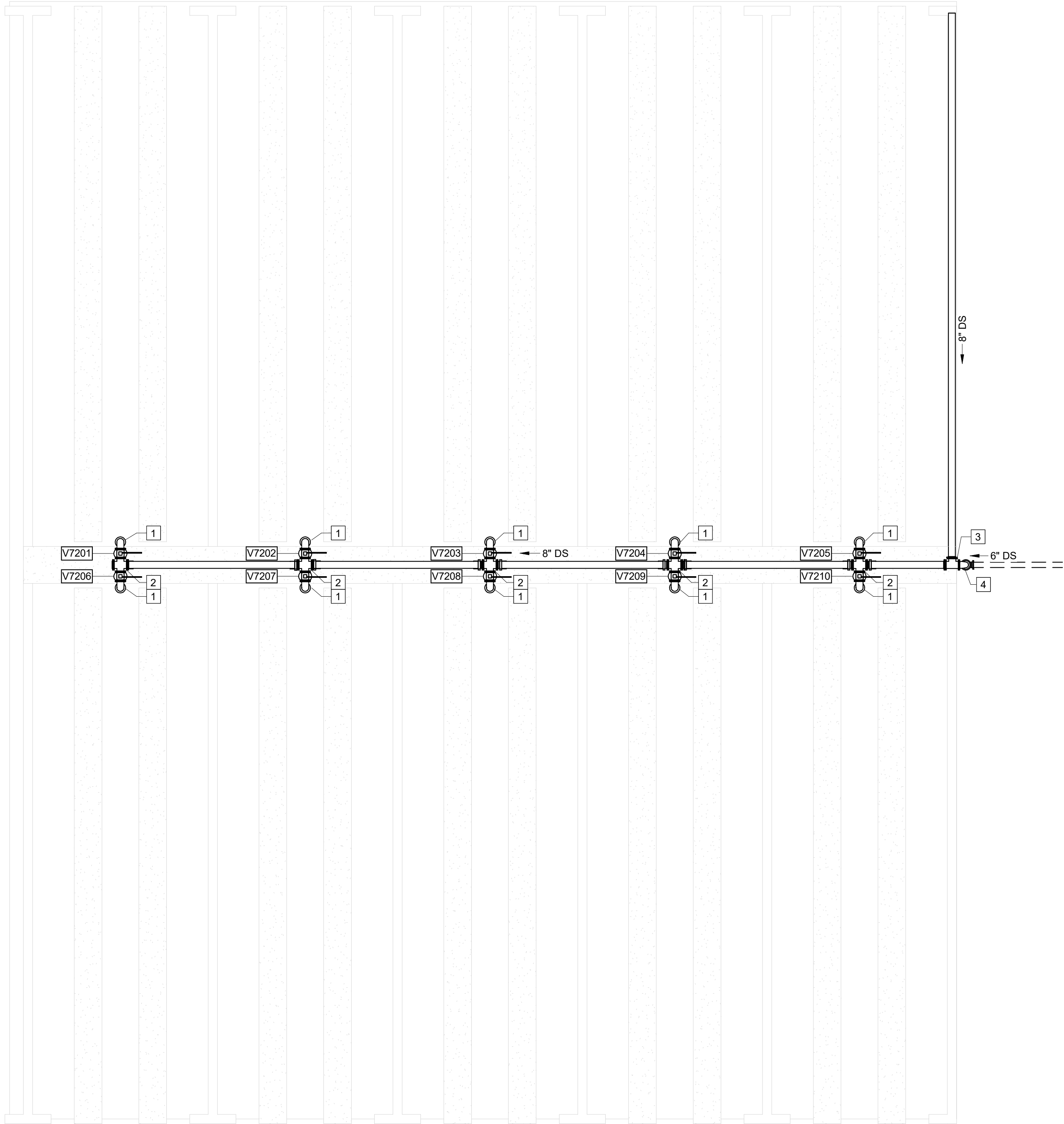


7B

PLAN

D-001

SCALE: 1/8" = 1'-0"



KEY NOTES: #

1. 8" 90° FL BEND
2. 8" CROSS REDUCING FL
3. 8" TEE
4. 8" X 6" 90° FL BEND

SLUDGE DRYING BED -
PLAN

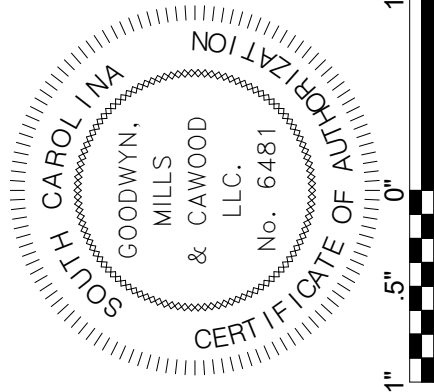
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PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION

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ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% submittal	03.08.2024
Conformed Set	
Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

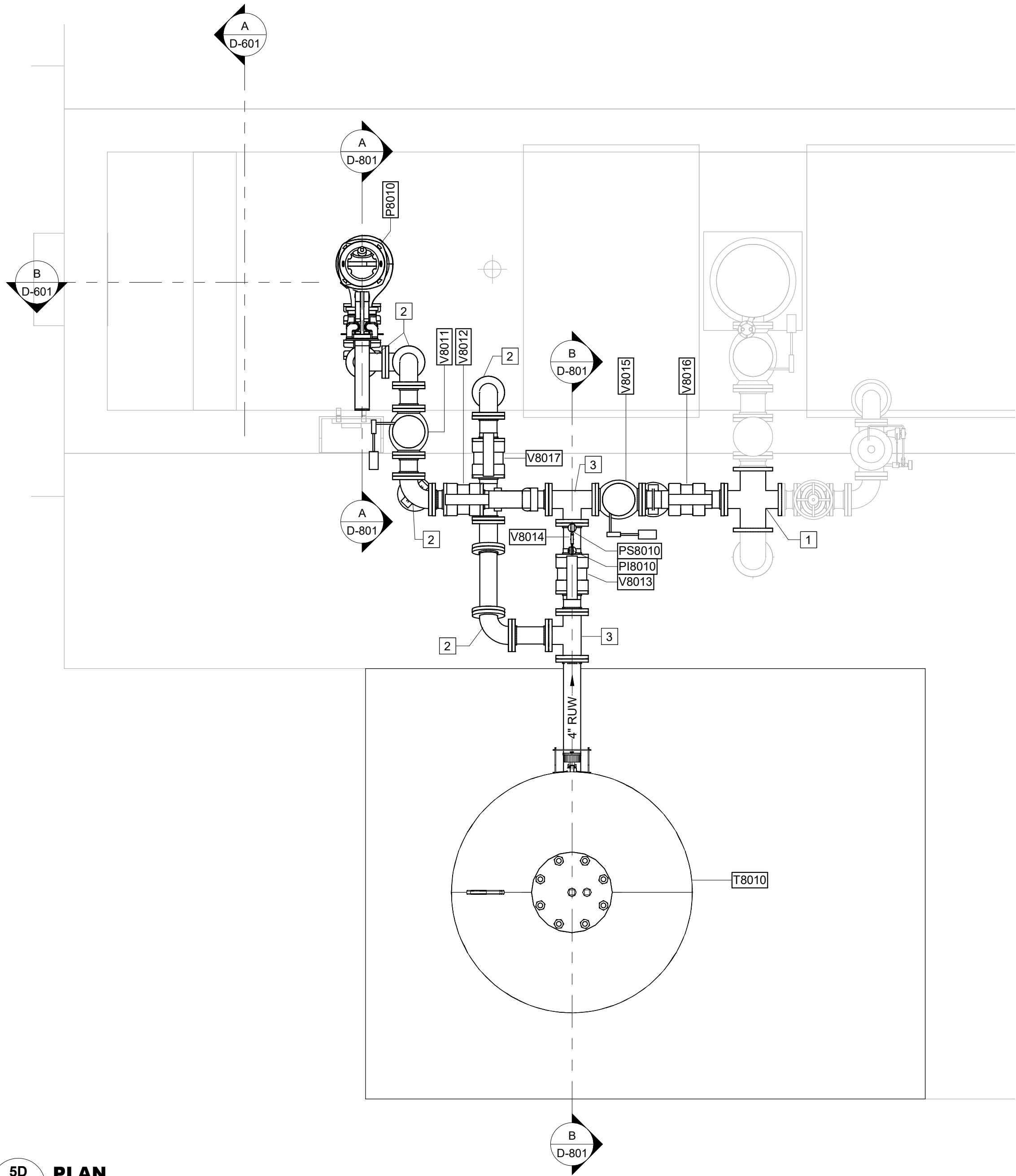


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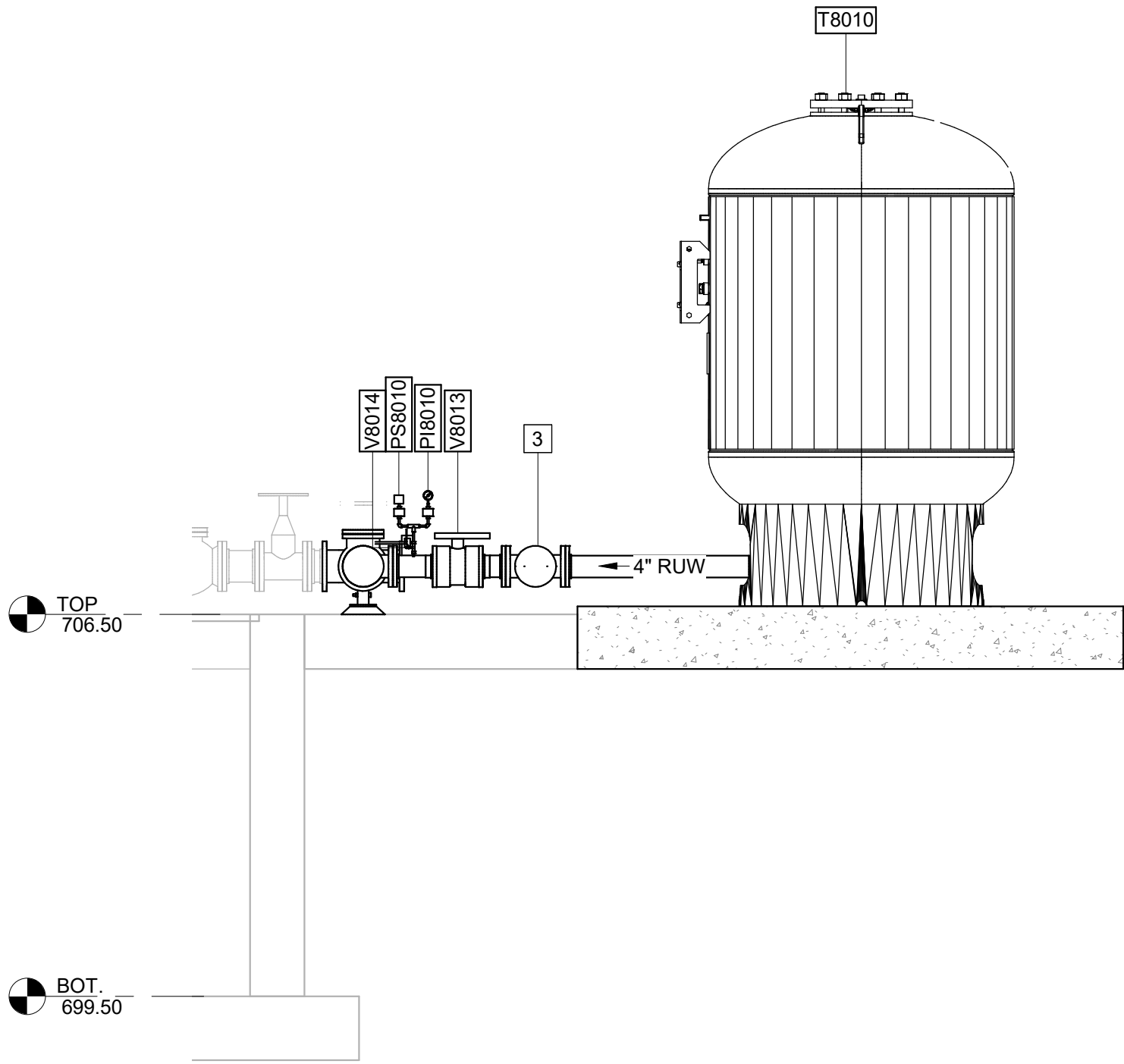
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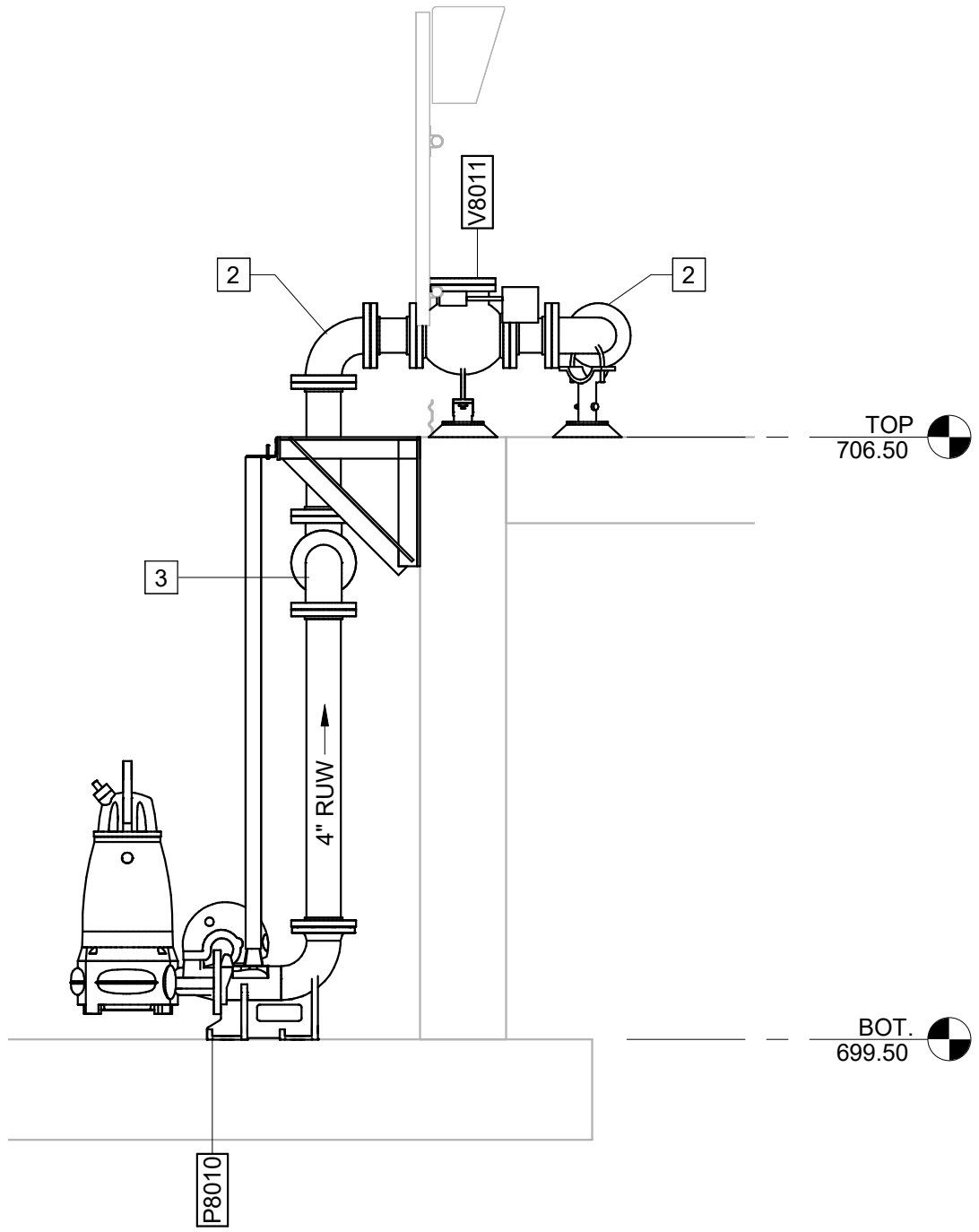
5D **PLAN**
D-501 SCALE: 1/2" = 1'-0"



B SECTION
D-801 SCALE: 3/8" = 1'-0"



A SECTION
D-801 SCALE: 1/2" = 1'-0"



KEY NOTES: #

1. REMOVE EXISTING 6"x4" FL TEE & REPLACE W/ 6"x4" FL CROSS
2. 4" 90° FL BEND
3. 4" TEE FL.

**REUSE WATER SYSTEM
PLAN & SECTIONS**

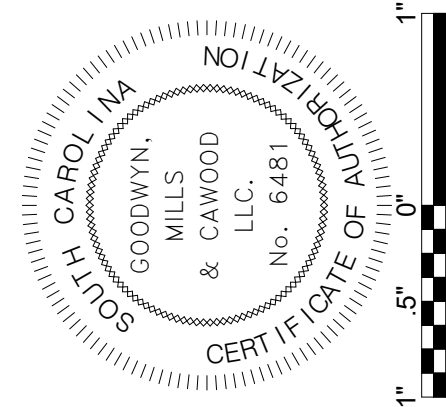
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**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**

PENDLETON, SOUTH CAROLINA
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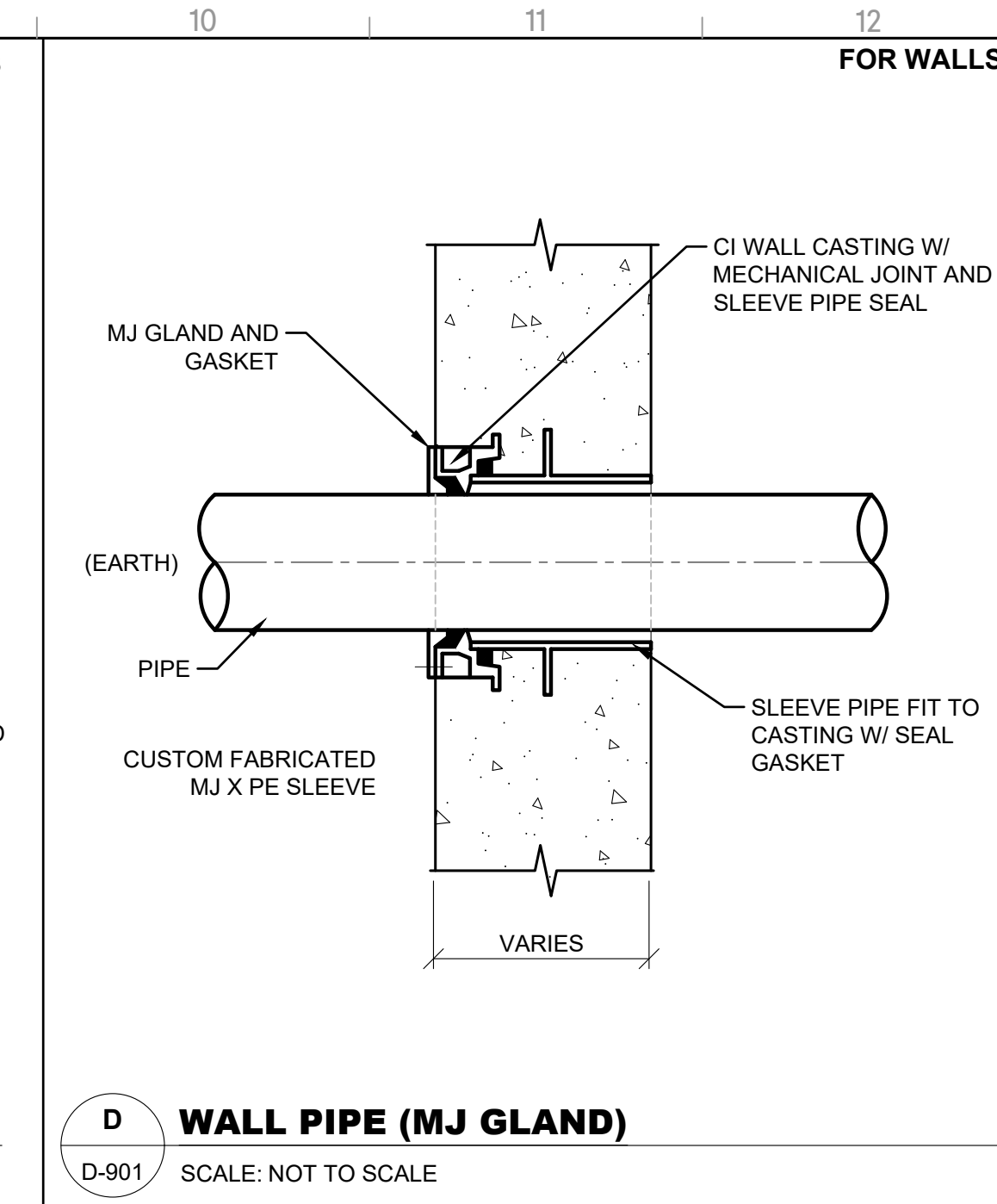
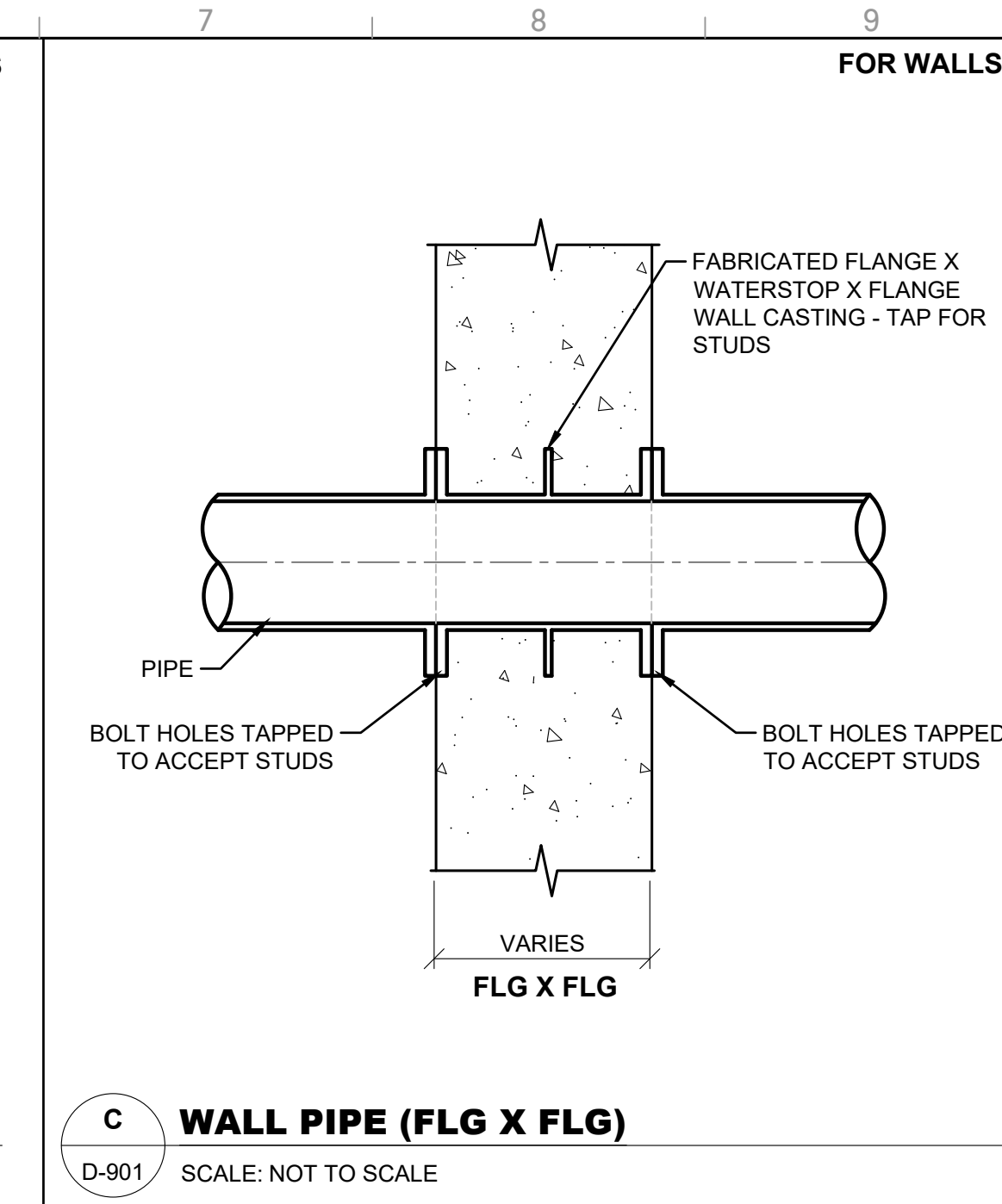
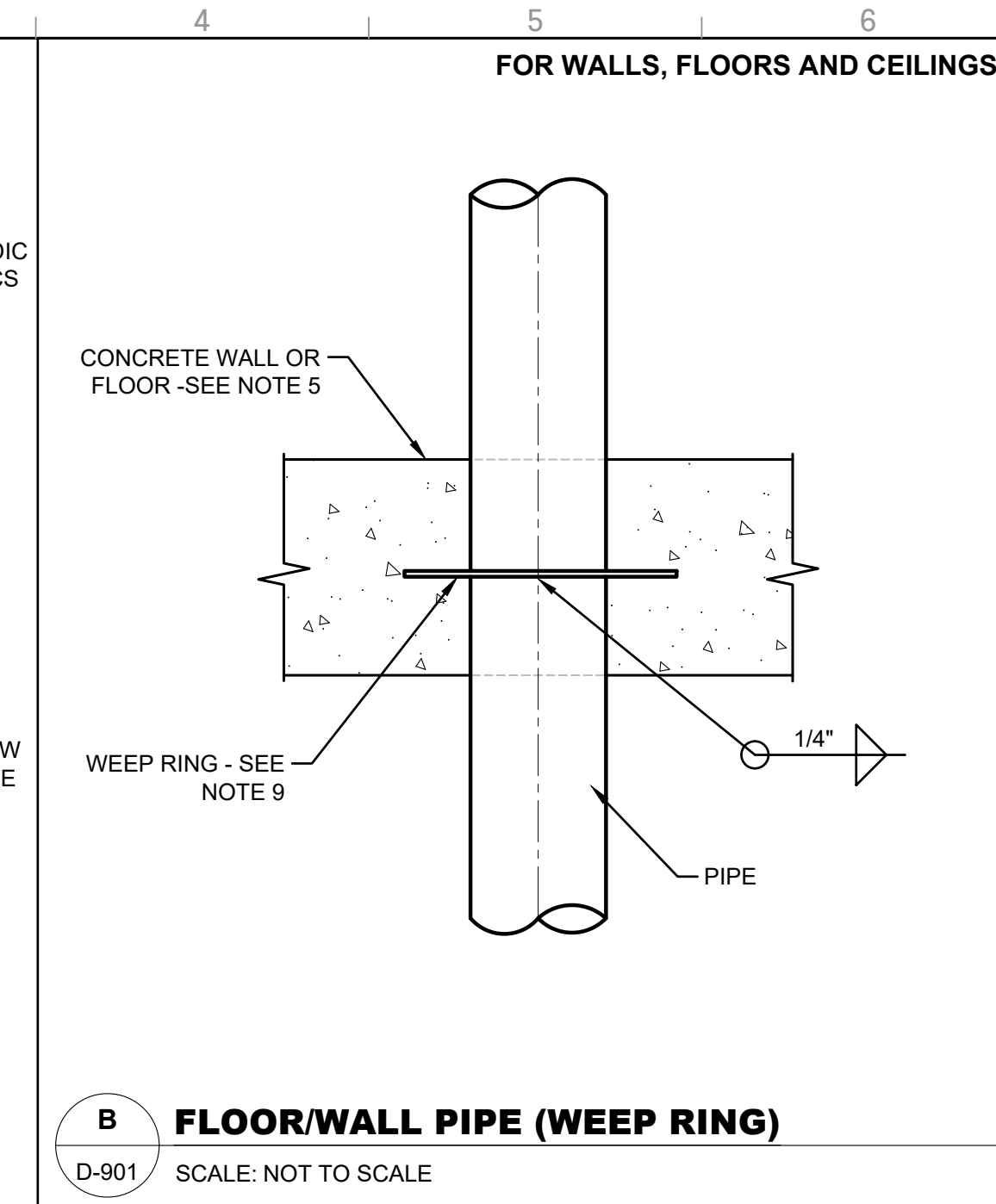
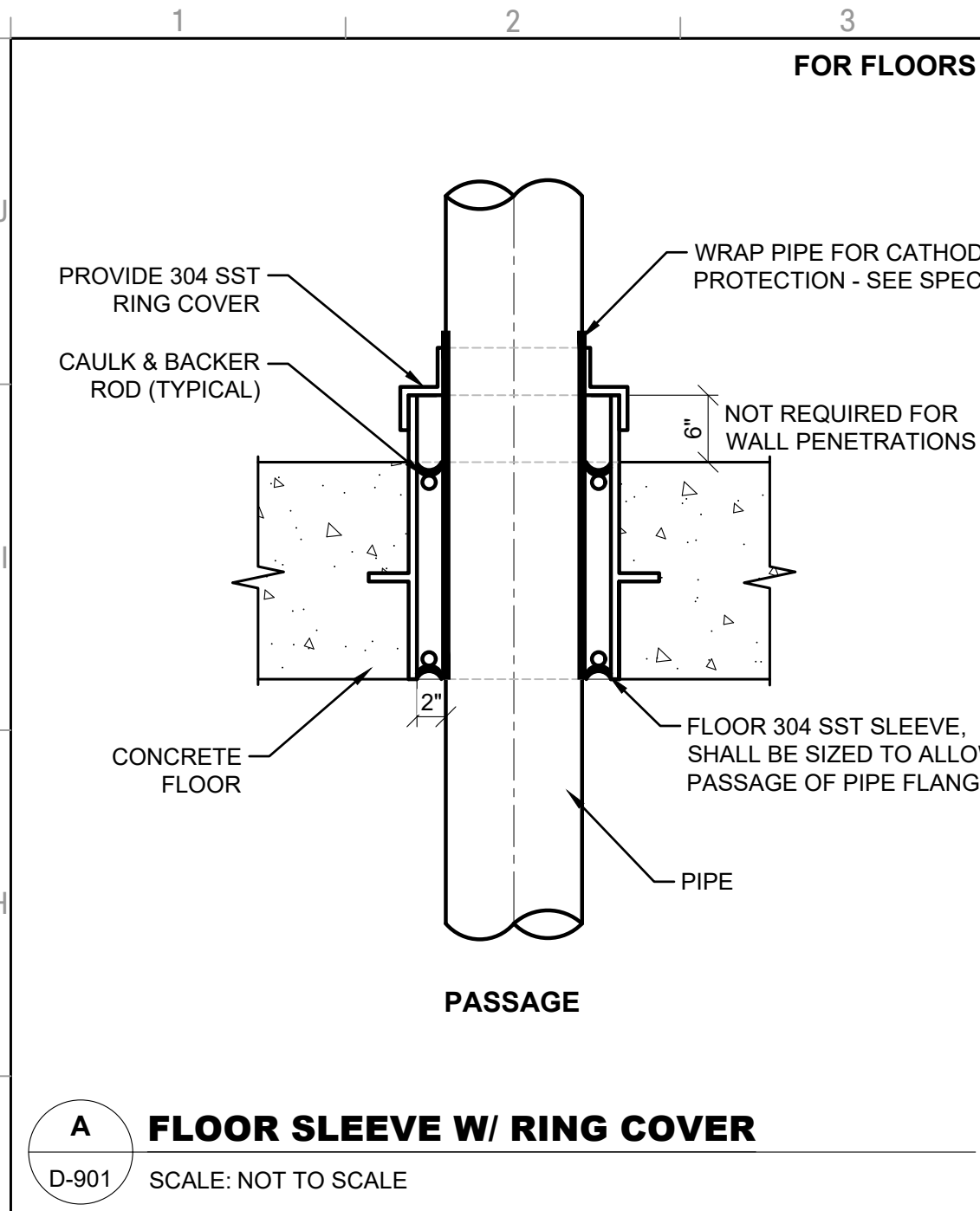
GMC PROJECT #CGRE220027

ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.06.2024
Conformed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH



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DRAWING FILE: T:\Projects\SC\Penleton - Town of CGRE220027 - Penleton-Clemson WWTP\0 DWG\CAD\01 BID DRAWINGS\10 PROCESS\D-901 PIPE PENETRATIONS v2.dwg
PLOT DATE: Mar 11, 2024 3:53pm



- PIPE PENETRATION NOTES:**
- ALL SLEEVES SHALL BE 304 STAINLESS STEEL, SCH 20 UNLESS NOTED OTHERWISE.
 - SEAL FLANGES SHALL BE DRILLED TO 150 POUND STANDARD. EACH JOINT SHALL BE GASKETED.
 - WHERE NOTED, DUCTILE IRON FLANGES MAY BE INSTALLED FLUSH W/ WALL & TAPPED FOR STUDS.
 - PROVIDE CURB WHERE PENETRATING FLOOR EXCEPT FOR PENETRATION TYPE A. CURB SHALL BE 4" HIGH & 3" WIDE.
 - PROVIDE A MINIMUM OF 3" CLEARANCE BETWEEN REINFORCING STEEL & PIPE PENETRATIONS.
 - FLEXIBLE JOINTS SHALL BE PROVIDED FOR UNDERGROUND PIPING AS SPECIFIED.
 - RESTRAINED FLEXIBLE COUPLINGS FOR STEEL PIPE SHALL BE DESIGNED FOR 100 PSI LINE PRESSURE IN ACCORDANCE W/ AWWA MANUAL M11. FIGURES 19.15 & 19.16 & TABLE 19.17 SHALL BE UTILIZED.
 - INSULATION SHALL NOT EXTEND THROUGH SLEEVES UNLESS OTHERWISE NOTED.
 - WEEP RINGS SHALL HAVE A MINIMUM DIAMETER EQUAL TO THE PIPE DIAMETER PLUS 3 INCHES.
 - SLEEVED DIAMETER SHALL BE AS RECOMMENDED BY THE MECHANICAL SEAL MANUFACTURER.
 - ALL WALL PIPE SHALL BE CAST UNLESS OTHERWISE NOTED.
 - PROVIDE PIPE JOINT WITHIN TWO (2) FEET OF EXTERIOR WALL FACE OF WALL AT CONNECTION TO ALL NEW & EXISTING STRUCTURES OR MANHOLES.
 - DETAIL NUMBERS G, H, I, & J REPRESENT MODIFICATIONS TO EXISTING STRUCTURES & NEW CONSTRUCTION.

GMC

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SEAL OF THE STATE OF SOUTH CAROLINA
GOODYWN MILLS CAWOOD, LLC
No. 6481
CERTIFICATE OF AUTHORITY

1" = 0' 5" 1"

ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	06.07.2023
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100% Submittal	03.08.2024

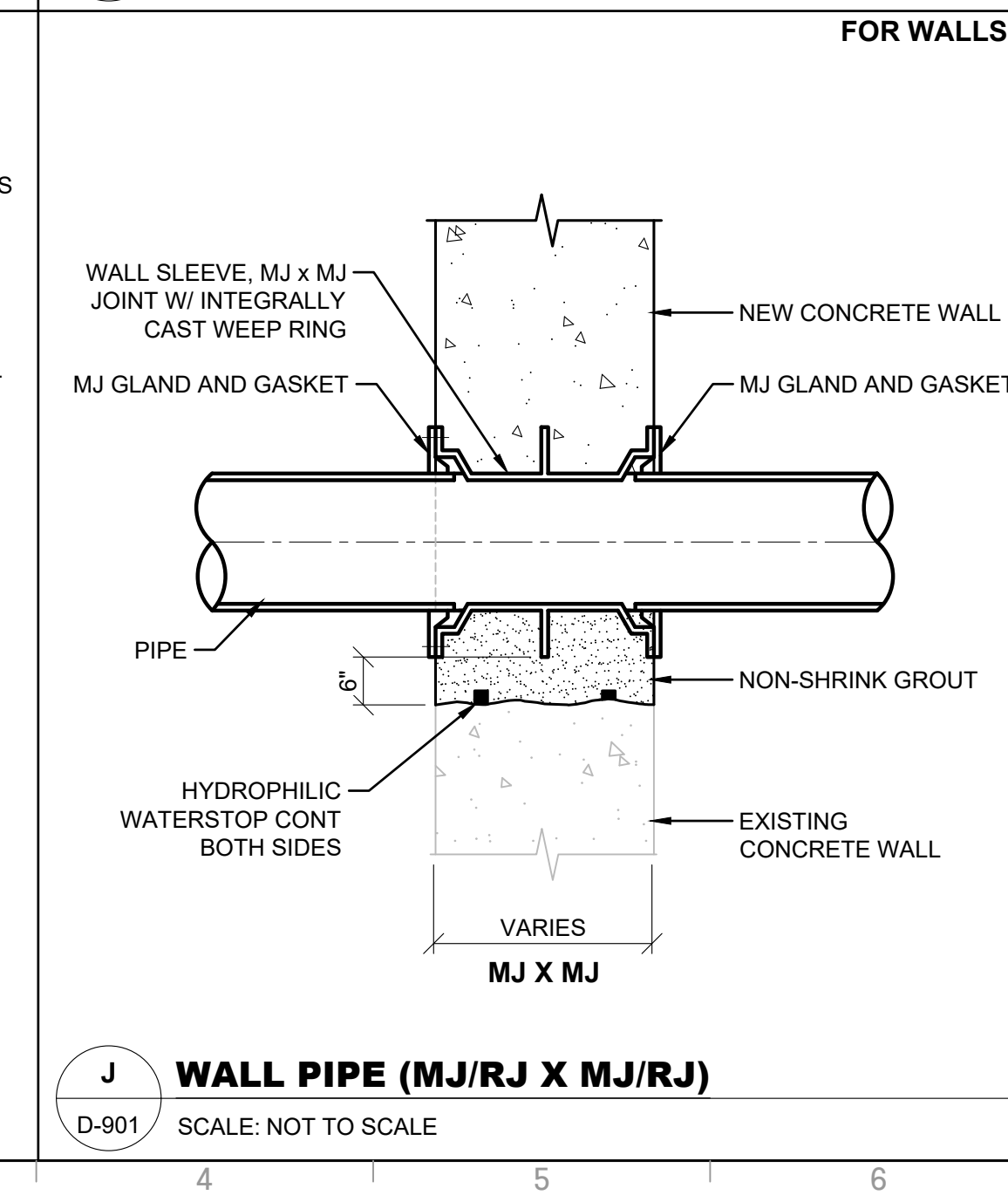
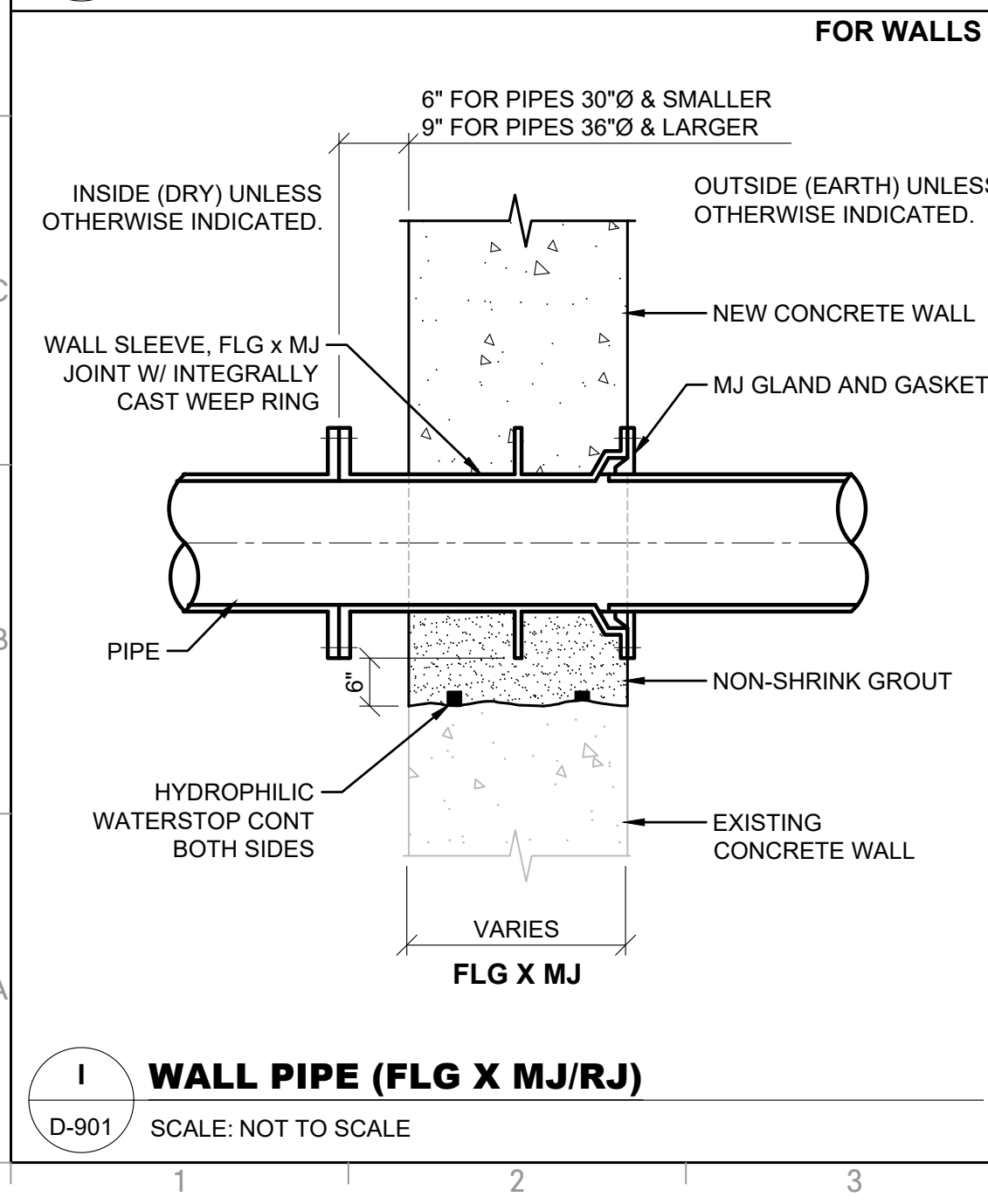
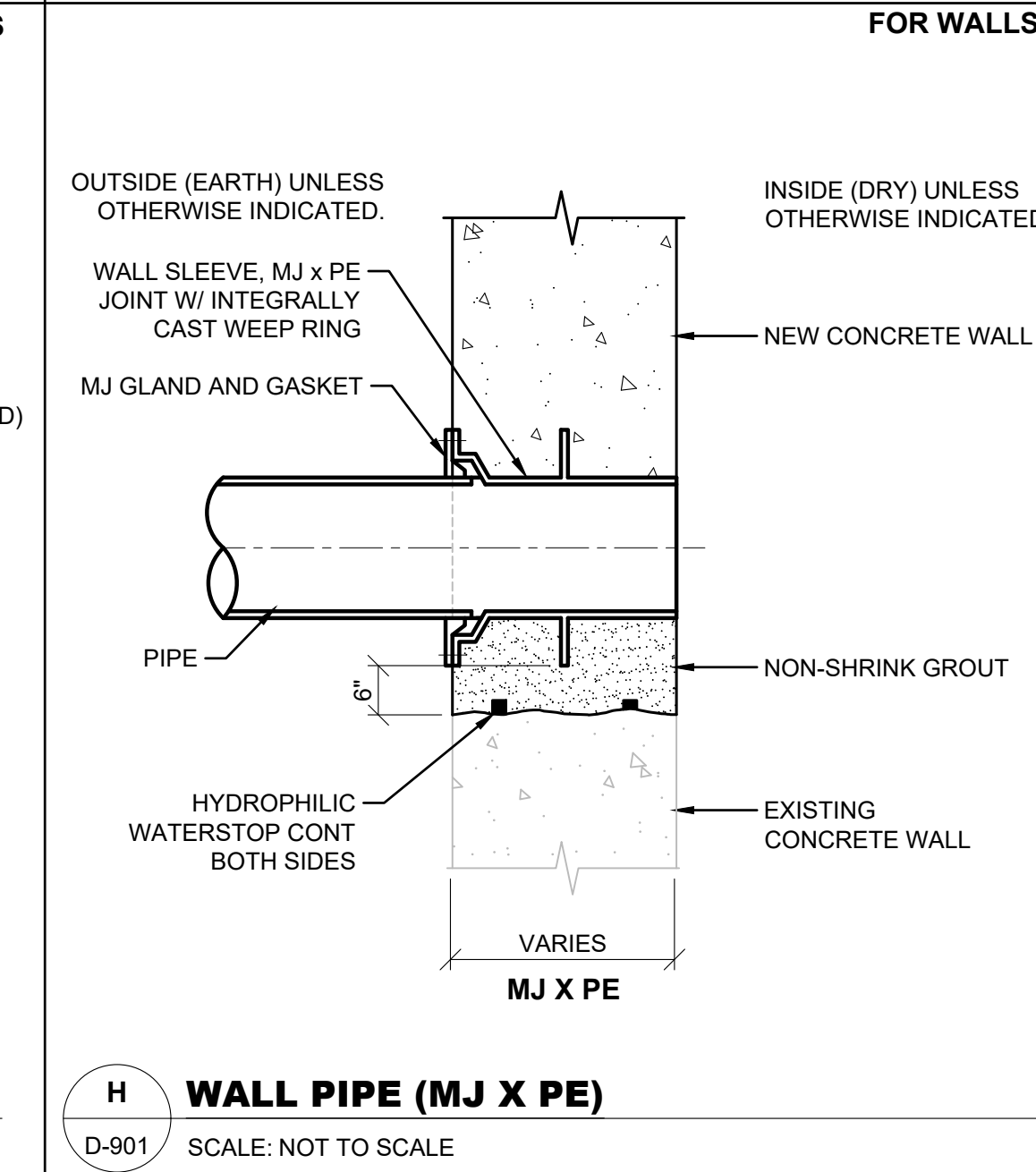
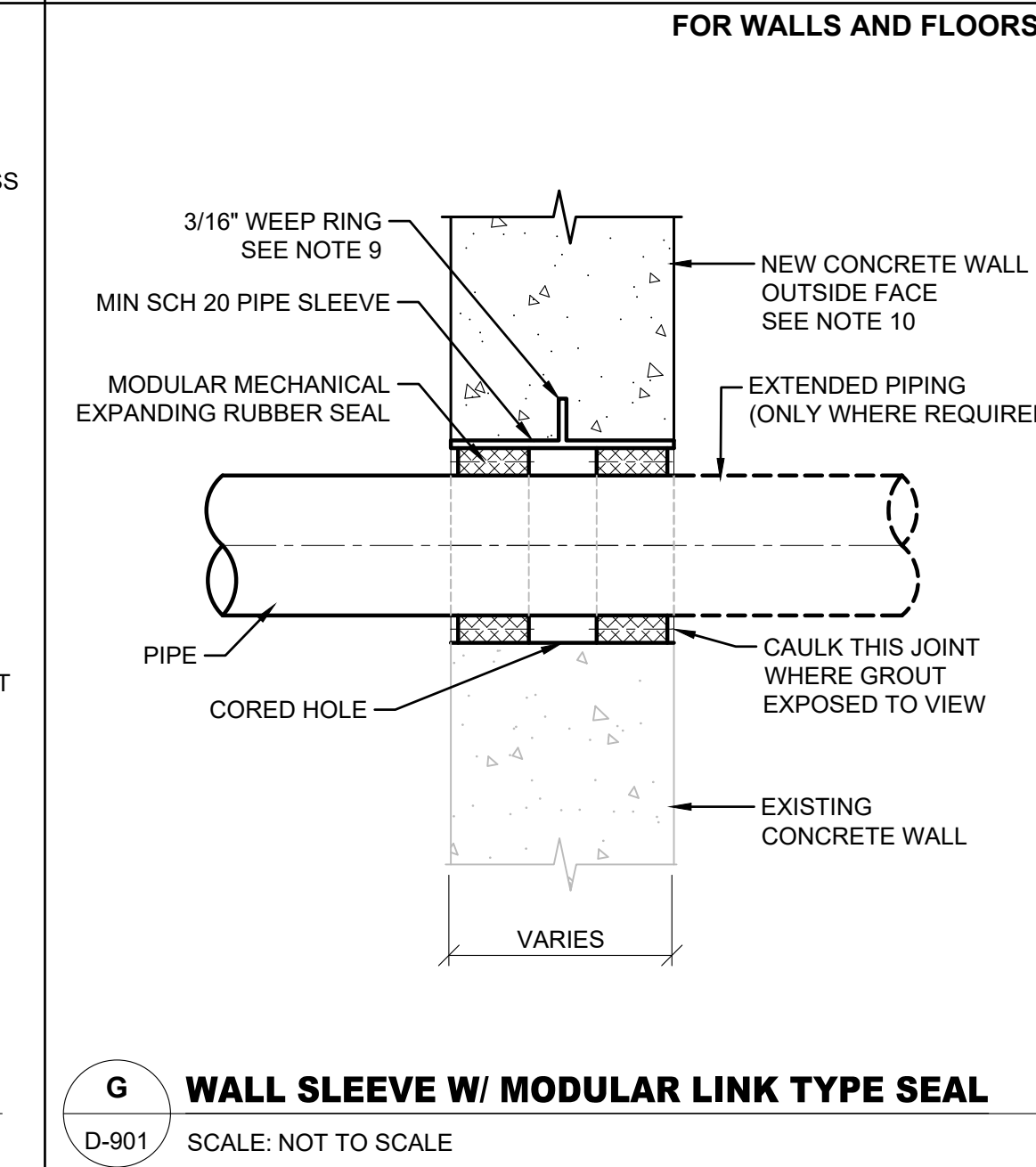
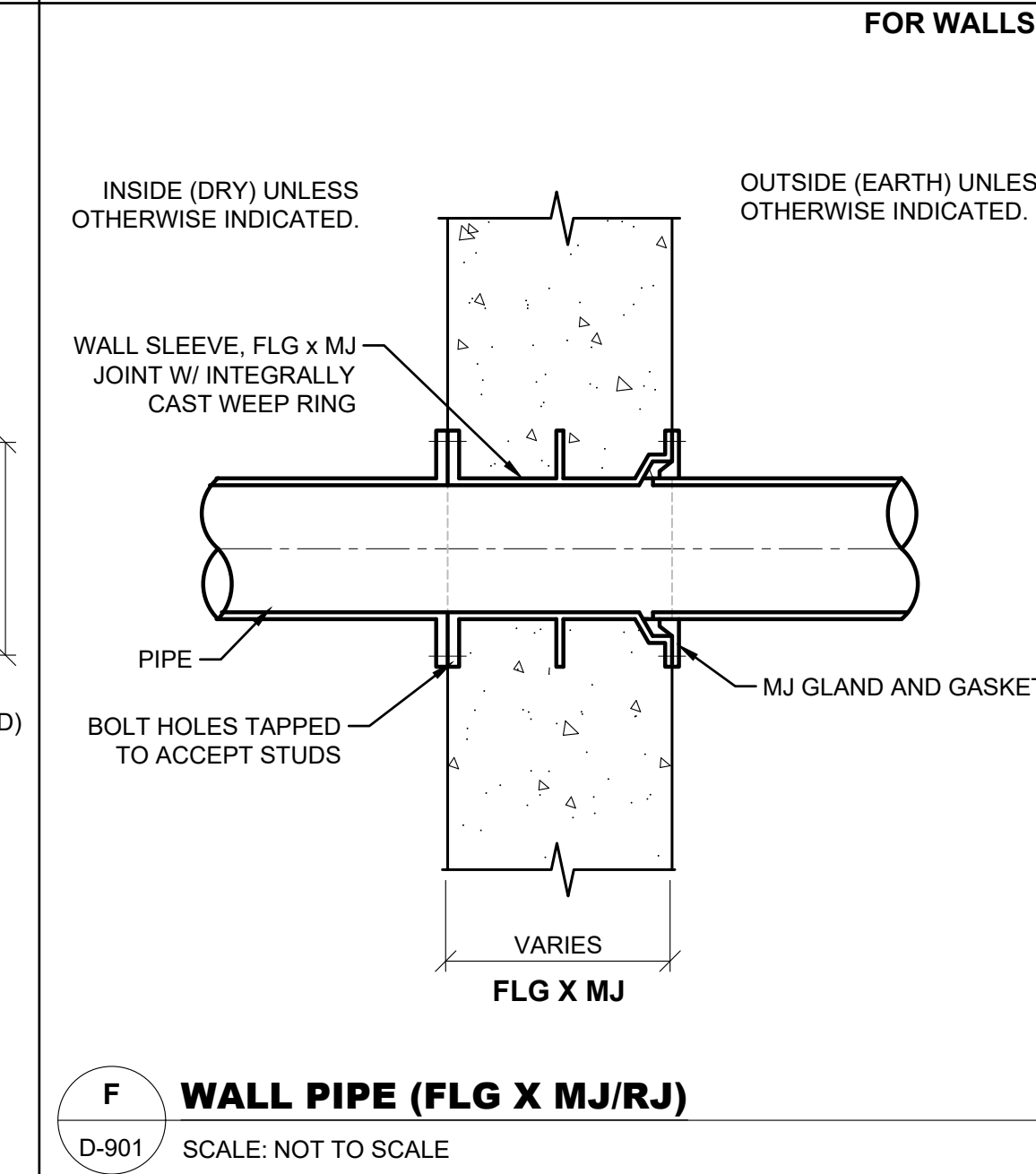
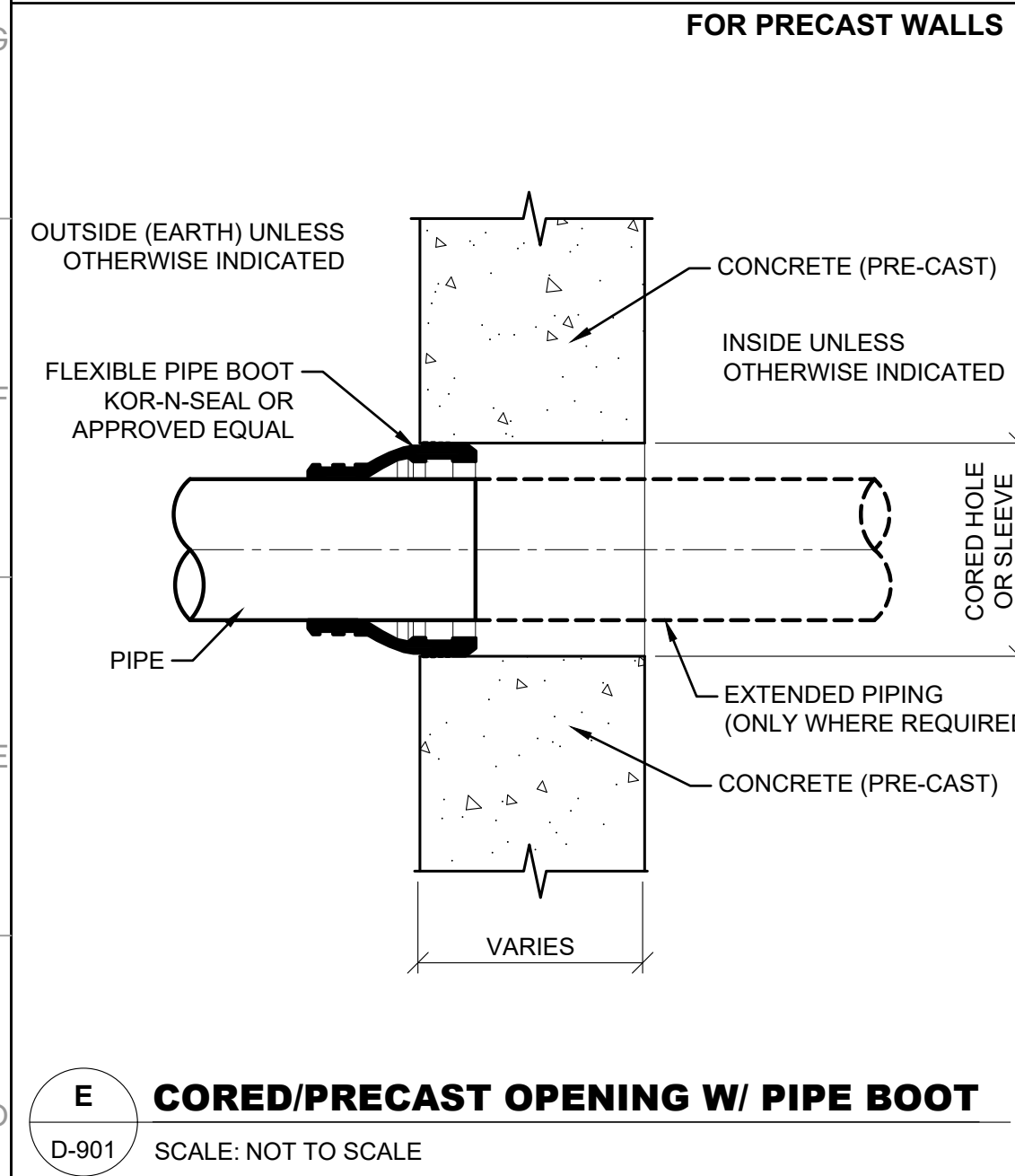
Project Manager:	WN
Engineer:	TR
Design:	JX
Drawn By:	HKD

PROCESS PIPING
PIPE PENETRATION
DETAILS

D-901

PENLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027



DRAWING FILE: T:\1\Projects\SC\Pendleton_Town d\CGREZ2007 - Pendleton-Clemson WWTP\U.DWG-CAD\01 BID DRAWINGS\10 PROCESS\D-902 PIPE SUPPORTS\Z.dwg
PLOTTED: Mar 11, 2024 - 3:53pm

TABLE A

NOMINAL PIPE SIZE (INCHES)	SUPPORT ROD SIZE AND MAXIMUM LOAD PER ROD SEE NOTES 2 AND 3				MAXIMUM PIPE SPAN (FEET) SEE NOTE 4			
	ONE ROD SUPPORT SYSTEM		TWO ROD SUPPORT SYSTEM					
	ROD SIZE (INCHES)	MAX LOAD (POUNDS)	ROD SIZE (INCHES)	MAX LOAD (POUNDS)	STEEL SEE NOTE 3	COPPER	PLASTIC SEE NOTE 5	CAST IRON SEE NOTE 6
3/8 TO 3/4	3/8	610	3/8	610	5	5	CONTINUOUS	---
1	3/8	610	3/8	610	5	5	5	---
1 1/4	3/8	610	3/8	610	5	5	5	---
1 1/2	3/8	610	3/8	610	5	5	5	---
2	3/8	610	3/8	610	10	5	5	12 FEET FOR DUCTILE IRON 10 FEET FOR CAST IRON
2 1/2	3/8	610	3/8	610	10	10	5	
3	3/8	610	3/8	610	10	20	5	
4	1/2	1130	3/8	610	10	20	10	
6	3/4	1810	1/2	1130	15	20	20	
8	3/4	2710	1/2 (5/8)	1130 (1810)	15	20	20	
10	3/4 (1)	2710 (4960)	5/8 (3/4)	1810 (2710)	20	---	20	
12	7/8 (1 1/4)	3770 (8000)	3/4 (7/8)	2710 (3370)	20	---	20	
14	1	4960	---	---	20	---	---	
16	1	4960	---	---	20	---	---	
18	1	4960	---	---	20	---	---	
20	1 1/4	8000	---	---	20	---	---	
24	1 1/4	8000	---	---	20	---	---	
30	1 1/2	12,000	1 1/2	24,000	20	---	---	

TABLE B

X INDICATES PIPE HANGERS SUITABLE FOR CONDITIONS LISTED BELOW:	PIPE HANGER TYPE						
	1	2	3	4	5	6	7
SERVICE TEMPERATURE							
33° F - 59° F							
INSULATED	-	-	X	X	X	-	-
120° F - 450° F							
UNINSULATED	X	X	X	X	X	X	X
60° F - 119° F							
	X	X	X	-	-	X	X
PIPING MATERIALS							
STEEL	X	X	X	X	X	X	X
COPPER	-	X	-	X	-	X	X
PLASTIC	X	X	-	X	X	X	X
CAST IRON	X	X	-	X	X	X	X

GENERAL NOTES:

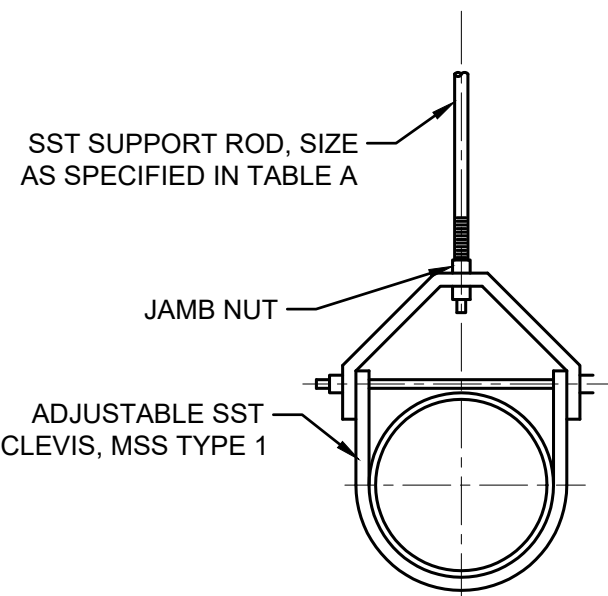
- WHERE NO REFERENCE TO PIPE SUPPORT SYSTEMS ARE GIVEN ON THE DRAWINGS, THE CONTRACTOR SHALL USE AN APPROPRIATE SYSTEM. SEE TABLE "B". PIPE AND CONDUIT SUPPORT SYSTEMS SHALL BE UNISTRUT, ELCEN, OR EQUAL, AND SHALL BE DESIGNED BY THE CONTRACTOR TO MEET THE MINIMUM LOAD AND SPAN REQUIREMENTS AS SPECIFIED.
- MATERIALS FOR HANGERS, SUPPORTS AND ASSOCIATED HARDWARE SHALL BE 304 OR 316 SST.
- UNLESS OTHERWISE SPECIFIED, EXPANSION ANCHORS SHALL NOT BE USED.
- MSS REFERS TO THE MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, STANDARD PRACTICE SP58 AND SP69.
- HANGER BRACKETS AND SUPPORT COMPONENTS MAY BE INTERCHANGED.
- CONCRETE INSERTS IN AREA BELOW WATER SURFACE OR NORMALLY SUBJECT TO SUBMERGING SHALL BE EMBEDDED ANCHOR BOLTS OR EQUAL.
- PROVIDE PLASTIC OR RUBBER CHANNEL END CAPS AT EXPOSED ENDS OF CHANNELS 7'-0" ABOVE FLOOR AND BELOW.
- MAXIMUM DESIGN WEIGHTS AND LOADS SHALL BE AS SHOWN IN TABLE "A" OR AS SHOWN IN THE DETAILS ON THIS DRAWING.
- WHEN SUPPORT PIPING REQUIRES HORIZONTAL FLEXIBILITY NORMAL TO A STEEL BEAM AXIS, USE STRUCTURAL ATTACHMENTS C AND D AS SHOWN ON DRAWING D-903.
- ALL PIPING SUPPORTED BY HANGERS AND/OR STRUCTURAL ATTACHMENTS SHALL BE BRACED AGAINST HORIZONTAL, VERTICAL, AXIAL, AND LONGITUDINAL SWAY. BRACING SHALL BE CALCULATED TO RESIST SEISMIC LOADINGS AS SPECIFIED BY SMACNA AND AS INDICATED IN THE SPECIFICATIONS.
- FITTINGS SHALL NOT BE LESS THAN MSS CL B.
- UNLESS OTHERWISE SPECIFIED, TRAPEZE AND PIPE RACK COMPONENTS SHALL HAVE A MINIMUM THICKNESS OF 12 GAGE WITH A MAXIMUM DEFLECTION 1/240 OF THE SPAN. MINIMUM CHANNEL COMPONENT SIZE SHALL BE 1 5/8" SQUARE 316 SST AS MANUFACTURED BY SUPER STRUT, UNISTRUT, ELCEN, OR EQUAL.

TABLE A NOTES:

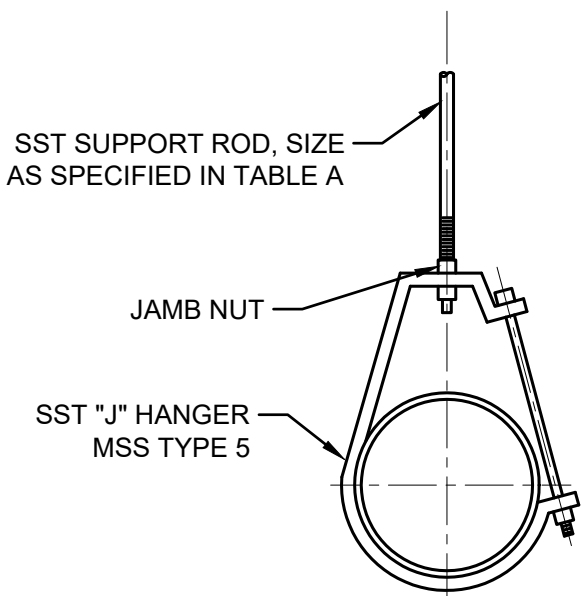
- DESIGN WEIGHT SHALL BE TWICE THE WEIGHT OF THE PIPE FULL OF WATER PLUS THE WEIGHT OF VALVES, FITTINGS, INSULATING MATERIALS, AND SUSPENDED HANGER COMPONENTS ON THE RUN OF PIPE BEING SUPPORTED.
- ROD SIZES SHOWN ARE FOR THE SUPPORT OF A SINGLE PIPE. WHEN SUPPORTING MORE THAN ONE PIPE, ROD SHALL BE SIZED USING THE DESIGN WEIGHTS (SEE NOTE 1) TO DETERMINE THE TOTAL DESIGN LOAD. THE TOTAL DESIGN LOAD SHALL NOT EXCEED THE MAXIMUM LOADS IN THE TABLE ABOVE.
- ROD SIZES AND MAXIMUM LOADS IN PARENTHESIS ARE FOR 8", 10" OR 12" STEEL PIPE ONLY, AT SPANS SHOWN.
- PIPE SHALL NOT HAVE POCKETS FORMED IN THE SPAN DUE TO SAGGING OF THE PIPE BETWEEN SUPPORTS CAUSED BY THE WEIGHT OF THE PIPE, MEDIUM IN THE PIPE, INSULATION, VALVES AND FITTINGS.
- SPAN SHOWN IS FOR SCHEDULE 80 PVC PIPE AT 100 DEGREES F. SPANS FOR OTHER PLASTICS, OTHER PVC PIPE SCHEDULES, AND PIPES AT HIGHER TEMPERATURES, SHALL BE SHORTENED IN ACCORDANCE WITH THE PIPE MANUFACTURER'S RECOMMENDATIONS. CONTINUOUS MEANS PIPE SHALL BE IN UNISTRUT OR SIMILAR CHANNEL.
- PROVIDE A MINIMUM OF ONE PIPE HANGER PER PIPE LENGTH, WITHIN 4 INCHES OF THE BELL.
- PIPE HANGER AND SUPPORT SELECTION SHALL BE IN ACCORDANCE WITH TABLE B.

TABLE B NOTES:

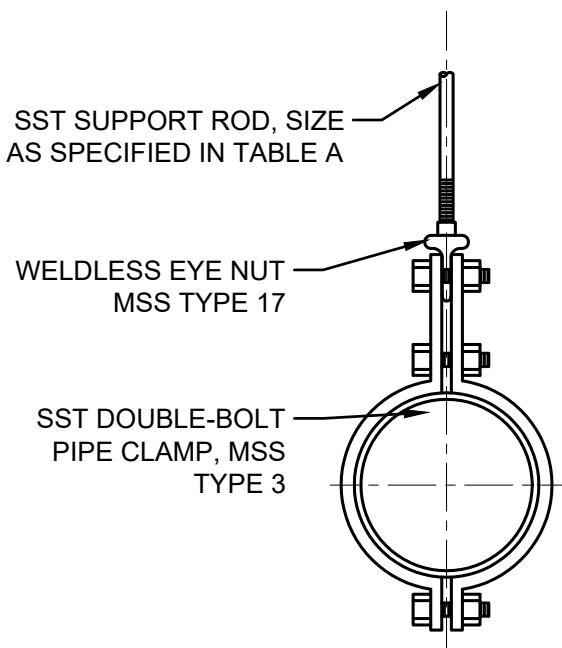
- FOR SERVICES OTHER THAN THOSE SHOWN IN TABLE "B", PIPE ATTACHMENTS SHALL BE THOSE SPECIFIED IN THE PIPE SPECS.



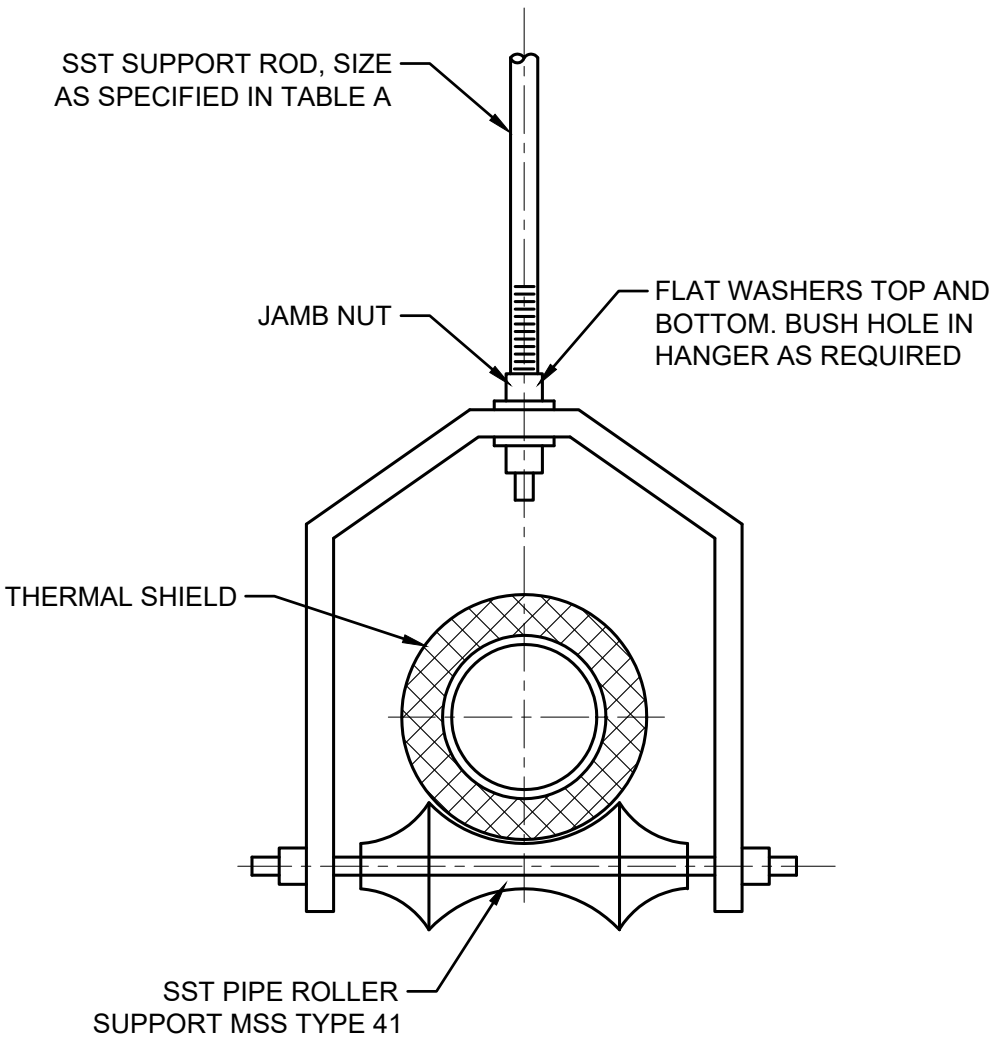
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D-902 SCALE: NOT TO SCALE



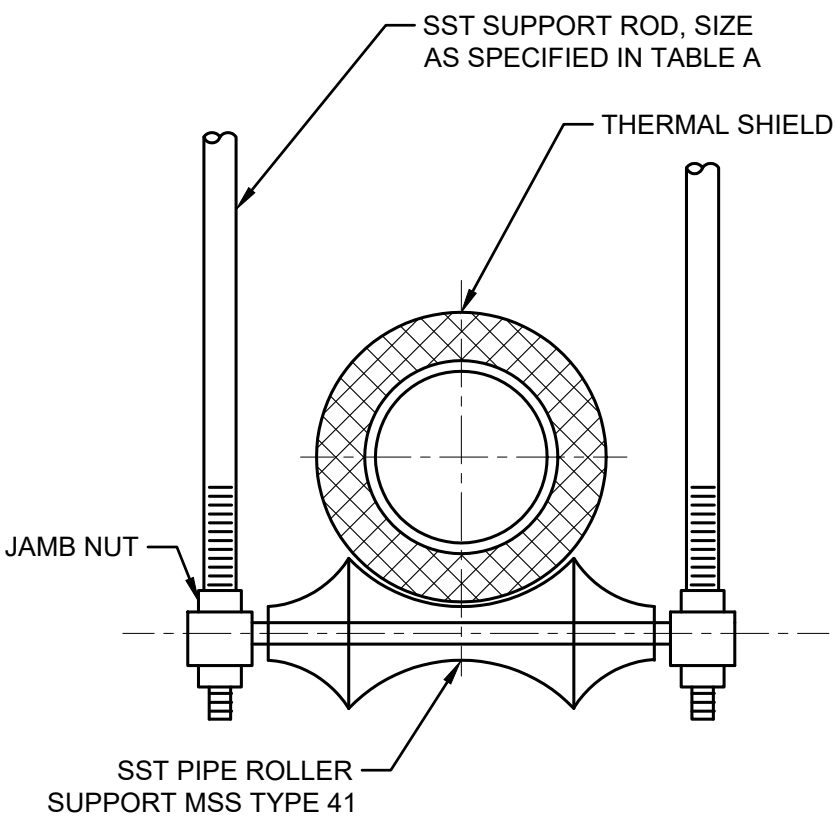
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D-902 SCALE: NOT TO SCALE



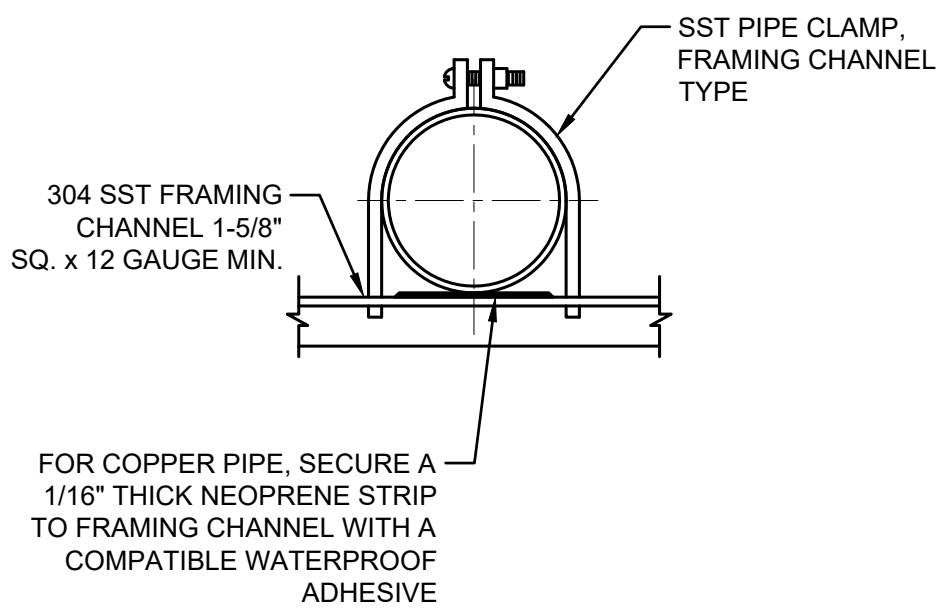
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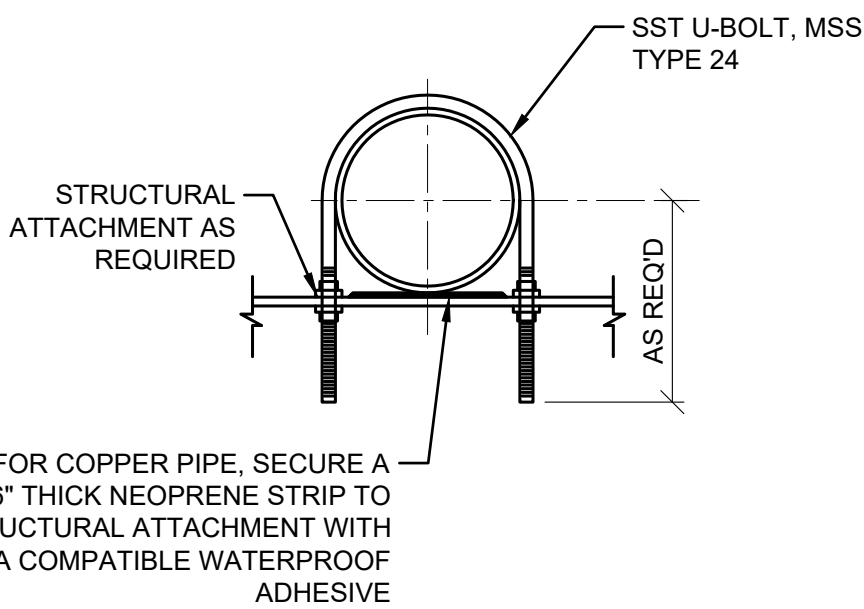
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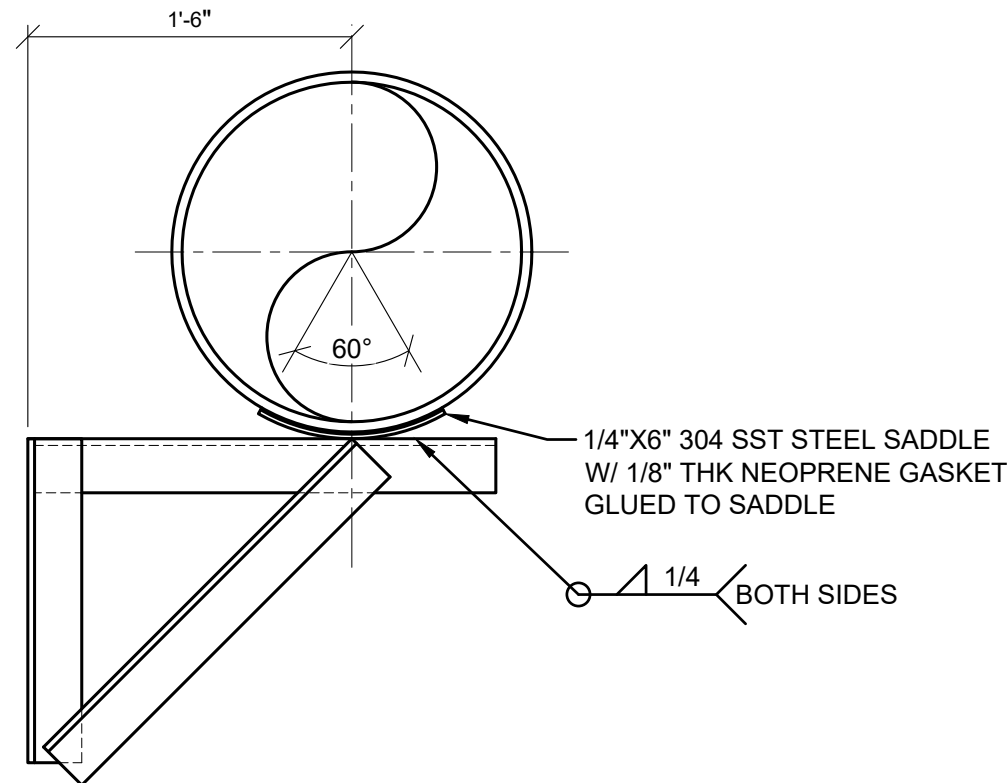
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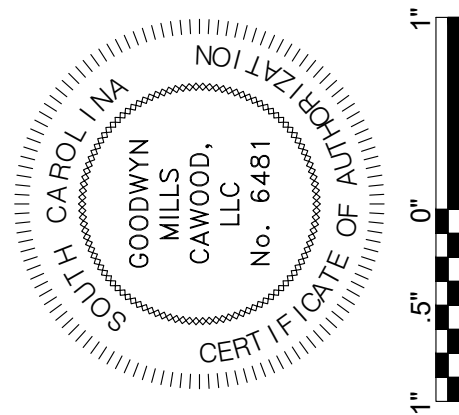
6 TYPE 6 PIPE HANGER
D-902 SCALE: NOT TO SCALE



7 TYPE 7 PIPE HANGER
D-902 SCALE: NOT TO SCALE



8 TYPE 8 PIPE HANGER
D-902 SCALE: NOT TO SCALE



ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
Project Manager:	WN
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Designer:	JX
Drawn By:	HKD

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
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GMC PROJECT #CGRE220027

PROCESS PIPING
SUPPORT DETAILS

D-902

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- TYPE 15 PIPE HANGER NOTES:**
1. SPACING SHALL BE AS SPECIFIED IN TABLE A / D-902 ON PRIOR SHEET.
 2. TOTAL LOADS ON END CONNECTIONS SHALL NOT EXCEED 1/2 THE MAXIMUM ALLOWABLE LOAD AT MID-POINT.



15 TYPE 15 PIPE HANGER

D-903 SCALE: NOT TO SCALE



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30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
100% Submittal	03/08/2024
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Project Manager:	WN
Engineer:	TR
Designer:	JX
Drawn By:	HKD

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Town of Pendleton
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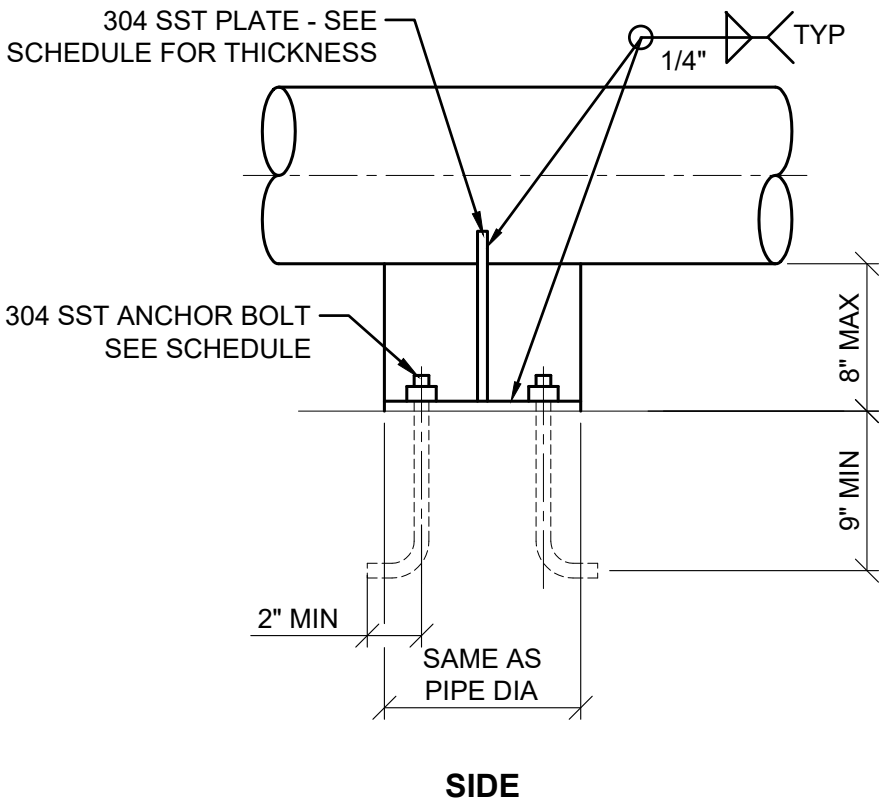
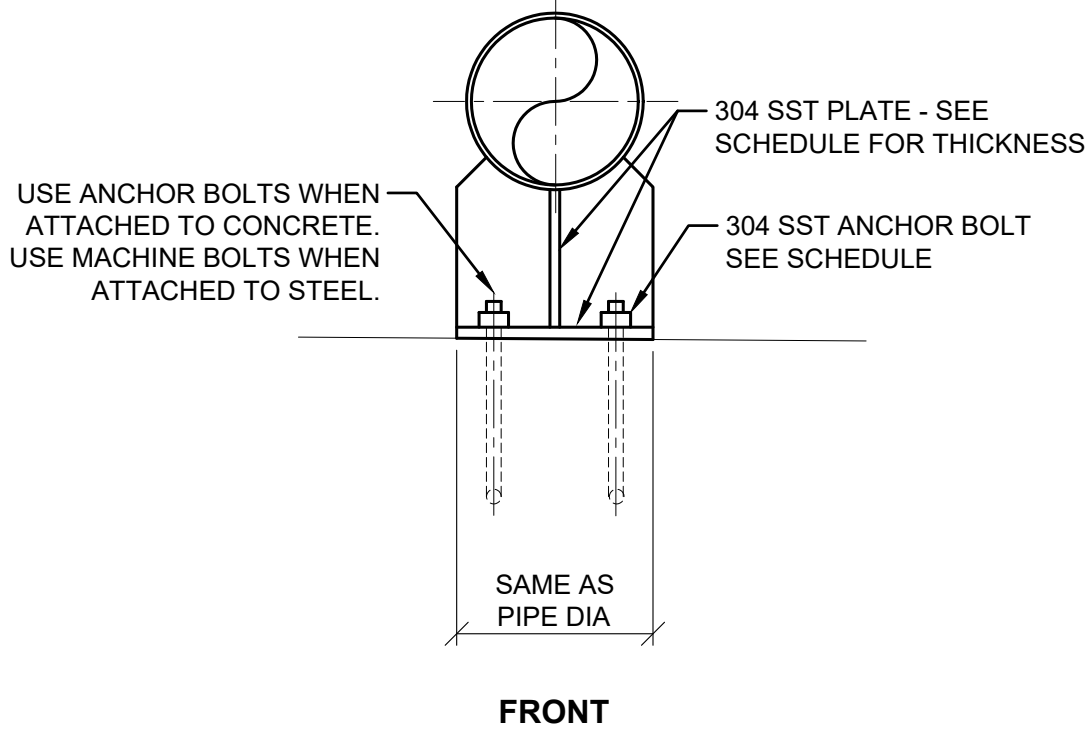
GMC PROJECT #CGRE220027

PROCESS PIPING SUPPORT DETAILS

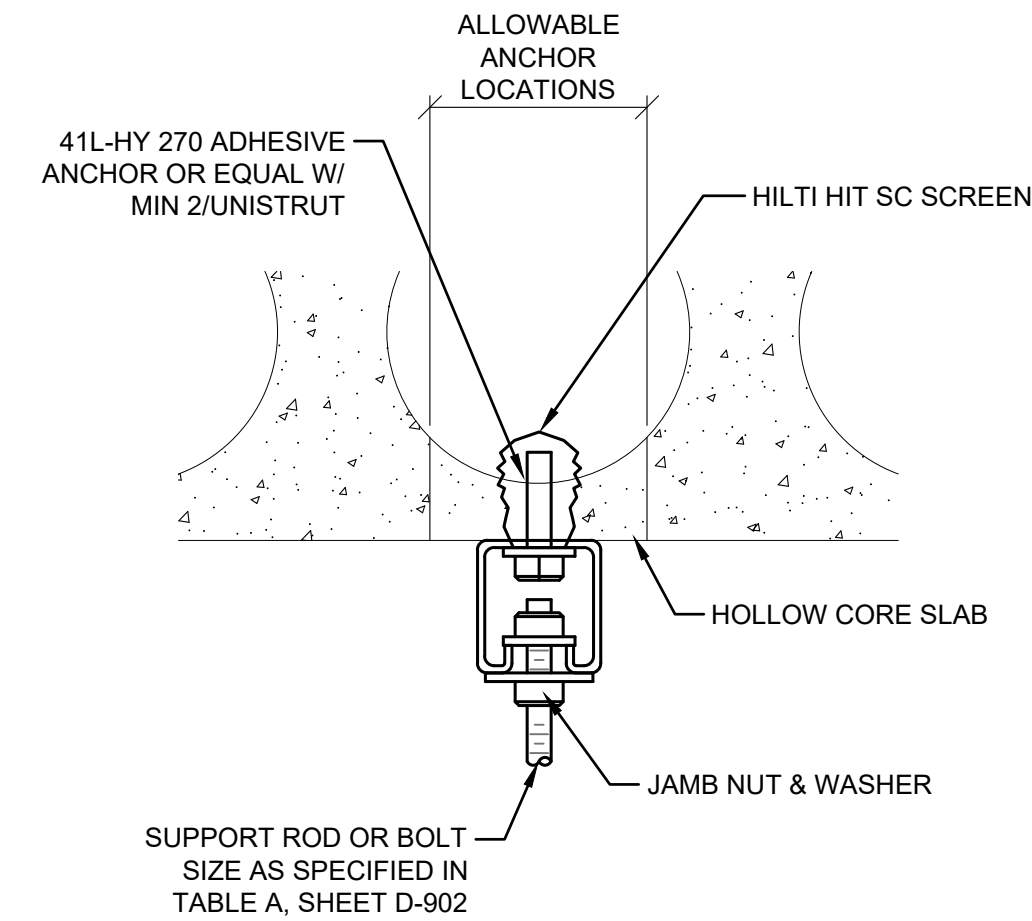
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PLOTTED: Mar 11, 2024 - 3:53pm

COMPONENT SCHEDULE		
PIPE SIZE	BOLT SIZE	PL THK
2" & 2-1/2"	3/8"	1/4"
3" TO 6"	1/2"	3/8"
8" TO 12"	5/8"	3/8"
14" TO 16"	3/4"	1/2"
18" TO 20"	7/8"	5/8"

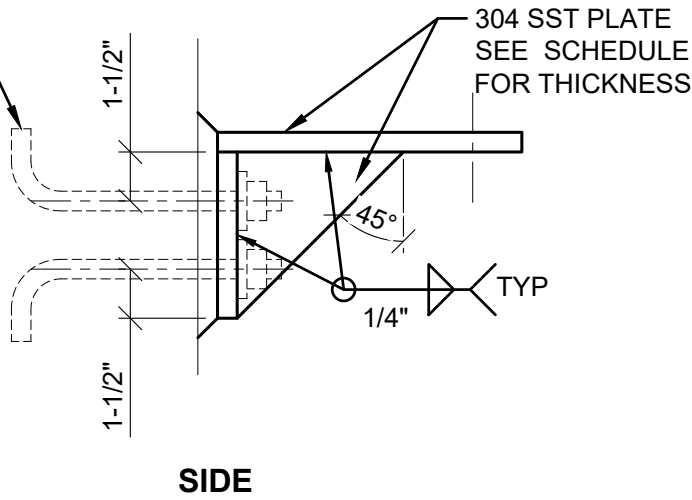
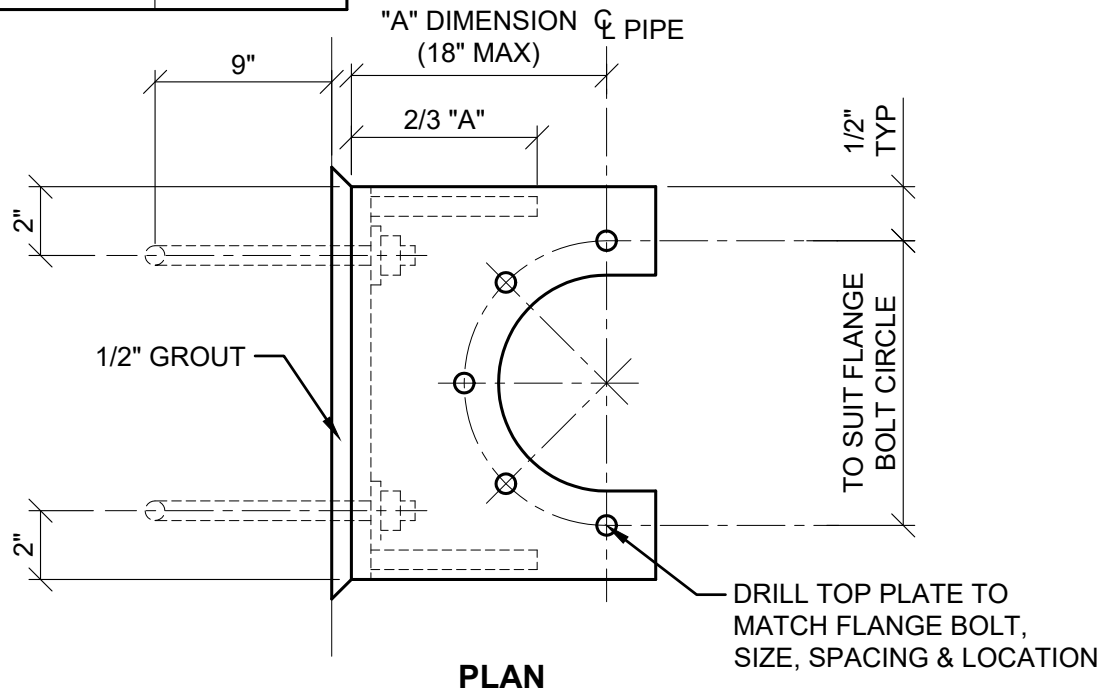


L ATTACHMENT TYPE L
D-905 SCALE: NOT TO SCALE



N ATTACHMENT TYPE N
D-905 SCALE: NOT TO SCALE

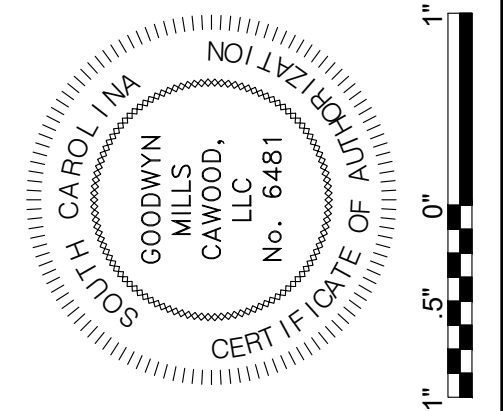
COMPONENT SCHEDULE		
PIPE SIZE	BOLT SIZE	PL THK
2" & 2-1/2"	3/8"	1/4"
3" TO 6"	1/2"	3/8"
8" TO 12"	5/8"	3/8"
14" TO 16"	3/4"	1/2"
18" TO 20"	7/8"	5/8"
24" TO 30"	1"	3/4"



M ATTACHMENT TYPE M
D-905 SCALE: NOT TO SCALE

GENERAL NOTES:

- FOR EXISTING CONCRETE, NEW PRECAST CONCRETE OR NEW CONCRETE MASONRY UNITS USE SURFACE MOUNT CHANNEL UNISTRUT P-1000 OR EQUAL. FOR ALL POURED-IN-PLACE CONCRETE, USED EMBEDDED CONCRETE INSERT CHANNELS, UNISTRUT P3200 OR EQUAL AND DELETE THE SURFACE MOUNT ANCHOR BOLTS.
- SPACING SHALL BE AS REQUIRED BUT SHALL NOT EXCEED THOSE SPANS SHOWN IN TABLE A ON SHEET D-902.

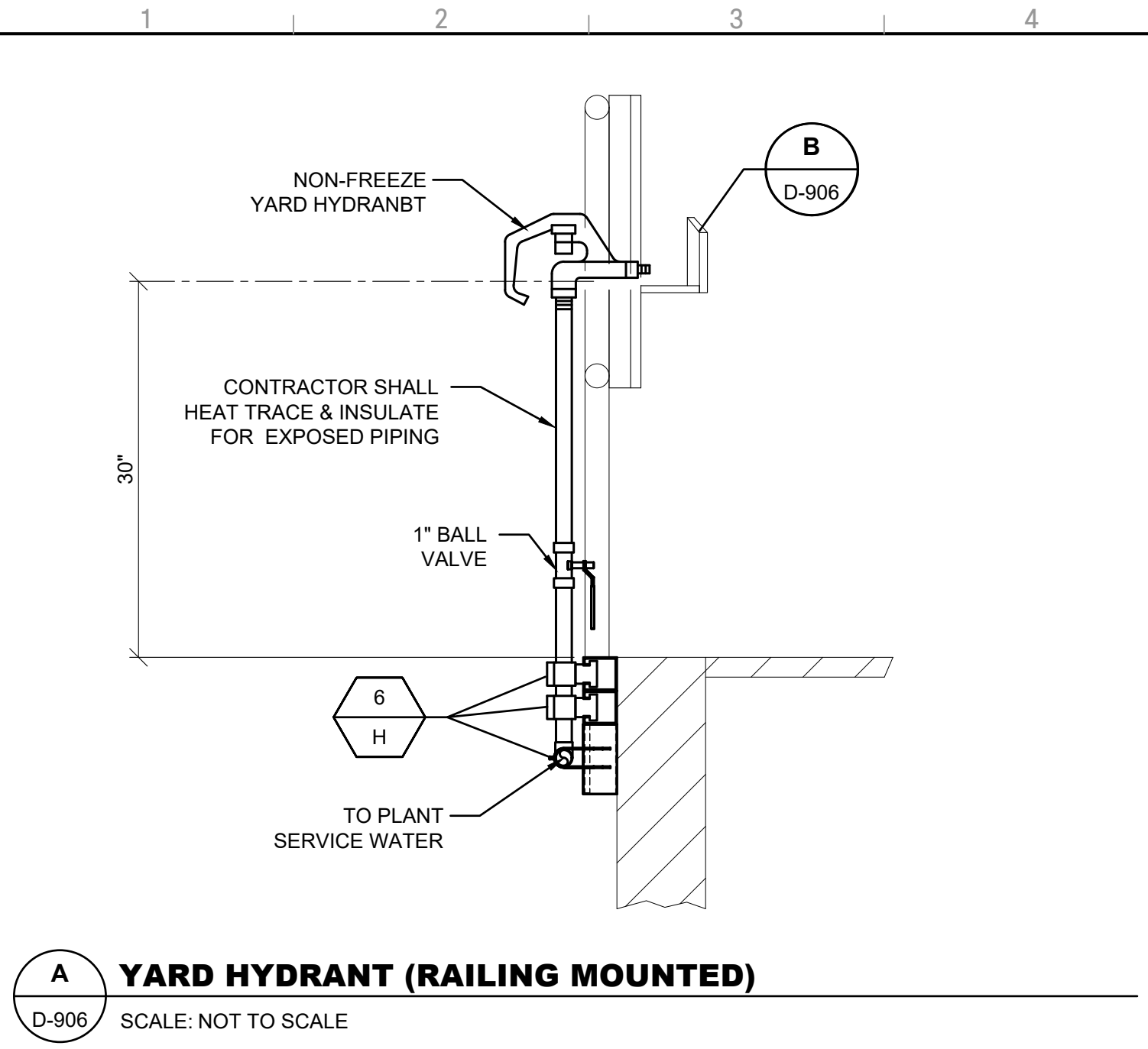


ISSUE		DATE
30% Submittal		01.18.2023
60% Submittal		08.07.2023
90% Submittal		12.04.2023
100% Submittal		03.08.2024
Conformed Set		
Project Manager:		WN
Engineer:		TR
Designer:		JX
Drawn By:		HKD

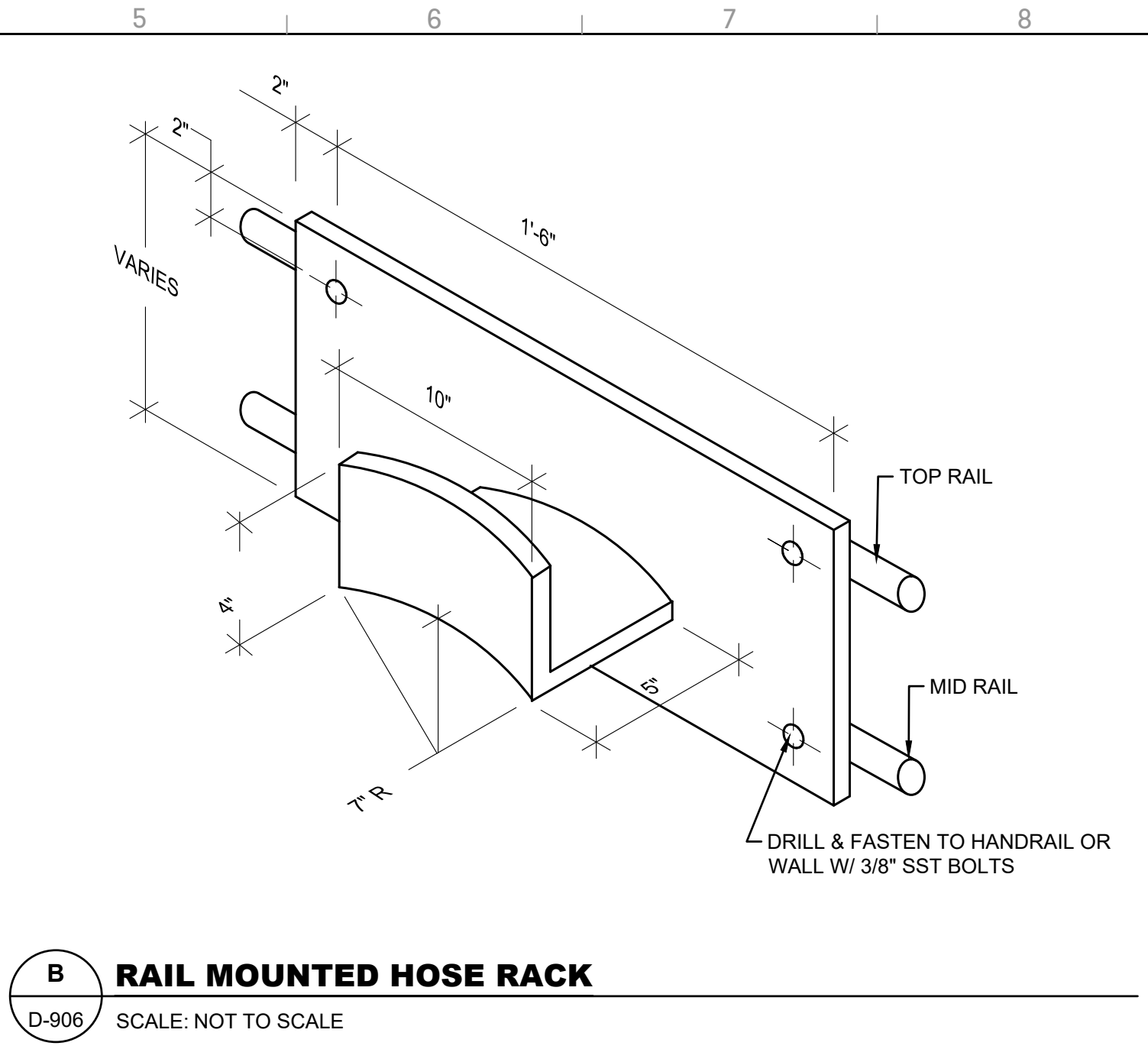
PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

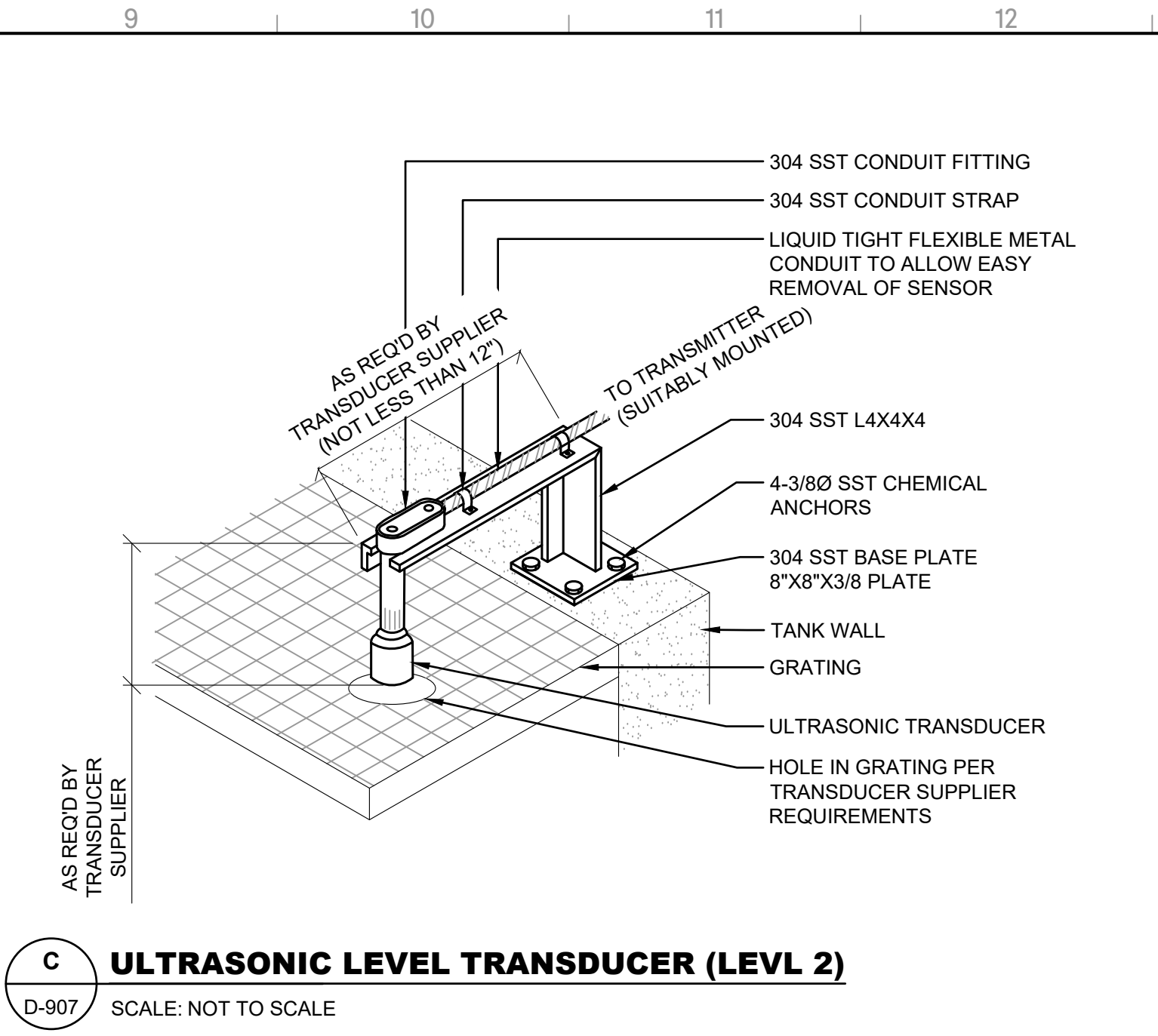
PROCESS PIPING
STRUCTURAL
ATTACHMENT
DETAILS
D-905



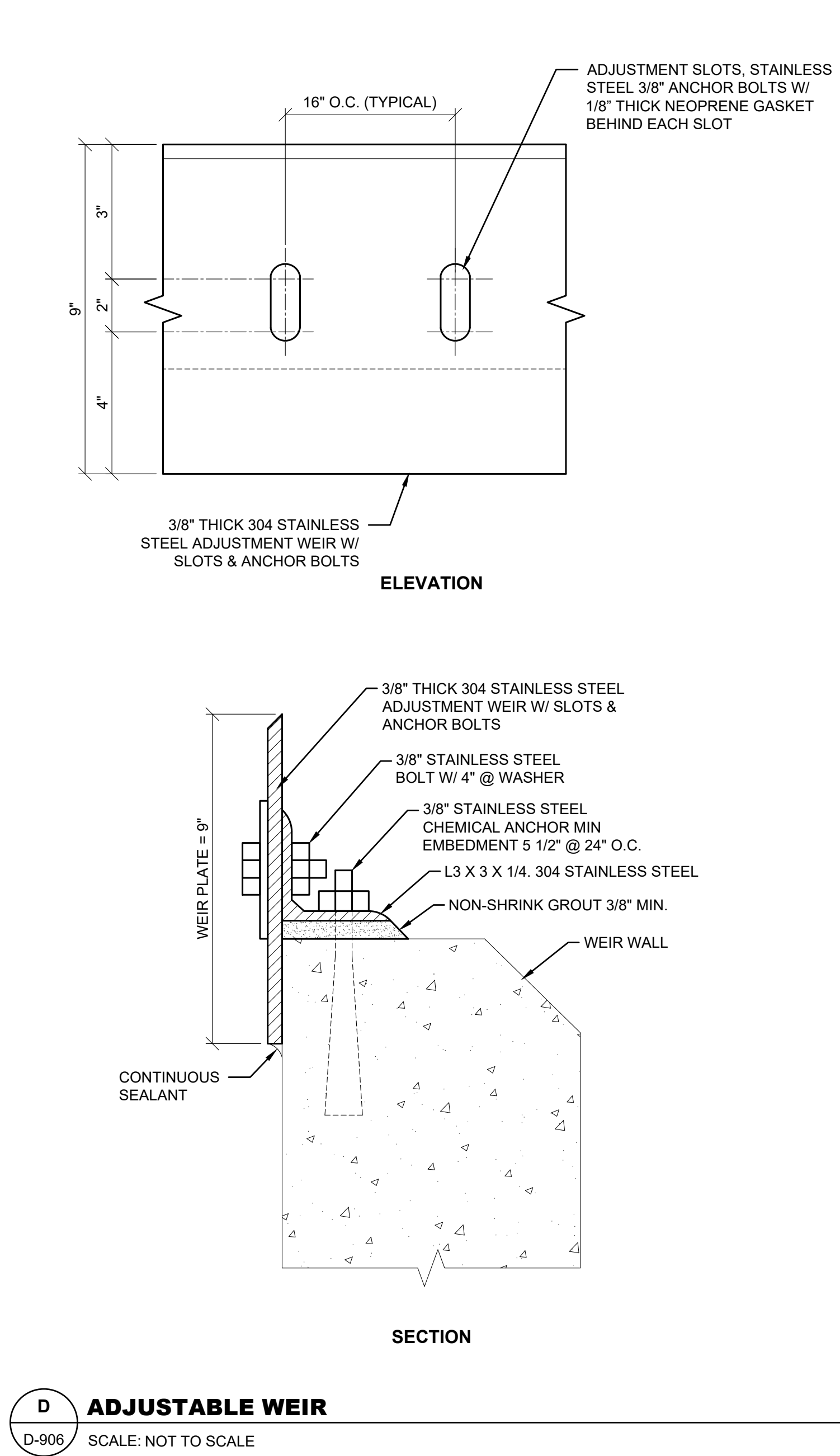
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D-906 SCALE: NOT TO SCALE



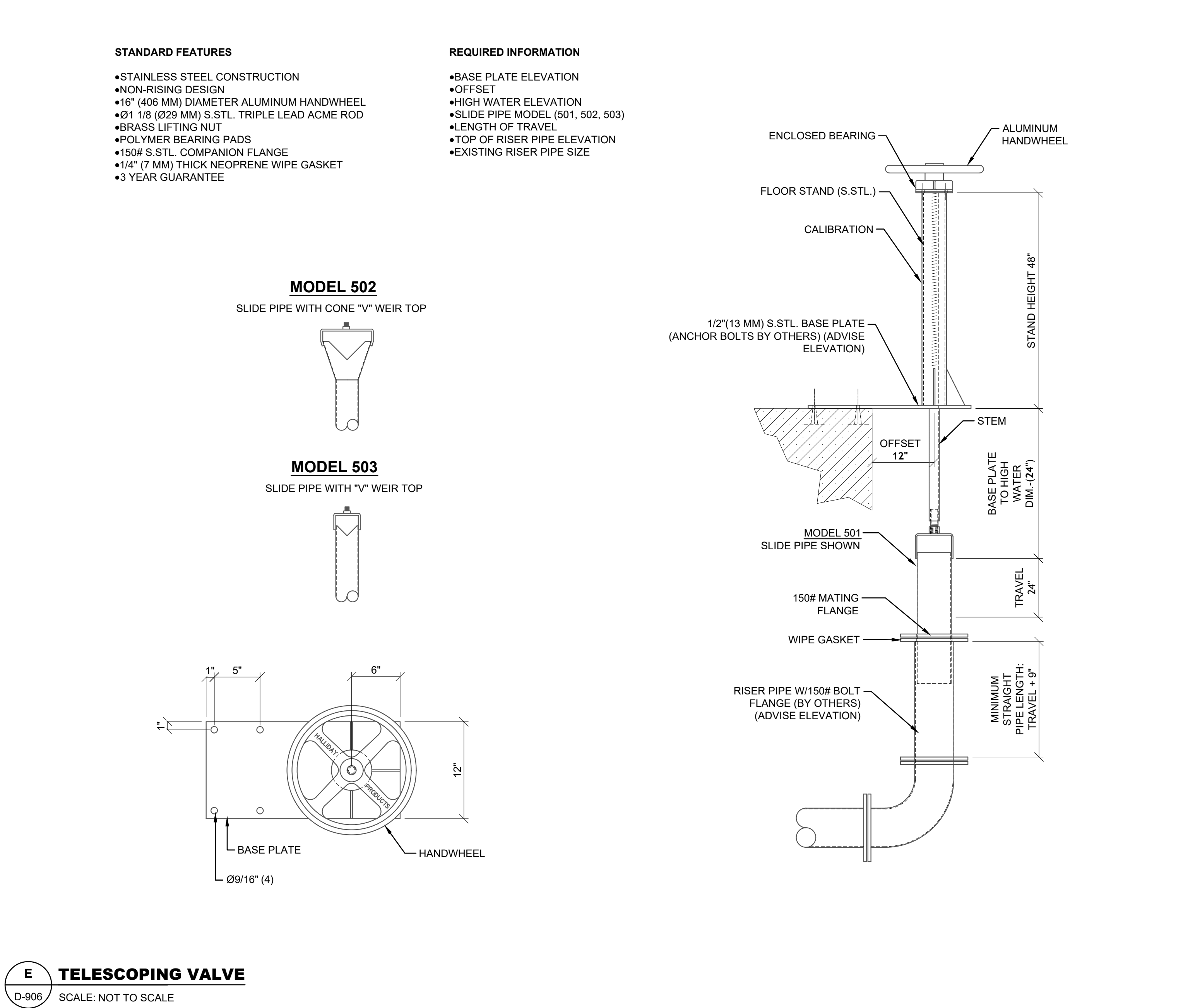
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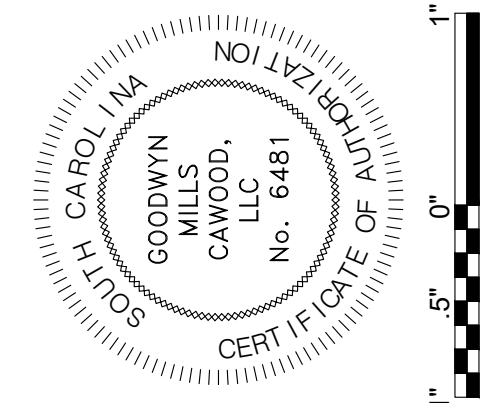
C ULTRASONIC LEVEL TRANSDUCER (LEVEL 2)
D-907 SCALE: NOT TO SCALE



D ADJUSTABLE WEIR
D-906 SCALE: NOT TO SCALE



E TELESCOPING VALVE
D-906 SCALE: NOT TO SCALE



ISSUE	DATE
30% Submittal	01/18/2023
60% Submittal	08/07/2023
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100% Submittal	03/08/2024
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PENDLETON - CLEMSON
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PROCESS
DETAILS

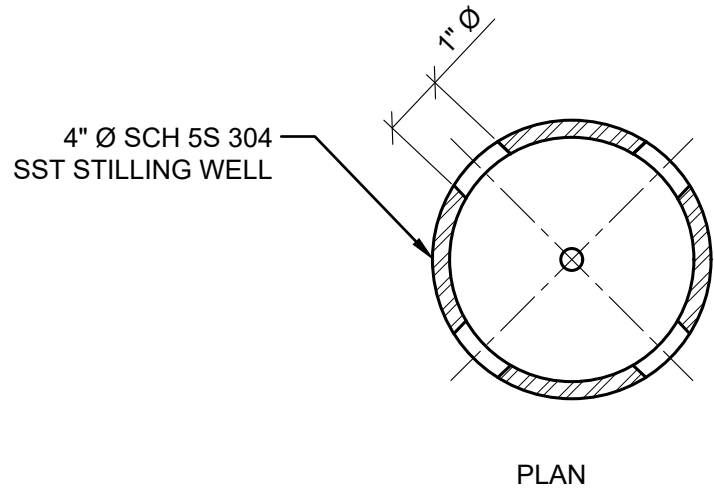
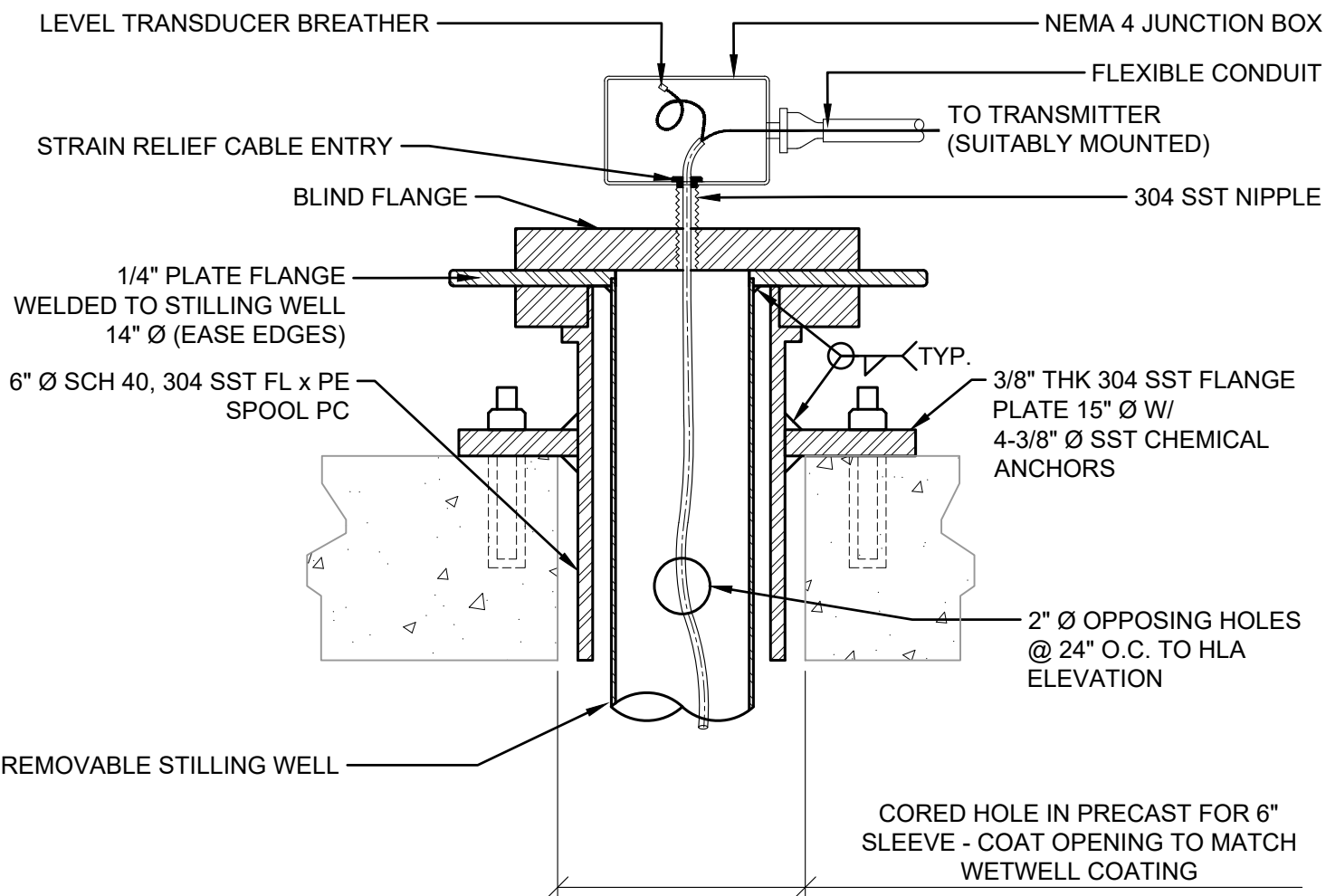
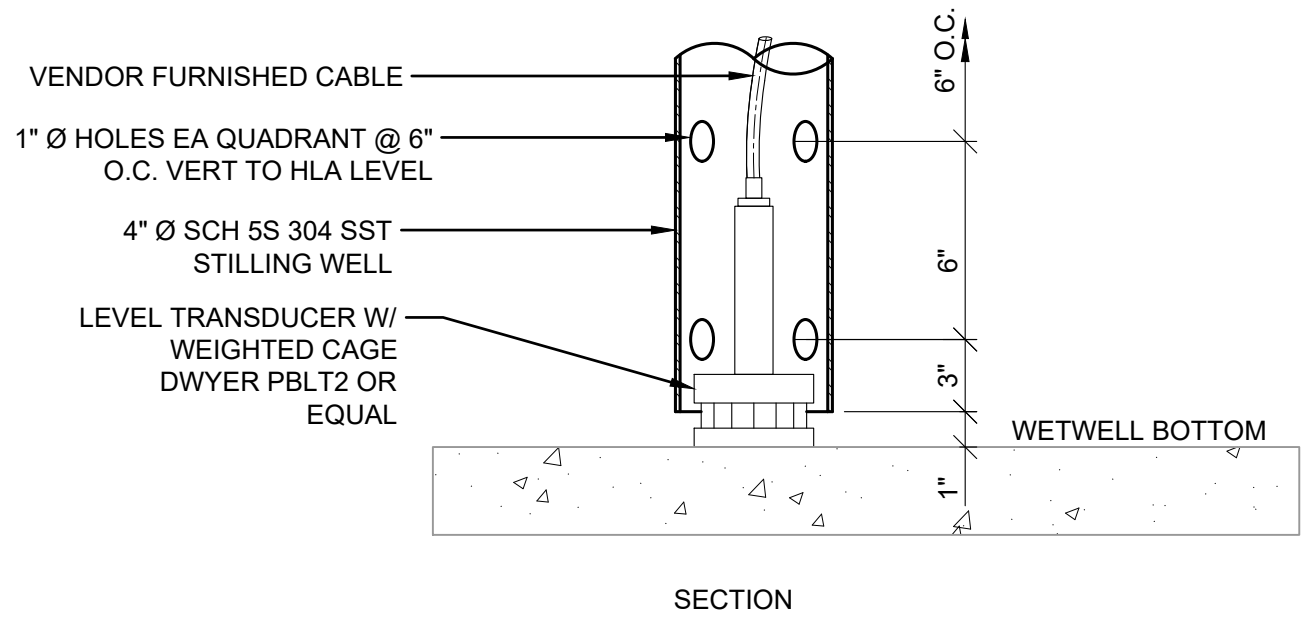
D-906

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PLOTTED: Mar 11, 2024 - 3:53pm

F
D-907

SUBMERSIBLE LEVEL TRANSDUCER

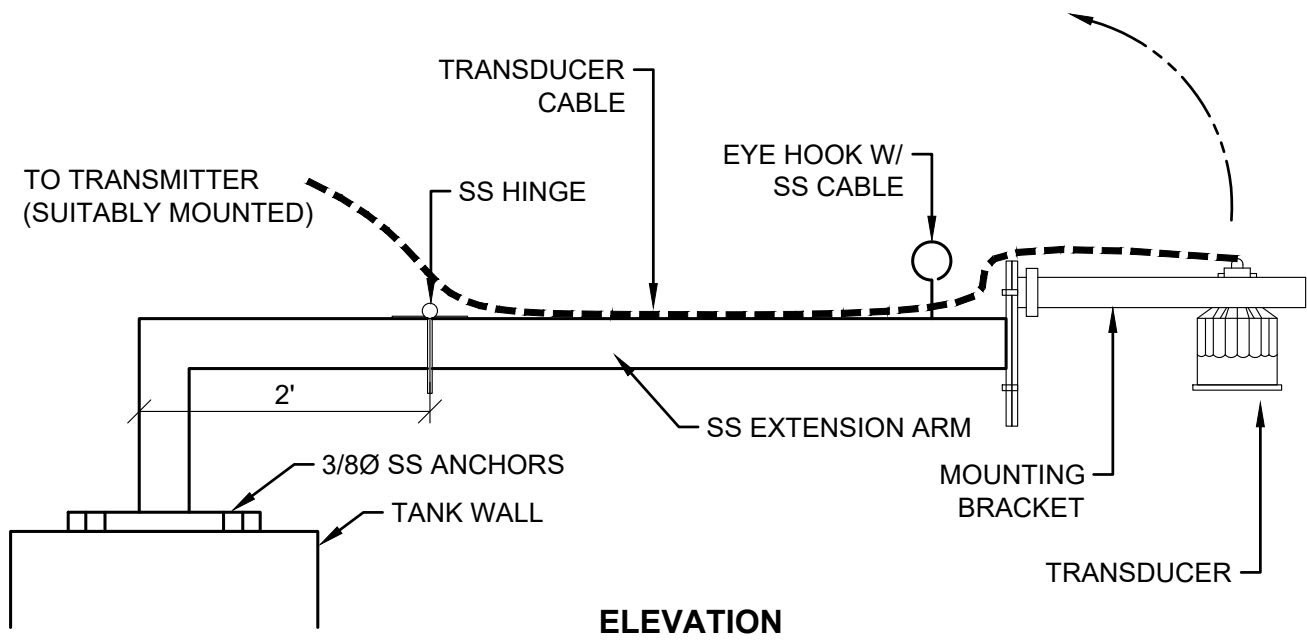
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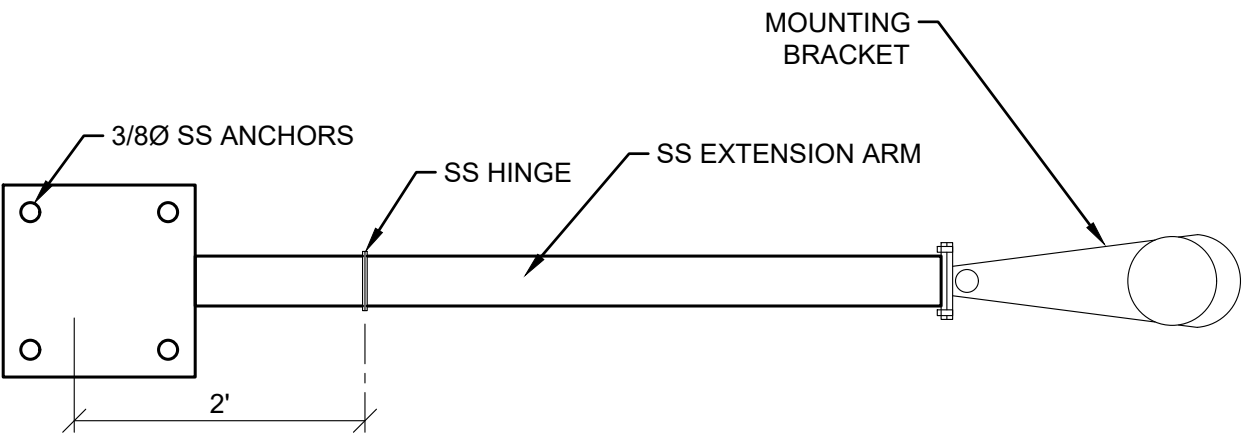
G
I-901

LEVEL TRANSDUCER W/ HINGED EXTENSION ARM

SCALE: NOT TO SCALE



PLAN (BOTTOM LOOKING UP)



ELEVATION

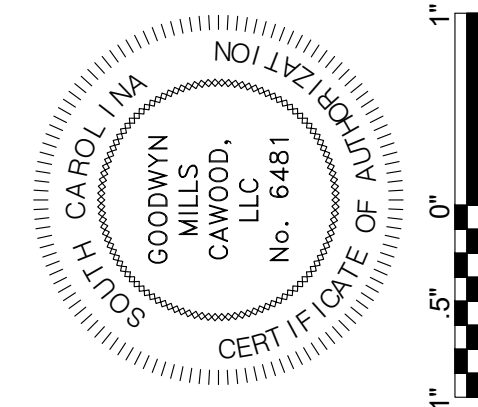
PROCESS
DETAILS

D-907

PENDLETON - CLEMSON
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PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

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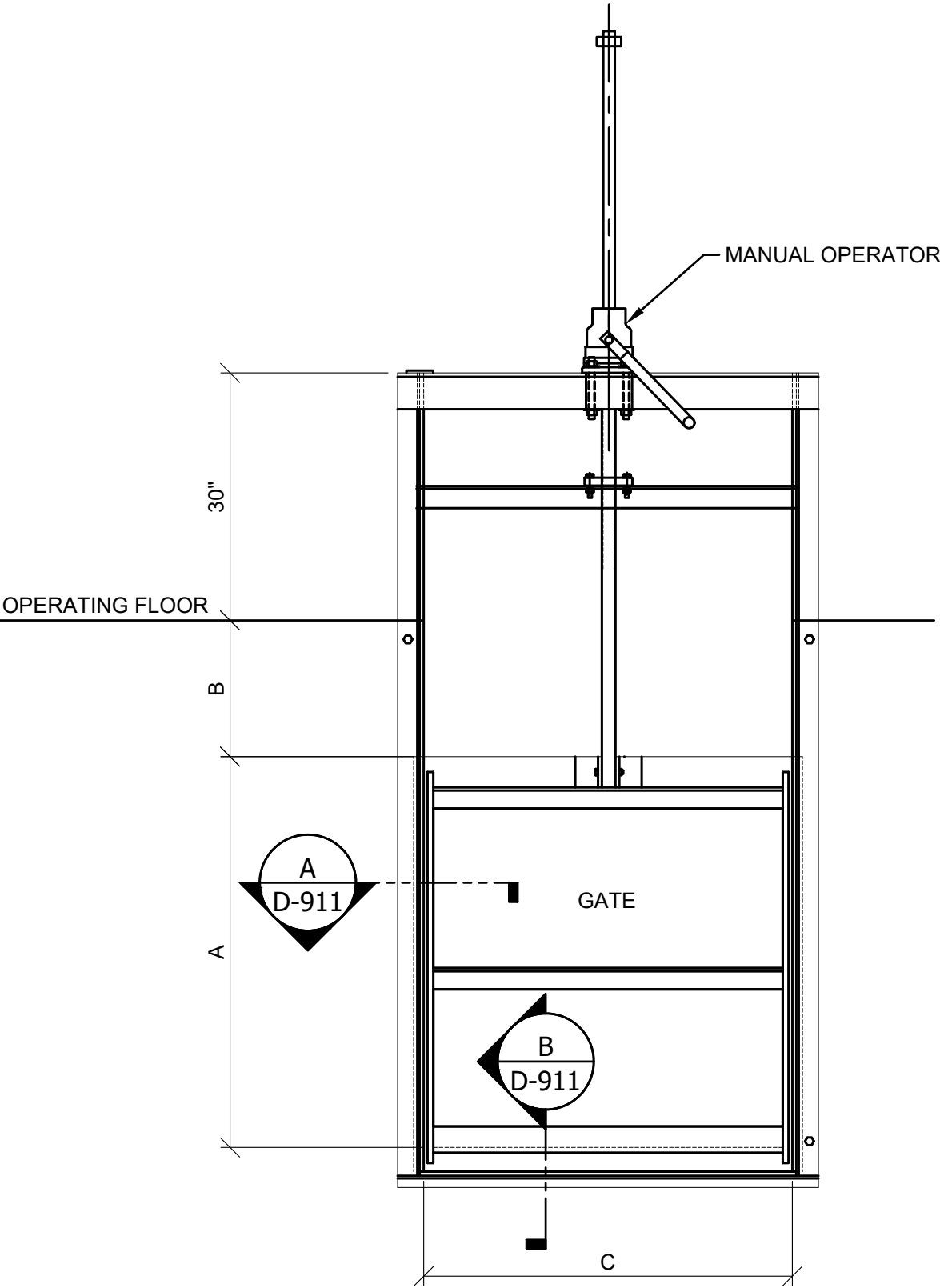
ISSUE	DATE
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Engineer:	TR
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Drawn By:	HKD



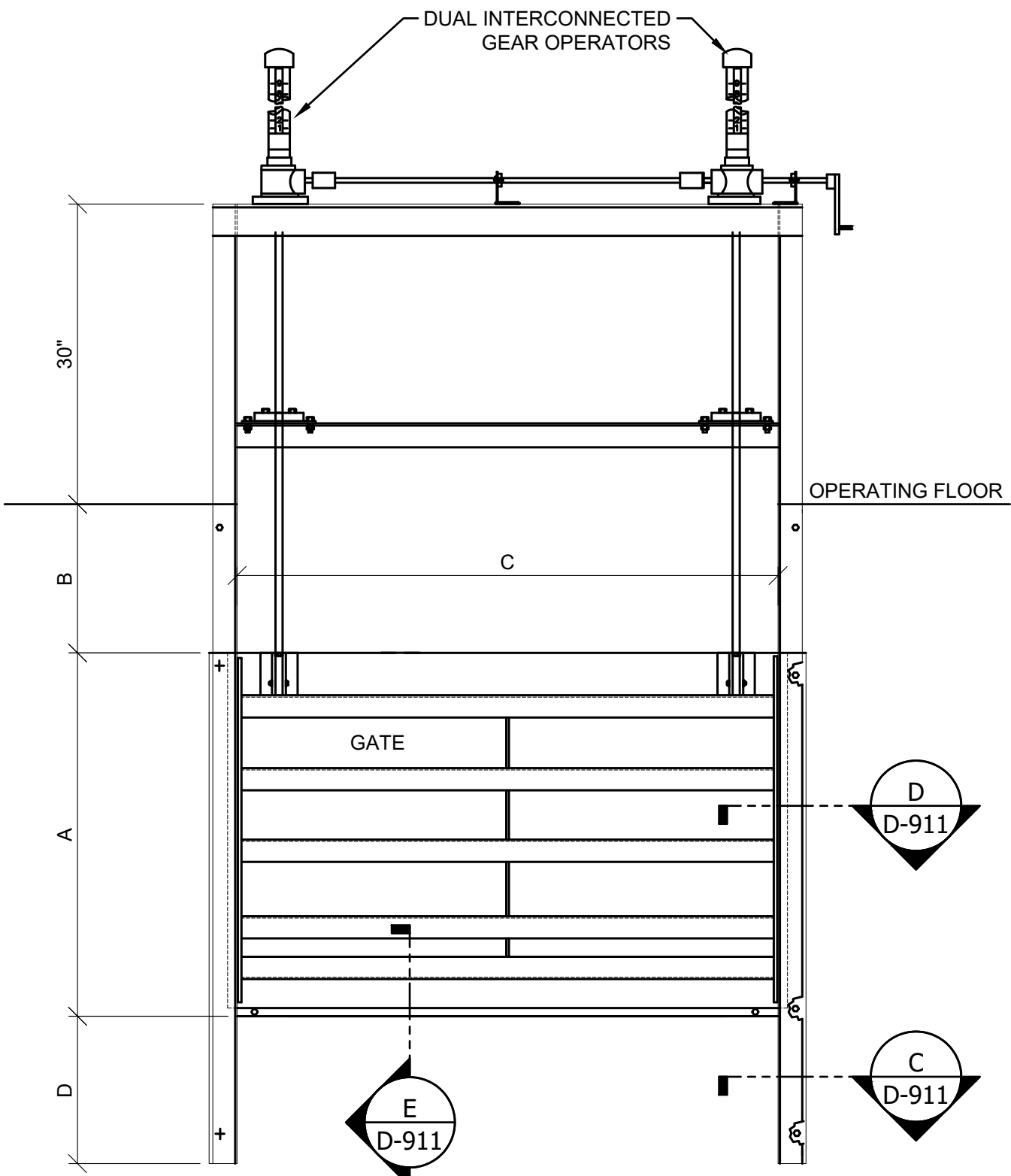
GMC
117 Welborn St.
Greenville, SC 29601
T 864.527.0460

DRAWING FILE: \\T:\Projects\SC\Pendleton, Town of\CGRE220027 - Pendleton-Clemson WWTP\0 DWG\CAD\01 BID DRAWINGS\10 PROCESS\D-911 GATE SCHEDULE & DETAILS.dwg
PLOTED: Mar 11, 2024 - 3:53pm

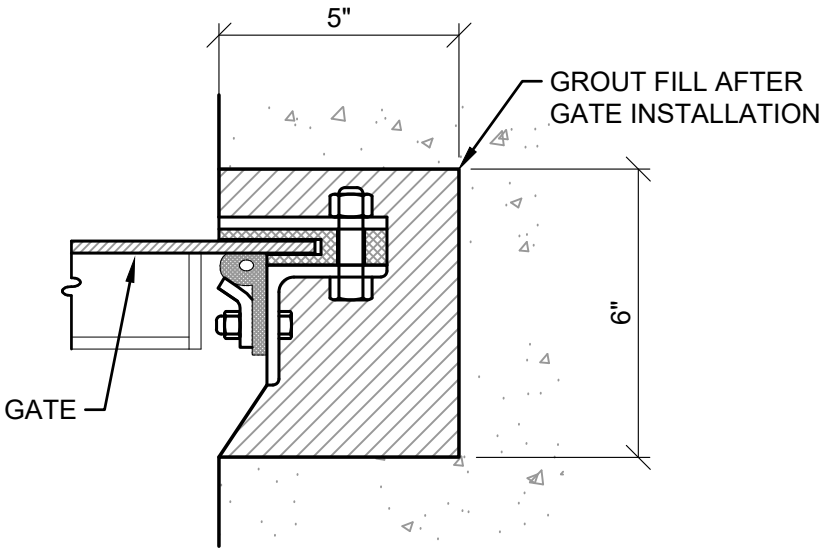
TAG	TYPE	LOCATION	MOUNTING	OPERATOR & OPERATOR SUPPORT	HEIGHT A (INCHES)	HEIGHT B (INCHES)	WIDTH C (INCHES)	HEIGHT D (INCHES)	DESIGN SEATING HEAD (INCHES)	DESIGN UNSEATING HEAD (INCHES)	NOTES	P&ID Sheet Number	Process Sheet Number	Labeled
SG1001	Slide Gate	Coarse Mechanical Screen	Wall Mounted	Handwheel	84	36	48		30			I-101	D-103	
SG1002	Slide Gate	Coarse Mechanical Screen	Wall Mounted	Handwheel	84	36	36		30			I-101	D-103	
SG1003	Slide Gate	Coarse Mechanical Screen	Wall Mounted	Handwheel	84	36	36		30			I-101	D-103	
SG1004	Slide Gate	Coarse Mechanical Screen	Wall Mounted	Handwheel	84	36	48		30			I-101	D-103	
SG1201	Slide Gate	Vortex Grit Chamber	Wall Mounted	Handwheel	54	30	36		21			I-101	D-112	
SG1211	Slide Gate	Vortex Grit Chamber	Wall Mounted	Handwheel	54	30	36		21			I-112	D-113	
SG1212	Slide Gate	Vortex Grit Chamber	Wall Mounted	Handwheel	42	18	22		15			I-112	D-113	
SG1221	Slide Gate	Vortex Grit Chamber	Wall Mounted	Handwheel	54	30	36		21			I-112	D-114	
SG1222	Slide Gate	Vortex Grit Chamber	Wall Mounted	Handwheel	42	18	22		15			I-112	D-114	
SG1231	Slide Gate	Vortex Grit Chamber	Wall Mounted	Handwheel	42	18	46		15			I-112	D-116	
SG1232	Slide Gate	Vortex Grit Chamber	Wall Mounted	Handwheel	42	18	46		15			I-112	D-116	
WG6001	Weir Gate	UV Disinfection	Wall Mounted	Automated	32	24	72	18	24	24	Design head provided by UV Manufacturer	I-601	D-502	



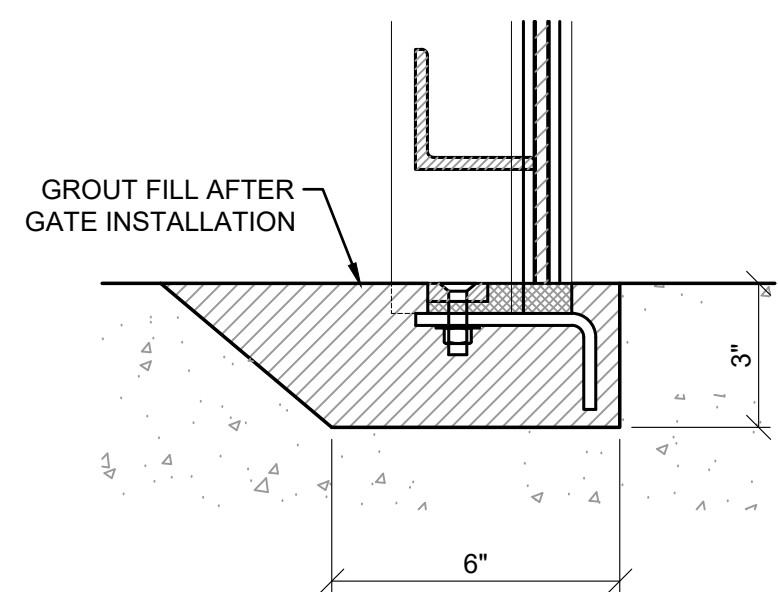
1 SECTION - UPWARD OPENING SLIDE GATE
D-911 SCALE: NOT TO SCALE



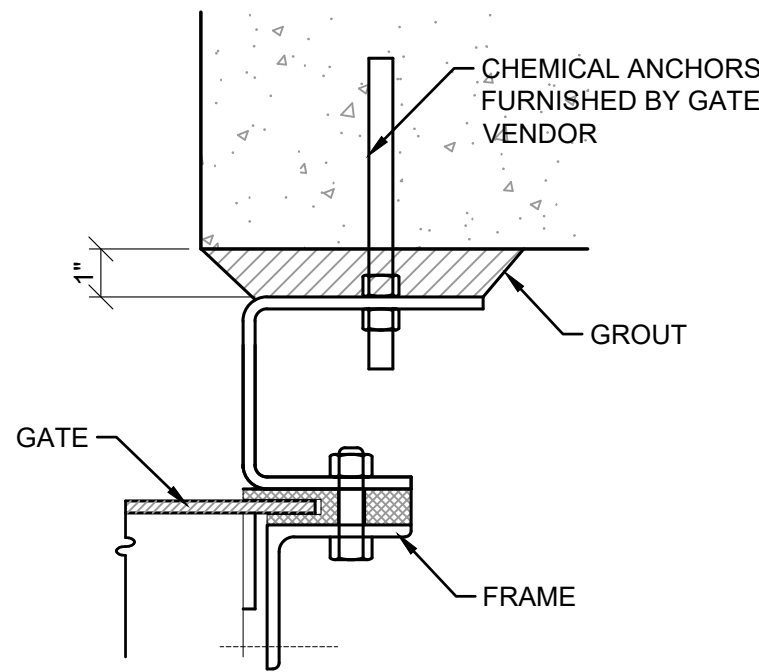
2 SECTION - DOWNWARD OPENING SLIDE GATE
D-911 SCALE: NOT TO SCALE



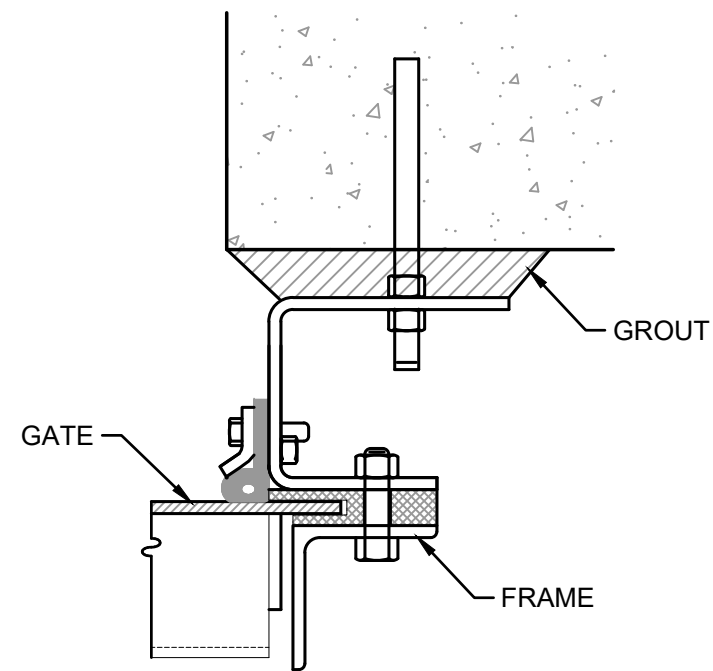
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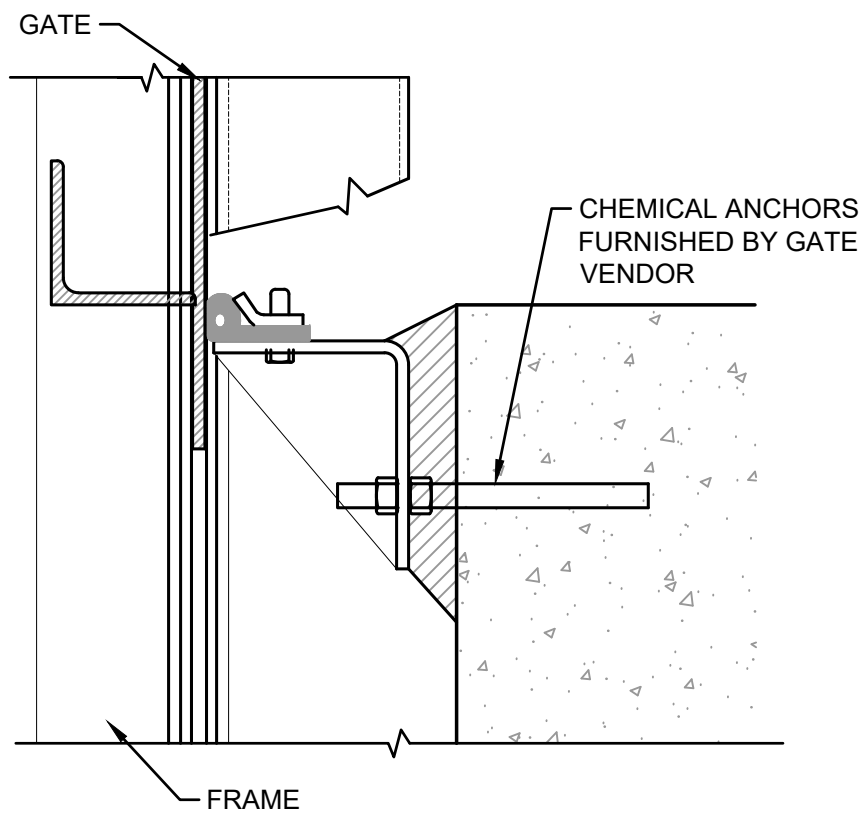
B DETAIL
D-911 SCALE: NOT TO SCALE



C DETAIL
D-911 SCALE: NOT TO SCALE



D DETAIL
D-911 SCALE: NOT TO SCALE



E VIEW TITLE
D-911 SCALE: NOT TO SCALE

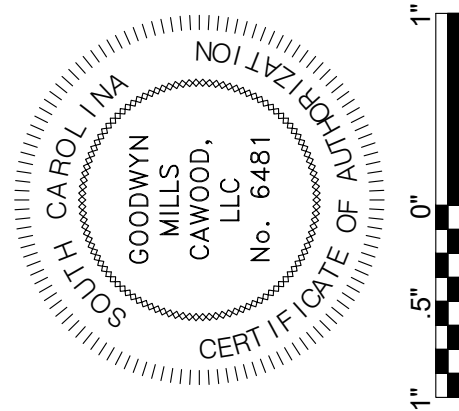
**GATESCHEDULE
& DETAILS
ATTACHMENTS**

D-911

**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

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Drawn By:	HKD



GMC
117 Welborn St.
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DRAWING FILE: T:\1 Projects\SC\Pendleton, Town of\CGRE20027 - Pendleton-Clemson WWTP\0 DWG\+CAD\01 BID DRAWINGS\10 PROCESS\D-921 VALVE SCHEDULE.dwg
PLOTTED: Mar 11, 2024 - 3:53pm

VALVE SCHEDULE

	TAG	SERVICE	TYPE	SIZE (INCHES)	CONNECTIONS	OPERATOR	NOTES
1000	V1011	RWW	BALL	1/4	THD	Lever	
	V1012	RWW	BALL	1/4	THD	Lever	
	V1013	RWW	AIR RELEASE	1/4	THD	N/A	
	V1014	RWW	CHECK	12	FLG	N/A	
	V1015	RWW	PLUG	12	FLG	Handwheel	
	V1021	RWW	BALL	1/4	THD	Lever	
	V1022	RWW	BALL	1/4	THD	Lever	
	V1023	RWW	AIR RELEASE	1/4	THD	N/A	
	V1024	RWW	CHECK	12	FLG	N/A	
	V1025	RWW	PLUG	12	FLG	Handwheel	
	V1031	RWW	BALL	1/4	THD	Lever	
	V1032	RWW	BALL	1/4	THD	Lever	
	V1033	RWW	AIR RELEASE	1/4	THD	N/A	
	V1034	RWW	CHECK	12	FLG	N/A	
	V1035	RWW	PLUG	12	FLG	Handwheel	
	V1041	RWW	BALL	1/4	THD	Lever	
	V1042	RWW	BALL	1/4	THD	Lever	
	V1043	RWW	AIR RELEASE	1/4	THD	N/A	
	V1044	RWW	CHECK	12	FLG	N/A	
	V1045	RWW	PLUG	12	FLG	Handwheel	
	V1051	RWW	BALL	1/4	THD	Lever	
	V1052	RWW	BALL	1/4	THD	Lever	
	V1053	RWW	AIR RELEASE	1/4	THD	N/A	
	V1054	RWW	CHECK	12	FLG	N/A	
	V1055	RWW	PLUG	12	FLG	Handwheel	
	V1110	RWW	PLUG	18	FLG	Handwheel	
	V1111	W	SOLENOID	1	THD	Electric Actuated	Furnished by Manufacturer
	V1112	W	BALL	1	THD	Lever	Furnished by Manufacturer
	V1113	W	PRESSURE REGULATING	1	THD	N/A	Furnished by Manufacturer
	V1114	W	BALL	1	THD	Lever	Furnished by Manufacturer
	V1115	W	SOLENOID	1/2	THD	Electric Actuated	
	V1116	W	BALL	1/2	THD	Lever	
	V1117	W	PRESSURE REGULATING	1/2	THD	N/A	
	V1118	W	SOLENOID	1/2	THD	Electric Actuated	
	V1120	RWW	PLUG	18	FLG	Handwheel	
	V1121	W	SOLENOID	1	THD	Electric Actuated	Furnished by Manufacturer
	V1122	W	BALL	1	THD	Lever	Furnished by Manufacturer
	V1123	W	PRESSURE REGULATING	1	THD	N/A	Furnished by Manufacturer
	V1124	W	BALL	1	THD	Lever	Furnished by Manufacturer
	V1130	RWW	PLUG	18	FLG	Handwheel	
	V1131	W	SOLENOID	1	THD	Electric Actuated	Furnished by Manufacturer
	V1132	W	BALL	1	THD	Lever	Furnished by Manufacturer
	V1133	W	PRESSURE REGULATING	1	THD	N/A	Furnished by Manufacturer
	V1134	W	BALL	1	THD	Lever	Furnished by Manufacturer
	V1140	RWW	PLUG	18	FLG	Handwheel	
	V1212	W	BALL	1/4	THD	Lever	Furnished by Manufacturer
	V1213	AIR	PINCH	4	FLG	Air Actuated	Furnished by Manufacturer
	V1214	VAC	SOLENOID	1/2	THD	Electric Actuated	Furnished by Manufacturer
	V1218	D	BALL	2	THD	Lever	Furnished by Manufacturer
	V1222	W	BALL	1/4	THD	Lever	Furnished by Manufacturer
	V1223	AIR	PINCH	4	FLG	Air Actuated	Furnished by Manufacturer
	V1224	VAC	SOLENOID	1/2	THD	Electric Actuated	Furnished by Manufacturer
	V1228	D	BALL	2	THD	Lever	Furnished by Manufacturer
2000	V2001	RWW	PLUG	20	FLG	Nut	
	V2002	RWW	PLUG	20	FLG	Nut	
	V2003	BYPASS	PLUG	24	FLG	Nut	
	V2004	RWW	PLUG	20	MJ	Nut	
	V2005	RWW	PLUG	20	FLG	Motorized	
	V2006	D	PLUG	8	MJ	Nut	
3000	V3100	RWW	PLUG	30	FLG	Handwheel	Furnished by BNR Manufacturer
	V3101	RWW	BALL	1	THD	Lever	Furnished by BNR Manufacturer
	V3102	RWW	AIR RELEASE	1	THD	N/A	Furnished by BNR Manufacturer
	V3103	RWW	CHECK	30	FLG	N/A	Furnished by BNR Manufacturer
	V3104	RWW	PLUG	30	FLG	Motorized	Furnished by BNR Manufacturer
	V3105	SN	PLUG	20	FLG	Handwheel	Furnished by BNR Manufacturer
	V3106	SN	PLUG	20	FLG	Motorized	Furnished by BNR Manufacturer
	V3107	WAS	PLUG	20	FLG	Handwheel	Furnished by BNR Manufacturer
	V3108	WAS	PLUG	20	FLG	Motorized	Furnished by BNR Manufacturer
	V3110	A	BUTTERFLY	12	FLG	Handwheel	Furnished by BNR Manufacturer

3000

TAG	SERVICE	TYPE	SIZE (INCHES)	CONNECTIONS	OPERATOR	NOTES
V3111	A	BALL	1/4	THD	Lever	Furnished by BNR Manufacturer
V3112	A	BUTTERFLY	6	FLG	Motorized	Furnished by BNR Manufacturer
V3113	A	BUTTERFLY	4	FLG	Motorized	Furnished by BNR Manufacturer
V3114	A	BUTTERFLY	4	FLG	Motorized	Furnished by BNR Manufacturer
V3115	A	BUTTERFLY	4	FLG	Handwheel	Furnished by BNR Manufacturer
V3200	RWW	PLUG	30	FLG	Handwheel	Furnished by BNR Manufacturer
V3201	RWW	BALL	1	THD	Lever	Furnished by BNR Manufacturer
V3202	RWW	AIR RELEASE	1	THD	N/A	Furnished by BNR Manufacturer
V3203	RWW	CHECK	30	FLG	N/A	Furnished by BNR Manufacturer
V3204	RWW	PLUG	30	FLG	Motorized	Furnished by BNR Manufacturer
V3205	SN	PLUG	20	FLG	Handwheel	Furnished by BNR Manufacturer
V3206	SN	PLUG	20	FLG	Motorized	Furnished by BNR Manufacturer
V3207	WAS	PLUG	20	FLG	Handwheel	Furnished by BNR Manufacturer
V3208	WAS	PLUG	20	FLG	Motorized	Furnished by BNR Manufacturer
V3210	A	BUTTERFLY	12	FLG	Handwheel	Furnished by BNR Manufacturer
V3211	A	BALL	1/4	THD	Lever	Furnished by BNR Manufacturer
V3212	A	BUTTERFLY	6	FLG	Motorized	Furnished by BNR Manufacturer
V3213	A	BUTTERFLY	4	FLG	Motorized	Furnished by BNR Manufacturer
V3214	A	BUTTERFLY	4	FLG	Motorized	Furnished by BNR Manufacturer
V3215	A	BUTTERFLY	4	FLG	Handwheel	Furnished by BNR Manufacturer
V3300	RWW	PLUG	30	FLG	Handwheel	Furnished by BNR Manufacturer
V3301	RWW	BALL	1	THD	Lever	Furnished by BNR Manufacturer
V3302	RWW	AIR RELEASE	1	THD	N/A	Furnished by BNR Manufacturer
V3303	RWW	CHECK	30	FLG	N/A	Furnished by BNR Manufacturer
V3304	RWW	PLUG	30	FLG	Motorized	Furnished by BNR Manufacturer
V3305	SN	PLUG	20	FLG	Handwheel	Furnished by BNR Manufacturer
V3306	SN	PLUG	20	FLG	Motorized	Furnished by BNR Manufacturer
V3307	WAS	PLUG	20	FLG	Handwheel	Furnished by BNR Manufacturer
V3308	WAS	PLUG	20	FLG	Motorized	Furnished by BNR Manufacturer
V3310	A	BUTTERFLY	12	FLG	Handwheel	Furnished by BNR Manufacturer
V3311	A	BALL	1/4	THD	Lever	Furnished by BNR Manufacturer
V3312	A	BUTTERFLY	6	FLG	Handwheel	Furnished by BNR Manufacturer
V3313	A	BUTTERFLY	4	FLG	Motorized	Furnished by BNR Manufacturer
V3314	A	BUTTERFLY	4	FLG	Motorized	Furnished by BNR Manufacturer
V3315	A	BUTTERFLY	4	FLG	Handwheel	Furnished by BNR Manufacturer
V3401	SN	BALL	2	THD	Lever	
V3402	SN	AIR RELEASE	2	THD	N/A	
V3411	SN	BALL	1/4	THD	Lever	
V3412	SN	BALL	1/4	THD	Lever	
V3413	SN	AIR RELEASE	1/4	THD	N/A	
V3414	SN	CHECK	8	FLG	N/A	
V3415	SN	PLUG	8	FLG	Handwheel	
V3421	SN	BALL	1/4	THD	Lever	
V3422	SN	BALL	1/4	THD	Lever	
V3423	SN	AIR RELEASE	1/4	THD	N/A	
V3424	SN	CHECK	8	FLG	N/A	
V3425	SN	PLUG	8	FLG	Handwheel	
V3501	WAS	TELESCOPING	8	FLG	Handwheel	
V3502	WAS	BALL	2	THD	Lever	
V3503	WAS	AIR RELEASE	2	THD	N/A	
V3611	AIR	BUTTERFLY	10	FLG	Handwheel	Furnished by BNR Manufacturer
V3612	D	BALL	1/4	THD	Lever	Furnished by BNR Manufacturer
V3613	AIR	BALL	1/4	THD	Lever	Furnished by BNR Manufacturer
V3614	AIR	SAFETY RELIEF	1/4	THD	N/A	Furnished by BNR Manufacturer
V3615	AIR	BALL	1/4	THD	Lever	Furnished by BNR Manufacturer
V3616	AIR	BALL	1/4	THD	Lever	Furnished by BNR Manufacturer
V3617	AIR	CHECK	10	FLG	N/A	Furnished by BNR Manufacturer
V3621	AIR	BUTTERFLY	10	FLG	Handwheel	Furnished by BNR Manufacturer
V3622	D	BALL	1/4	THD	Lever	Furnished by BNR Manufacturer
V3623	AIR	BALL	1/4	THD	Lever	Furnished by BNR Manufacturer
V3624	AIR	SAFETY RELIEF	1/4	THD	N/A	Furnished by BNR Manufacturer
V3625	AIR	BALL	1/4	THD	Lever	Furnished by BNR Manufacturer
V3626	AIR	BALL	1/4	THD	Lever	Furnished by BNR Manufacturer
V3627	AIR	CHECK	10	FLG	N/A	Furnished by BNR Manufacturer
V3631	AIR	BUTTERFLY	10	FLG	Handwheel	Furnished by BNR Manufacturer
V3632	D	BALL	1/4	THD	Lever	Furnished by BNR Manufacturer
V3633	AIR	BALL	1/4	THD	Lever	Furnished by BNR Manufacturer
V3634	AIR	SAFETY RELIEF	1/4	THD	N/A	Furnished by BNR Manufacturer
V3635	AIR	BALL	1/4	THD	Lever	Furnished by BNR Manufacturer
V3636	AIR	BALL	1/4	THD	Lever	Furnished by BNR Manufacturer
V3637	AIR	CHECK	10	FLG	N/A	Furnished by BNR Manufacturer

PENDLETON - CLEMSON

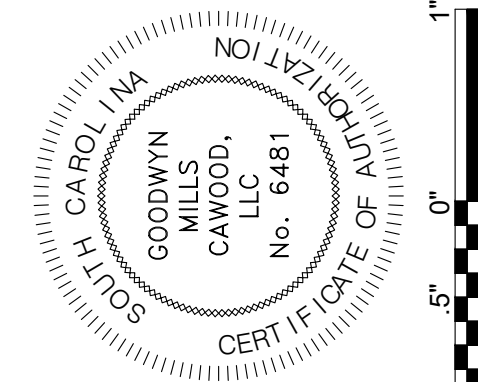
REGIONAL WWTP EXPANSION

PENDLETON, SOUTH CAROLINA
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GMC PROJECT #CGRE220027

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GMC
117 Welborn St.
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VALVE
SCHEDULE

D-921

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PLOTTED: Mar 11, 2024 - 3:54pm

VALVE SCHEDULE							
	TAG	SERVICE	TYPE	SIZE (INCHES)	CONNECTIONS	OPERATOR	NOTES
4000	V4001	SE	PLUG	24	FLG	Handwheel	
	V4002	BYPASS	PLUG	24	MJ	Nut	
	V4003	SE	PLUG	24	MJ	Nut	
	V4004	SE	BALL	2	THD	Lever	
	V4005	SE	AIR RELEASE	2	THD	N/A	
	V4006	SE	PLUG	20	FLG	Motorized	
5000	V5002	SE	PLUG	24	FLG	Handwheel	
	V5201	SE	BUTTERFLY	16	FLG	Handwheel	
	V5203	D	BALL	2	THD	Lever	
	V5204	REC	BALL	3	THD	Lever	
	V5205	BWW	BALL	2	THD	Lever	
	V5206	BWW	BALL	2	THD	Lever	
	V5207	BWW	BALL	2	THD	Lever	
	V5208	BWW	BALL	2	THD	Lever	
	V5209	D	BALL	3	THD	Lever	
	V5211	BWW	BALL	1/4	THD	Lever	
	V5212	BWW	BALL	1/4	THD	Lever	
	V5213	BWW	GATE	3	THD	Lever	
	V5221	BWW	BALL	1/4	THD	Lever	
	V5222	BWW	BALL	1/4	THD	Lever	
	V5223	BWW	GATE	3	THD	Lever	
	V5301	SE	BUTTERFLY	16	FLG	Handwheel	
	V5303	D	BALL	2	THD	Lever	
	V5304	REC	BALL	3	THD	Lever	
	V5305	BWW	BALL	2	THD	Lever	
	V5306	BWW	BALL	2	THD	Lever	
	V5307	BWW	BALL	2	THD	Lever	
	V5308	BWW	BALL	2	THD	Lever	
	V5309	D	BALL	3	THD	Lever	
	V5311	BWW	BALL	1/4	THD	Lever	
	V5312	BWW	BALL	1/4	THD	Lever	
	V5313	BWW	GATE	3	THD	Lever	
	V5321	BWW	BALL	1/4	THD	Lever	
	V5322	BWW	BALL	1/4	THD	Lever	
	V5323	BWW	GATE	3	THD	Lever	
7000	V7012	BYPASS	PLUG	8	FLG	Handwheel	
	V7021	SN	PLUG	6	FLG	Handwheel	Furnished by Manufacturer
	V7031	SN	PLUG	6	FLG	Handwheel	Furnished by Manufacturer
	V7032	WAS	PLUG	6	MJ	Nut	
	V7033	D	PLUG	6	MJ	Nut	
	V7034	DS	PLUG	6	MJ	Nut	
	V7035	AIR	BUTTERFLY	8	FLG	Handwheel	
	V7111	DS	BALL	1/4	THD	Lever	
	V7112	DS	CHECK	4	FLG	N/A	
	V7113	DS	PLUG	4	FLG	Handwheel	
	V7114	DS	PLUG	4	FLG	Handwheel	
	V7115	DS	PLUG	4	FLG	Handwheel	
	V7201	DS	PLUG	8	FLG	Handwheel	
	V7202	DS	PLUG	8	FLG	Handwheel	
	V7203	DS	PLUG	8	FLG	Handwheel	
	V7204	DS	PLUG	8	FLG	Handwheel	
	V7205	DS	PLUG	8	FLG	Handwheel	
	V7206	DS	PLUG	8	FLG	Handwheel	
	V7207	DS	PLUG	8	FLG	Handwheel	
	V7208	DS	PLUG	8	FLG	Handwheel	
	V7209	DS	PLUG	8	FLG	Handwheel	
	V7210	DS	PLUG	8	FLG	Handwheel	
	V7211	D	PLUG	8	MJ	Nut	
	V7212	D	PLUG	8	FLG	Nut	

VALVE SCHEDULE							
	TAG	SERVICE	TYPE	SIZE (INCHES)	CONNECTIONS	OPERATOR	NOTES
8000	V8011	RUW	CHECK	4	FLG	N/A	
	V8012	RUW	BALL	4	FLG	Lever	
	V8013	RUW	BALL	4	FLG	Lever	
	V8014	RUW	BALL	1/4	THD	Lever	
	V8015	RUW	CHECK	4	FLG	N/A	
	V8016	RUW	BALL	4	FLG	Lever	
	V8017	D	BALL	4	FLG	Lever	
	V8018	RUW	BALL	1/4	THD	Lever	
	V8019	RUW	BALL	2	THD	Lever	
	V8020	RUW	PRESSURE REGULATING	2	THD	N/A	
	V8021	RUW	BALL	2	THD	Lever	

VALVE
SCHEDULE

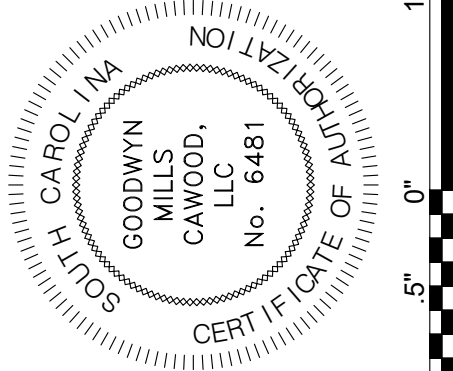
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PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

ISSUE

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08.07.2023	60% Submittal
12.04.2023	90% Submittal
03.08.2024	100% Submittal
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	Project Manager:
	Engineer:
	Designer:
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PLOTTER: Mar 18, 2022 2:45pm

ELECTRICAL LEGEND	
4' STRIP FLUORESCENT UNO. SURFACE MOUNTED OR CHAIN HUNG. LETTER "X" INDICATES FIXTURE TYPE. SEE LUMINAIRE SCHEDULE. THE LETTER "E" INDICATES EMERGENCY BATTERY BACKUP.	
WALL MOUNTED FIXTURE. LETTER "X" INDICATES FIXTURE TYPE. SEE LUMINAIRE SCHEDULE. THE LETTER "E" INDICATES EMERGENCY BATTERY BACKUP.	
LED SIGHT LIGHT FIXTURE. LETTER "X" INDICATES FIXTURE TYPE.	
POST TOP LED LIGHT FIXTURE. LETTER "X" INDICATES FIXTURE TYPE.	
THERMOSTAT	
DUPLEX RECEPTACLE WALL MOUNTED 18" A.F.F. TO CENTER UNO.	
QUADRAPLEX RECEPTACLE WALL MOUNTED 18" A.F.F. TO CENTER UNO.	
DUPLEX GROUND FAULT CIRCUIT INTERRUPTER (5mA) RECEPTACLE WALL MOUNTED 18" A.F.F. TO CENTER UNO.	
WEATHERPROOF TOGGLE SWITCH	
MOTOR - HORSEPOWER AS INDICATED.	
DISCONNECT SWITCH, SEE DISCONNECT SCHEDULE.	

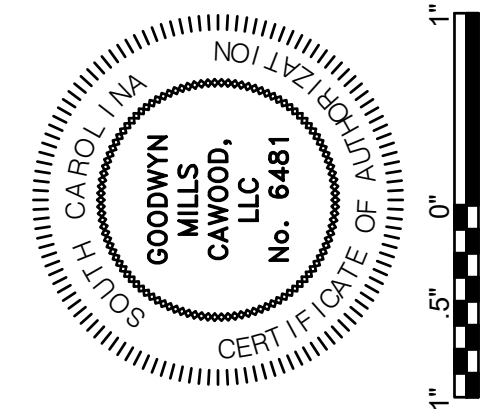
INSTRUMENT LEGEND	
MOTOR ACTUATED VALVES, SEE DRAWING FOR VOLTAGES	
SOLENOID VALVE	
CONTROL VALVE (FLOW, OTHER)	
FLOW METER	
TEMPERATURE SWITCH	
FLOW SWITCH	
LEVEL TRANSMITTER	
LEVEL ELEMENT	
ANALOG INSTRUMENT TRANSMITTER	
ANALYZER: pH, TURBIDITY (TURB), OR STREAMING CURRENT (SCD)	
FLOW TRANSMITTER	
FLOW ELEMENT	
DIFFERENTIAL PRESSURE INDICATOR	
HIGH LEVEL SWITCH	
PRESSURE INDICATING TRANSMITTER	

LINETYPE LEGEND	
CONDUIT OR RACEWAY EXPOSED TO VIEW. RUN PARALLEL OR PERPENDICULAR TO STRUCTURE. CONCEAL FROM VIEW AS MUCH AS POSSIBLE.	
CONDUIT OR RACEWAY CONCEALED IN CEILING CAVITY OR WALL.	
CONDUIT OR RACEWAY UNDERGROUND OR CONCEALED IN FLOOR SLAB.	

GROUNDING LEGEND	
GROUND CONNECTION, EXOTHERMIC.	
AIR TERMINAL, SEE DETAIL 1/E-905	
GROUND ROD & CONNECTION. (T" INDICATES TEST WELL)	
GROUND CONNECTION, 1-HOLE OR 2-HOLE SOLDERLESS MECHANICAL OR COMPRESSION LUG.	
GROUND CABLE FOR GROUNDING ELECTRODE SYSTEM (GES).	
DOWN LEAD, SEE DETAIL 3/E-905, 4/E-905	
DISSIPATION ARRAY SYSTEM (DAS) MOUNTED ON A 35'-0" TAPERED STEEL POLE. DAS SHALL BE MANUFACTURED BY LIGHTING ELIMINATORS @ LIGHTNINGPROTECTION.COM. PROVIDE 4/0CU CONDUCTOR UP POLE. ALL CONNECTIONS SHALL BE MADE THERMALLY. SEE DETAIL X/E-XXX.	
NETWORK BOND TO GROUND AND NEUTRAL BUSSES WITHIN SWITCHGEAR OR POWER PANELS. MINIMUM CONDUCTOR SIZE SHALL BE 4/0CU. ALL FIELD CONNECTIONS SHALL BE MADE THERMALLY. SLEEVE CONDUCTOR WITH 2" PVC.	
GROUNDING ELECTRODE BANK. MINIMUM OF 6 - 10'-0" COPPER GROUND RODS SPACE 20'-0" APART. MINIMUM CONDUCTOR SIZE SHALL BE 4/0CU. ALL CONNECTIONS SHALL BE MADE THERMALLY. SLEEVE CONDUCTOR WITH 2" PVC.	

ABBREVIATIONS			
ABB.	DESCRIPTION	ABB.	DESCRIPTION
A	AMPERES	LAHJ	LOCAL AUTHORITY HAVING JURISDICTION
AC	AIR CONDITIONING	LGT	LIGHT
ACT	ABOVE COUNTER TOP	LOTO	LOCK-OUT TAG-OUT
AFF	ABOVE FINISHED FLOOR	M	METER
AIC	AMPERES INTERRUPTING CAPACITY (MIN)	MAT	MASTER ANTENNA TELEVISION
APPROX.	APPROXIMATELY	MAX	MAXIMUM
AWG	AMERICAN WIRE GAUGE	MCM	THOUSAND CIRCULAR MILS
ANN	ANNUNCIATOR	MDP	MAIN DISTRIBUTION PANEL
BFG	BELOW FINISHED GRADE	MIN	MINIMUM
BLDG	BUILDING	MLO	MAIN LUGS ONLY
BPS	BOLTED PRESSURE SWITCH	MPC	MAIN POWER CENTER
C	CONDUIT	MTD, MTG	MOUNT (ED), (ING)
CAT	CATALOG	N	NORTH
CATV	CABLE TELEVISION	NEC	NATIONAL ELECTRIC CODE
CKT	CIRCUIT	NIC	NOT IN CONTRACT
CONT	CONTINUATION	NO	NUMBER
CR	CARD READER	NTS	NOT TO SCALE
DD	DUCT DETECTOR	OC	ON CENTER
DIA	DIAMETER	OSHA	OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
DIM	DIMENSION	P	POLE
DP	DISTRIBUTION PANEL	PC	PHOTO CELL
DWG	DRAWINGS	PMS	PROPERTY MANAGEMENT SYSTEM
EA	EACH	PNL	PANEL
EC	EMPTY CONDUIT	PVC	POLYVINYL CHLORIDE
ELEC	ELECTRICAL	RS	RAPID START
EMER	EMERGENCY	RSC	RIGID STEEL CONDUIT
EMT	ELECTRICAL METALLIC TUBING	SD	SMOKE DETECTOR
EOL	END OF LINE RESISTOR	SIM	SIMILAR
EQUIP	EQUIPMENT	S/S	STAINLESS STEEL
F	FUSED	SPST	SINGLE POLE SINGLE THROW
FA	FIRE ALARM	T	TRANSFORMER
FIN	FINISH	TC	TRAY CABLE
FIX	FIXTURE	TBB	TELEPHONE BACKBOARD
FLUOR.	FLUORESCENT	TEL	TELEPHONE
GFI	GROUND FAULT INTERRUPTER	TM	TV MONITOR
GRC	GALVANIZED RIGID STEEL CONDUIT	TYP	TYPICAL
GRND, G	GROUND	UNO	UNLESS OTHERWISE NOTED
HP	HORSEPOWER	V	VOLT
IAW	IN ACCORDANCE WITH	W	WIRE
IF	INSIDE FROST	WP	WEATHERPROOF
IG	ISOLATED GROUND	WW	WARM WHITE
INCAN	INCANDESCENT	XFMR	TRANSFORMER
J	JUNCTION	PDC	POWER DISTRIBUTION CONTROLLER
KVA	KILO-VOLT-AMPERE	E.W.	EACH WAY
KW	KILOWATT	OCEW	ON CENTER EACH WAY

GENERAL NOTES	
1.	ALL ELECTRICAL WORK AND MATERIALS SHALL CONFORM TO THE LATEST EDITION OF THE N.E.C. AND THE REQUIREMENTS OF THE LOCAL AUTHORITY HAVING JURISDICTION.
2.	CONDUIT ABOVE CEILINGS, IN WALLS, ETC., WHERE NOT SUBJECT TO MOISTURE OR DAMAGE SHALL BE EMT. WHERE SUBJECT TO DAMAGE, OUTSIDE BUILDING SHALL BE R1510 ALUMINUM.
3.	EQUIPMENT GROUNDING SHALL BE IN ACCORDANCE WITH N.E.C.
4.	ALL ELECTRICAL EQUIPMENT SHALL BE PROVIDED BY ELECTRICAL CONTRACTOR UNLESS NOTED OTHERWISE.
5.	ALL WORK SHALL BE COORDINATED WITH THE WORK OF OTHER TRADES TO AVOID INTERFERENCES AND CONFLICTS. REFER TO THE DRAWINGS OF THE RESPECTIVE SYSTEMS PRIOR TO SUBMISSION OF BIDS FOR ADDITIONAL WORK WHICH MAY BE REQUIRED AS PART OF THIS WORK. NO ALLOWANCES WILL BE MADE FOR THE LACK OF COORDINATION BETWEEN DISCIPLINES OR SYSTEMS AND EQUIPMENT.
6.	THE WORK SHALL BE COORDINATED WITH THE ENGINEERING DOCUMENTS FOR THE EXACT LOCATION OF LIGHT FIXTURES, EQUIPMENT, DEVICES, ETC. TO ASSURE PROPER PLACEMENT OF SAID DEVICES AND EQUIPMENT. WHERE A CONFLICT EXISTS BETWEEN ANY TWO DOCUMENTS, NOTIFY THE ENGINEER PRIOR TO ANY INSTALLATION FOR RESOLUTION.
7.	THE CONTRACTOR SHALL VERIFY ALL EQUIPMENT BEING INSTALLED PRIOR TO INSTALLATION TO ASSURE THAT THE FEEDER, DISCONNECT, STARTER, OVER CURRENT PROTECTION, ETC. MATCHES THE ACTUAL NAMEPLATE DATA AS SUPPLIED BY THE MANUFACTURER.
8.	SPECIFIC REQUIREMENTS REGARDING MATERIALS, WORKMANSHIP, AND THE WORK TO BE DONE ARE COVERED BY THE SPECIFICATIONS WHICH COMPLEMENT THE PLANS. WORK CALLED FOR BY THE SPECIFICATIONS OR THE PLANS IS REQUIRED THE SAME AS IF REQUIRED BY BOTH. WHERE A CONFLICT EXISTS BETWEEN THE PLANS AND SPECIFICATIONS, THE MORE STRINGENT REQUIREMENTS OF THE TWO SHALL APPLY.
9.	REFER TO EQUIPMENT CUT SHEETS AND MANUFACTURER'S DATA FOR ROUGH IN LOCATIONS OF ELECTRICAL CONNECTIONS AND INTERCONNECTIONS OF ALL EQUIPMENT.
10.	INSTALL OVER CURRENT PROTECTION AND BRANCH CIRCUIT WIRING PER U.L. LISTING REQUIREMENTS FOR EQUIPMENT SERVED - REFER TO NAMEPLATE DATA.
11.	PROVIDE START-UP ASSISTANCE TO OWNER PERSONNEL AND EQUIPMENT TECHNICIANS TO CONFIRM CORRECT PHASE ROTATION, PROPER OPERATION & SEQUENCE, AND CONTROLS.
12.	CONTRACTOR SHALL COORDINATE ELEVATIONS AND PIPING SYSTEM SLOPES SUCH THAT DUCTWORK, PIPING, RACEWAY, CABLE TRAY, AND ASSOCIATED EQUIPMENT IS INSTALLED AT UNIFORM ELEVATIONS WITH MINIMAL OFFSET. PROVIDE COORDINATION DRAWING TO ENGINEER FOR REVIEW PRIOR TO EQUIPMENT ORDERS AND ROUGH-IN.
13.	VERIFY ALL DOOR SWINGS WITH ARCHITECTURAL PLANS BEFORE ROUGHING IN LIGHT SWITCHES.
14.	ELECTRICAL CONTRACTOR TO FIELD MARK ELECTRICAL SERVICE EQUIPMENT WITH A CONSPICUOUS AND PERMANENT LABEL THAT INDICATES THE AVAILABLE FAULT CURRENT PER NEC 110.16 & 110.24.
15.	ELECTRICAL CONTRACTOR SHALL VERIFY THE LOCATION OF EXISTING UNDERGROUND UTILITIES PRIOR TO COMMENCEMENT OF ANY EXCAVATION.
16.	PROVIDE UNSWITCHED PHASE CONDUCTOR TO EMERGENCY LIGHTS AND/OR EXIT SIGNS FOR 24 HOUR OPERATION.
17.	ELECTRICAL EQUIPMENT SHALL BE FULLY RATED FOR THE FAULT CURRENT INDICATED ON THE PLANS. NO SERIES RATING WILL BE ACCEPTED.
18.	DO NOT INSTALL DEVICES WITHIN 24" OF EACH OTHER IN ANY FIRE RATED WALLS.
19.	SEAL ALL PENETRATIONS IN ACCORDANCE WITH A UL APPROVED METHOD TO MAINTAIN THE UL RATING OF THE WALL AS INDICATED IN ARCHITECTURAL PLANS.
20.	FINAL CONNECTIONS TO MOTORS AND OTHER EQUIPMENT AS INDICATED ON PLANS SHALL BE WITH FLEXIBLE STEEL CONDUIT IN DRY LOCATIONS AND LIQUID TIGHT FLEX IN WET, DAMP, OR SPRAY DOWN LOCATIONS. VERIFY EXACT LOCATION OF ALL MOTORS AND EQUIPMENT BEFORE ROUGH IN.
21.	ELECTRICAL CONTRACTOR SHALL NOTE THAT ONLY BASIC AIR CONDITIONING AND HEATING CONTROLS ARE SHOWN ON DRAWINGS. EXACT LAYOUT AND DIAGRAMS MUST BE OBTAINED FROM RESPECTIVE SUBCONTRACTORS FOR A COMPLETE COORDINATED WORKING LAYOUT.
22.	SUBSURFACE CONDUIT SHALL BE SCHEDULE 40PVC UNO. VERTICAL TURN UPS SHALL BE GRC SWEEP 90S WITH A BITUMASTIC COATING OR PVC COATED RGC UNO.
23.	ALL EMPTY CONDUITS SHALL HAVE A 200 LBS NYLON PULL STRING. SUBSURFACE CONDUITS TURNING UP AND TERMINATING SHALL BE CAPPED ON BOTH ENDS TO PREVENT ENTRY OF RODENTS, WATER, AND OTHER FOREIGN MATTER. DUCT TAPE IS NOT CONSIDERED AN ACCEPTABLE MEANS OF CAPPING.
24.	IT SHALL BE THE RESPONSIBILITY OF THE ELECTRICAL CONTRACTOR TO VISIT THE SITE AND TO BECOME THOROUGHLY FAMILIAR WITH ALL EXISTING CONDITIONS PRIOR TO BID DATE AS HE SHALL BE RESPONSIBLE FOR THE SAME.
25.	ELECTRICAL CONTRACTOR WILL PROVIDE ALL MATERIAL TO FINALIZE A NEAT, COMPLETE, AND PROPERLY WORKING ELECTRICAL SYSTEM WHICH CONFORMS TO ALL LOCAL CODES AND THE NATIONAL ELECTRICAL CODE (N.E.C.), PLANS, AND SPECIFICATIONS.
26.	CONTRACTOR SHALL REPAIR ANY DISTURBED AREA TO SAME COMPACTION, GRADE, SLOPE, ETC. AS ORIGINAL AREA INCLUDING REPLACEMENT OF SOD, GRASS, ROCK, GRAVEL, RIP-RAP, ETC. TO THE SATISFACTION OF THE OWNER AND ENGINEER.
27.	SLOPE ALL AREAS AROUND CONCRETE PADS TO PREVENT WATER PONDING.
28.	CLEAN UP ALL DEBRIS AROUND CONSTRUCTION SITE DAILY.
29.	REMOVE ANY SPILLED DIRT, CONCRETE, ETC. FROM ANY DRIVEWAYS, ROADWAYS OR CONSTRUCTION SITE AS DIRECTED BY OWNER OR ENGINEER.



ISSUE DATE	
30% Submittal	01.18.2023
60% Submittal	08.07.2023
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100% Submittal	03.08.2024
Conformed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

ELECTRICAL NOTES,
ABBREVIATIONS,
& LEGEND

E-001

GMC

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PLOTTED: Mar 15, 2024 - 3:53pm



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E-002

SITE PLAN

SCALE: 1" = 60'-0"



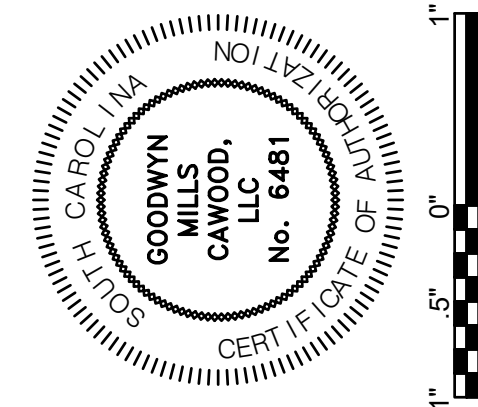
KEY
SITE PLAN

E-002

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SCALE: 1" = 60'-0"

SCALE: 1" = 60'-0"

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1. INSTALL BOLLARDS AROUND GENERATORS, TRANSFORMERS, ETC. WHERE EQUIPMENT IS INSTALLED IN AREAS SUBJECT TO VEHICULAR TRAFFIC. SEE DETAILS FOR BOLLARD INSTALLATION REQUIREMENTS.

PENDLETON - CLEMSON

REGIONAL WWTP EXPANSION

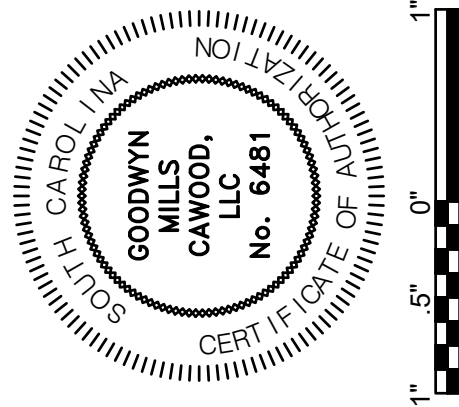
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Town of Pendleton
City of Clemson
Anderson County

F-003

GMC PROJECT #CGRE220027

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30% Submittal	01.18.2023
60% Submittal	08.07.2023
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Conformed Set	
Project Manager:	JB
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Designer:	JB
Drawn By:	MBH



CNC

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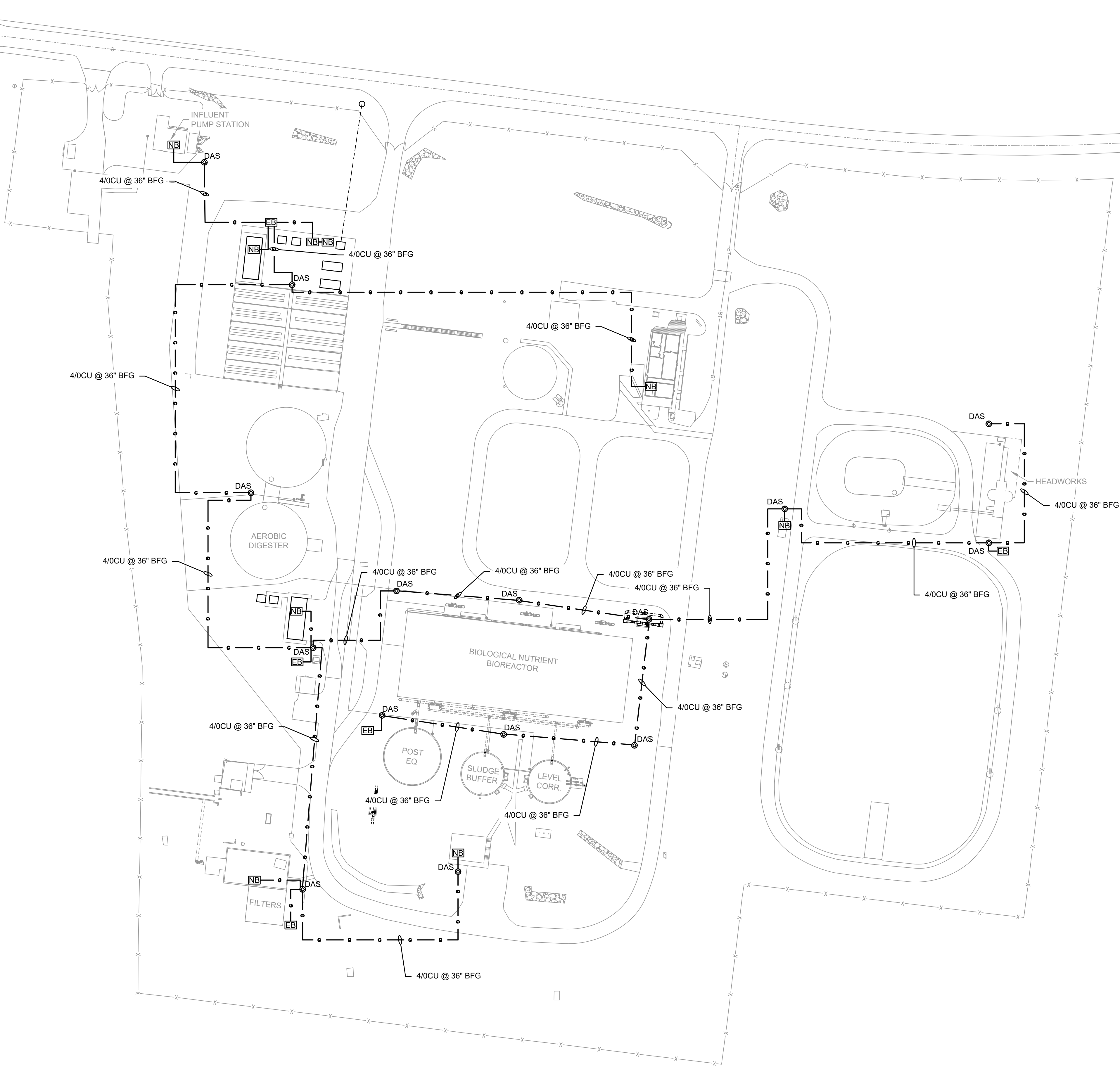


1

E-004

SITE PLAN

SCALE: 1" = 60'-0"



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**LIGHTNING
PROTECTION AND
SUPPLEMENTAL
GROUND SYSTEM**

E-004

PENDLETON - CLEMSON

REGIONAL WWT EXPANSION

PENDLETON, SOUTH CAROLINA

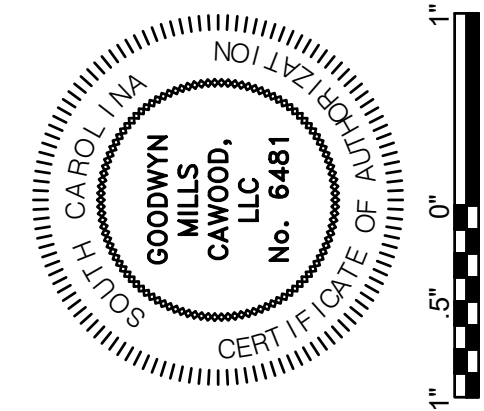
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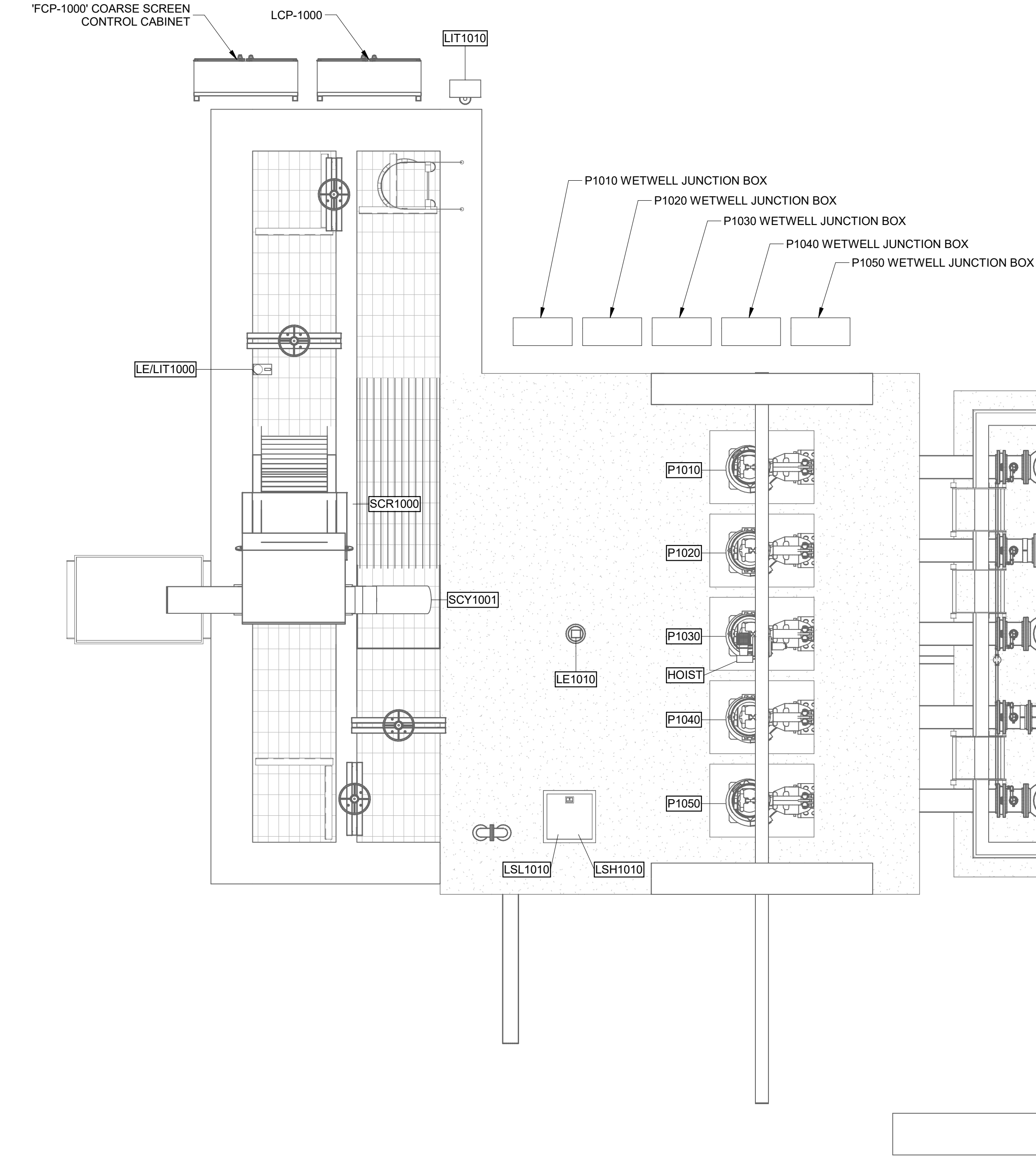


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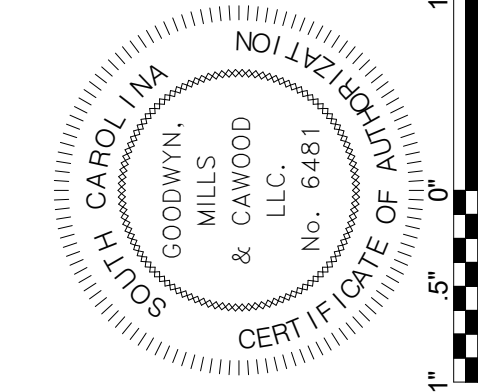
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1
E-101
SCALE: 1/4" = 1'-0"



- GENERAL NOTES:**
- SEE SCHEDULES FOR CONDUIT, WIRE, AND CONNECTION REQUIREMENTS FOR EQUIPMENT SHOWN.
 - SEE DETAIL 2/E-903 FOR WETWELL JUNCTION BOX REQUIREMENTS.
 - SEE WIRING SCHEDULES FOR CONNECTION DETAILS TO SHOWN FIELD INSTRUMENTS AND EQUIPMENT.



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INFLUENT PUMP
STATION - PLAN

E-101

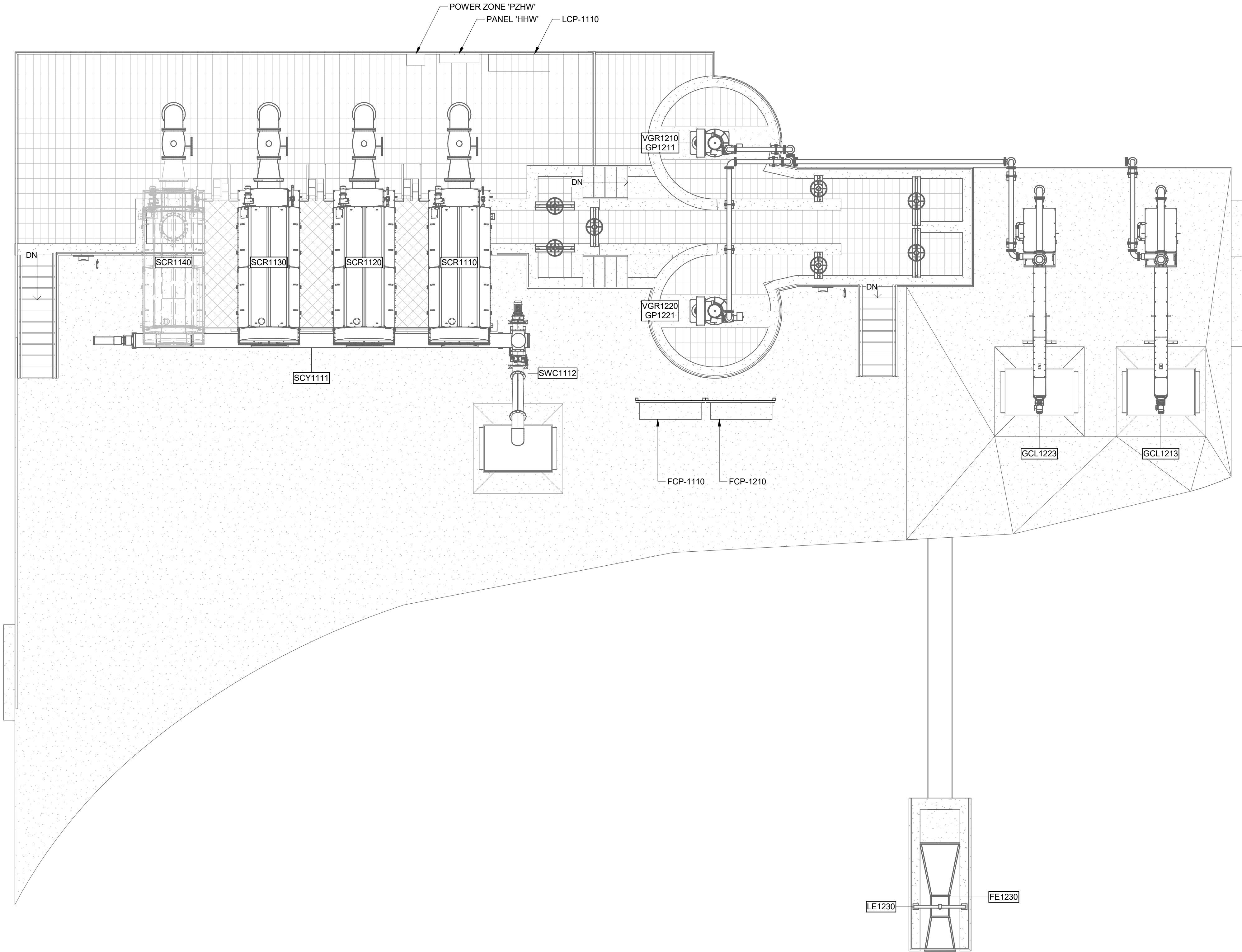
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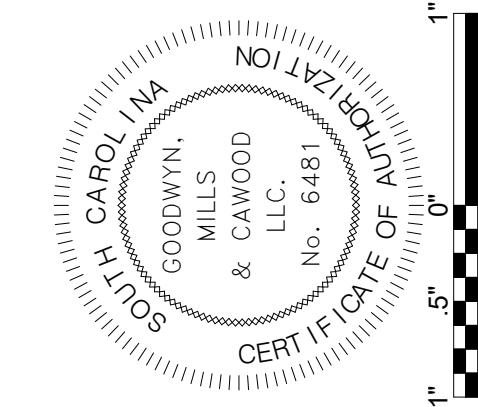
PLAN

SCALE: 3/16" = 1'-0"



GENERAL NOTES:

1. SEE SCHEDULES FOR CONDUIT, WIRE, AND CONNECTION REQUIREMENTS FOR EQUIPMENT SHOWN.
2. SEE WIRING SCHEDULES FOR CONNECTION DETAILS TO SHOWN FIELD INSTRUMENTS AND EQUIPMENT.



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HEADWORKS - UPPER
PLAN

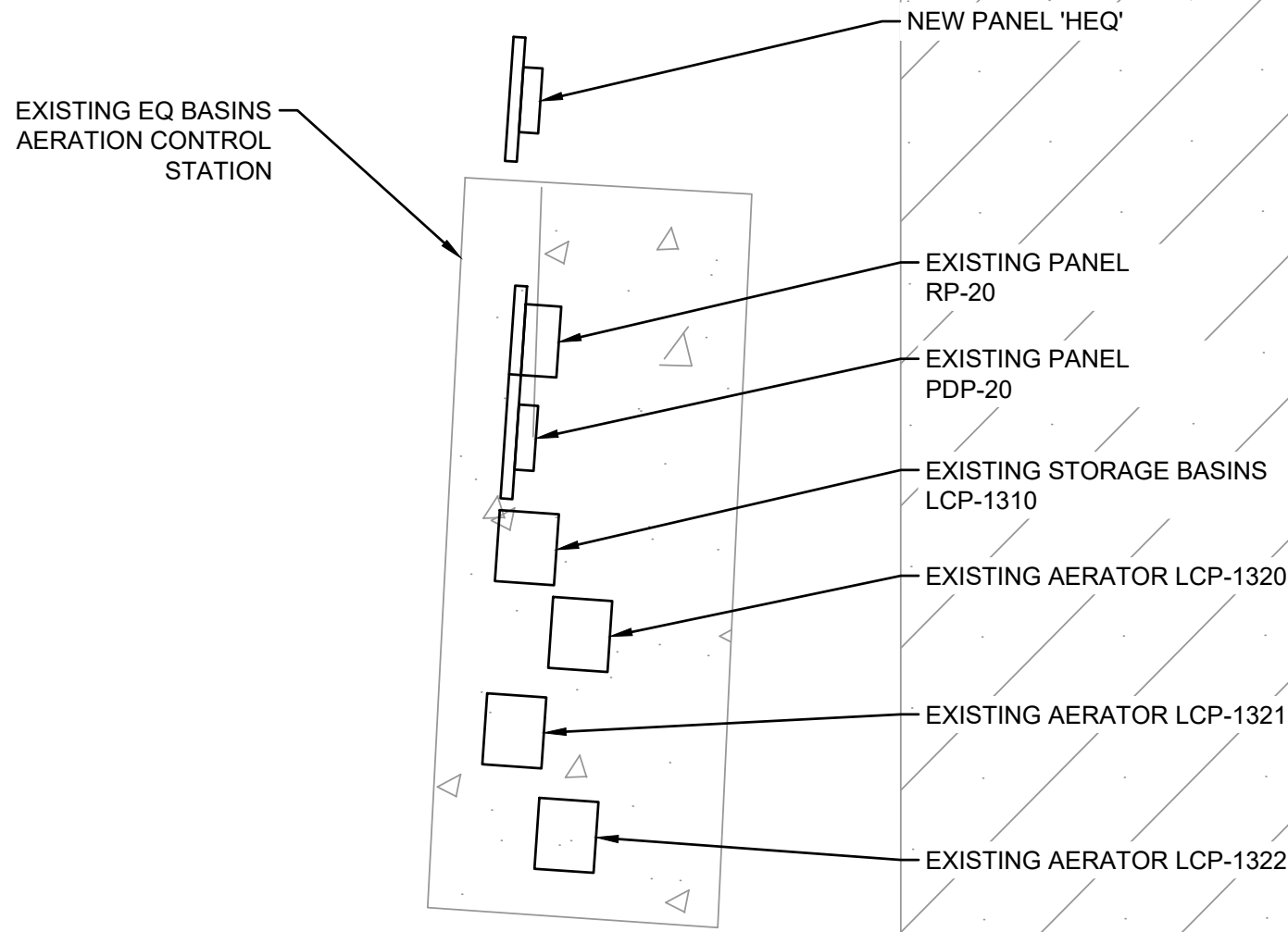
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PLOT FILE: Mar 13, 2024 - 3:58pm



1
E-121

PLAN
SCALE: 1"=5'



GENERAL NOTES:

1. SEE SCHEDULES FOR CONDUIT, WIRE, AND CONNECTION REQUIREMENTS TO EQUIPMENT SHOWN.

**EQUALIZATION
BASIN - PLAN**

E-121

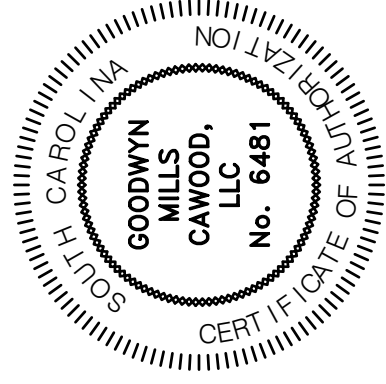
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100% Submittal	03.08.2024
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Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH



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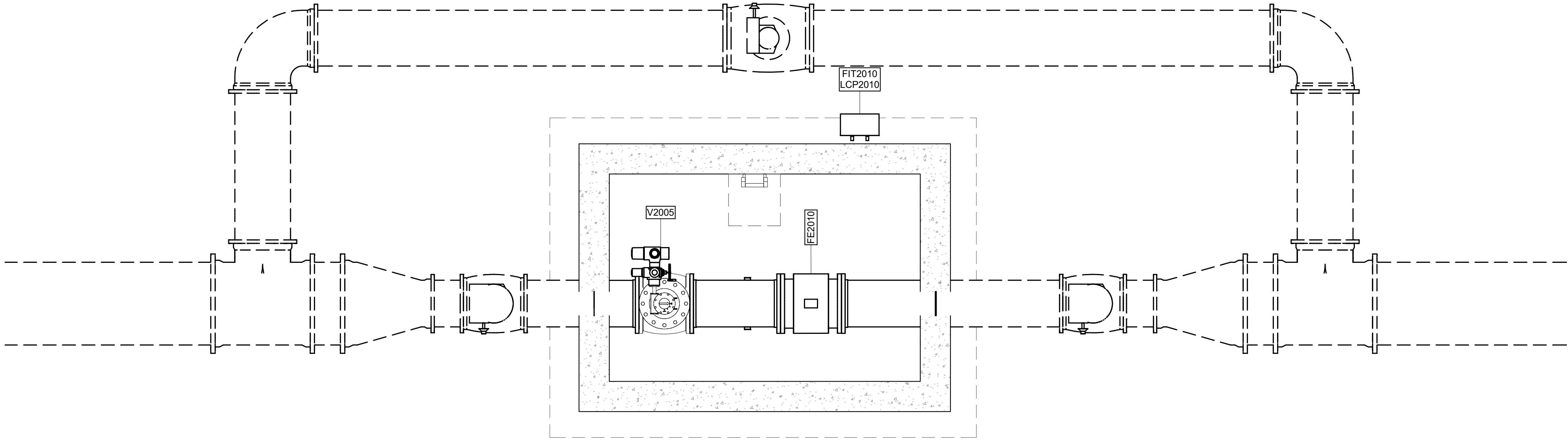
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3/13/2024 3:36:59 PM

1

E-201

PLAN

SCALE: 3/8" = 1'-0"



GENERAL NOTES:
1. SEE WIRING SCHEDULES FOR CONNECTION DETAILS TO SHOWN FIELD INSTRUMENTS AND EQUIPMENT.

BNR FLOW CONTROL
VALVE PLAN

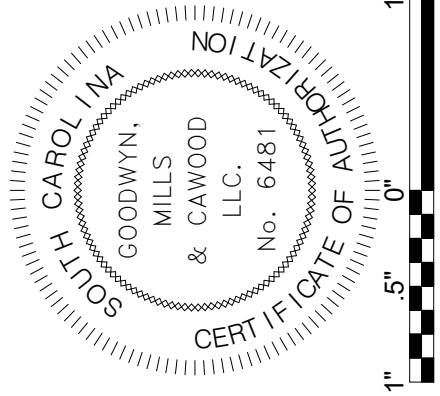
E-201

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION

PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH

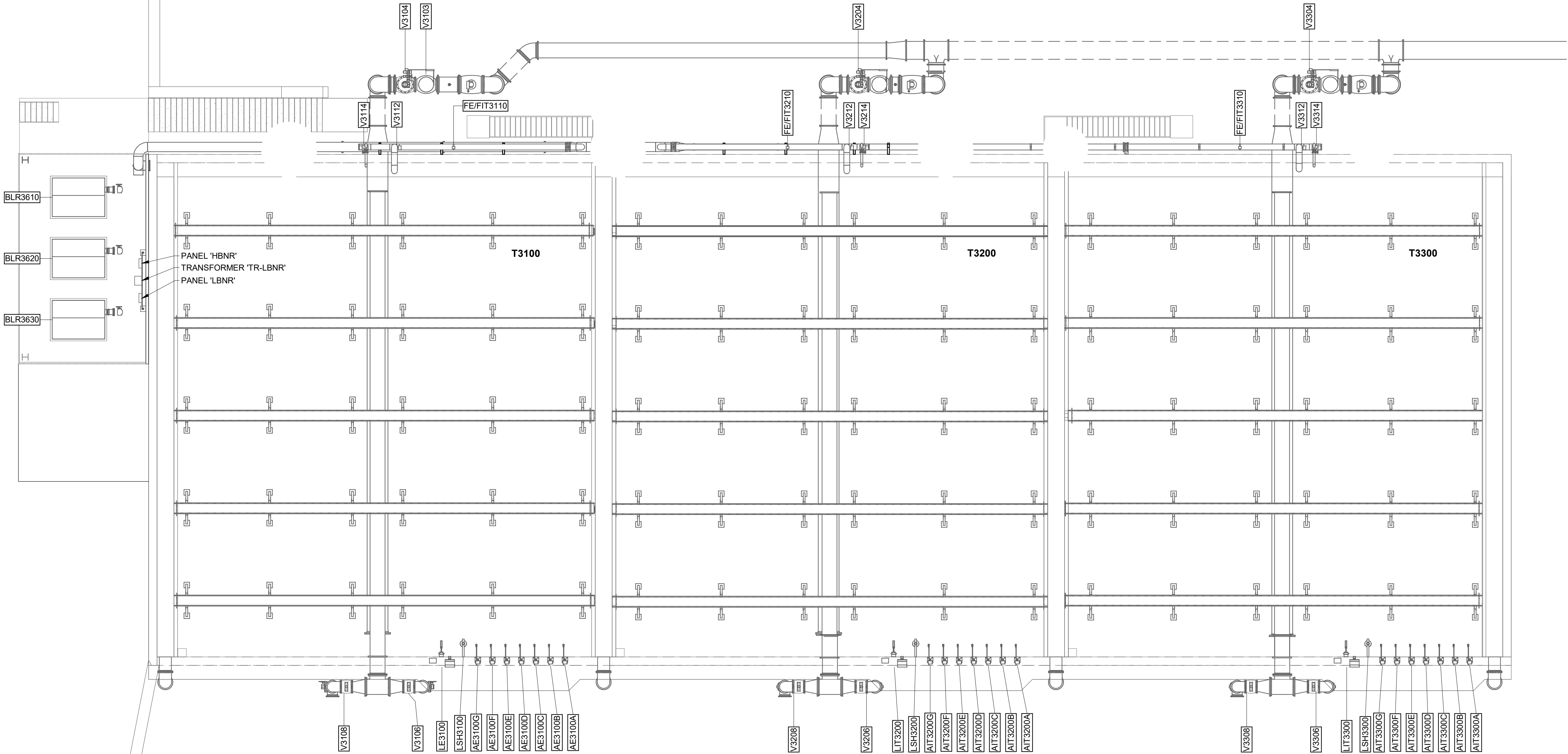


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BM 360\\CGCRE220027 - Pendleton-Clemson WWTP Expansion\BNR.rvt
3/13/2024 3:35:30 PM



1
E-301
PLAN
SCALE: 3/32" = 1'-0"



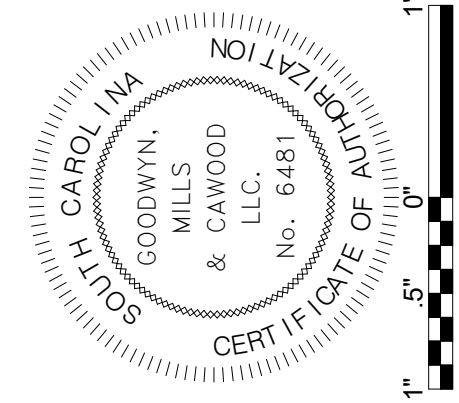
- GENERAL NOTES:**
- SEE SCHEDULES FOR CONDUIT, WIRE, AND CONNECTION REQUIREMENTS FOR EQUIPMENT SHOWN.
 - SEE WIRING SCHEDULES FOR CONNECTION DETAILS TO SHOWN FIELD INSTRUMENTS AND EQUIPMENT.

BIOLOGICAL
NUTRIENT
BIOREACTOR - PLAN
E-301

PENDLETON - CLEMSON
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PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

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30% Submittal	01.18.2023
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Designer:	JB
Drawn By:	MBH



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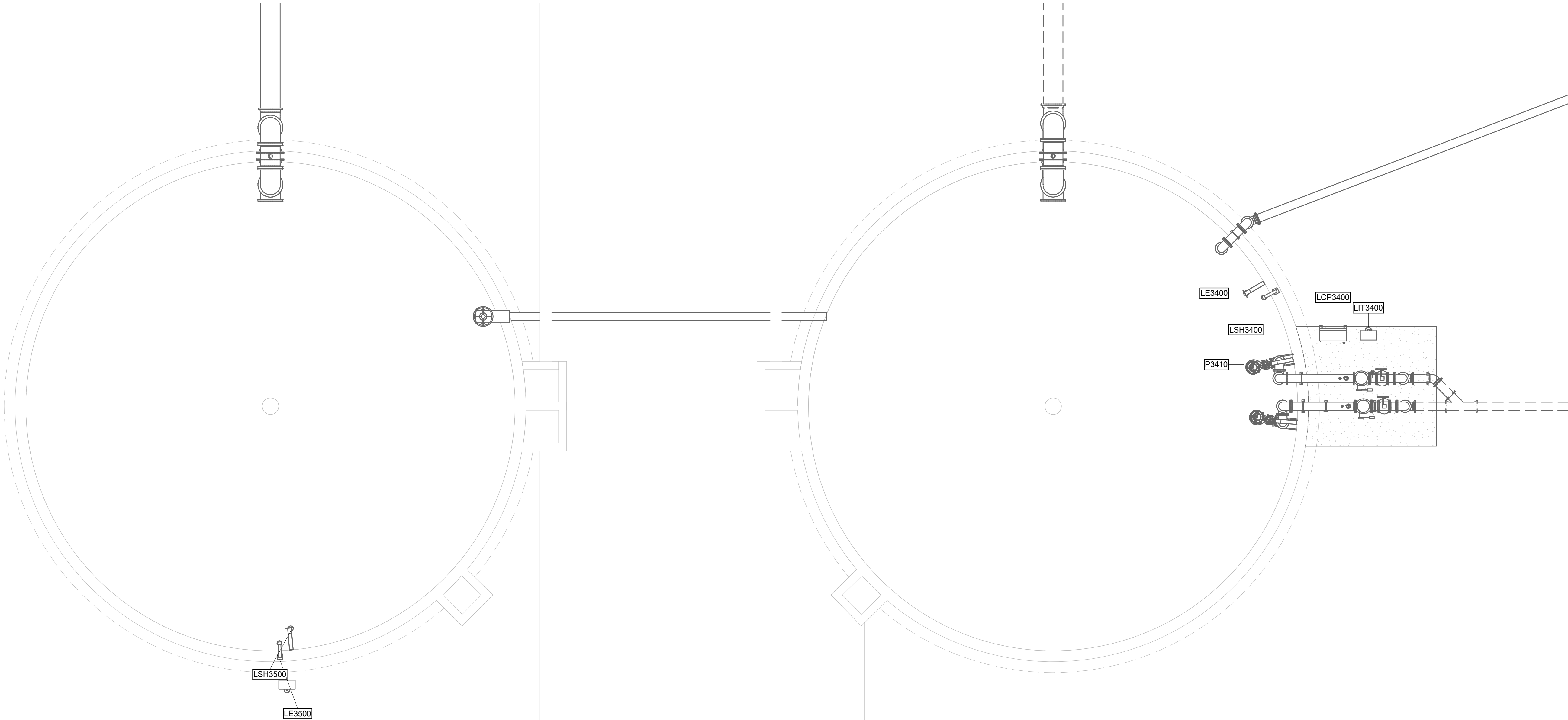


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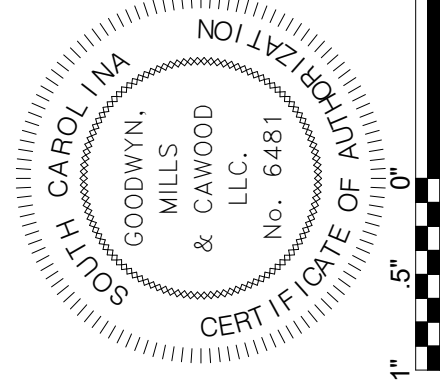
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E-311

PLAN
SCALE: 3/16" = 1'-0"



GENERAL NOTES:

1. SEE SCHEDULES FOR CONDUIT, WIRE, AND CONNECTION REQUIREMENTS FOR EQUIPMENT SHOWN.
2. SEE WIRING SCHEDULES FOR CONNECTION DETAILS TO SHOWN FIELD INSTRUMENTS AND EQUIPMENT.



ISSUE	DATE
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Conformed Set	
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Designer:	JB
Drawn By:	MBH

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**SLUDGE BUFFER &
LEVEL CORRECTION
TANKS - PLAN**

E-311

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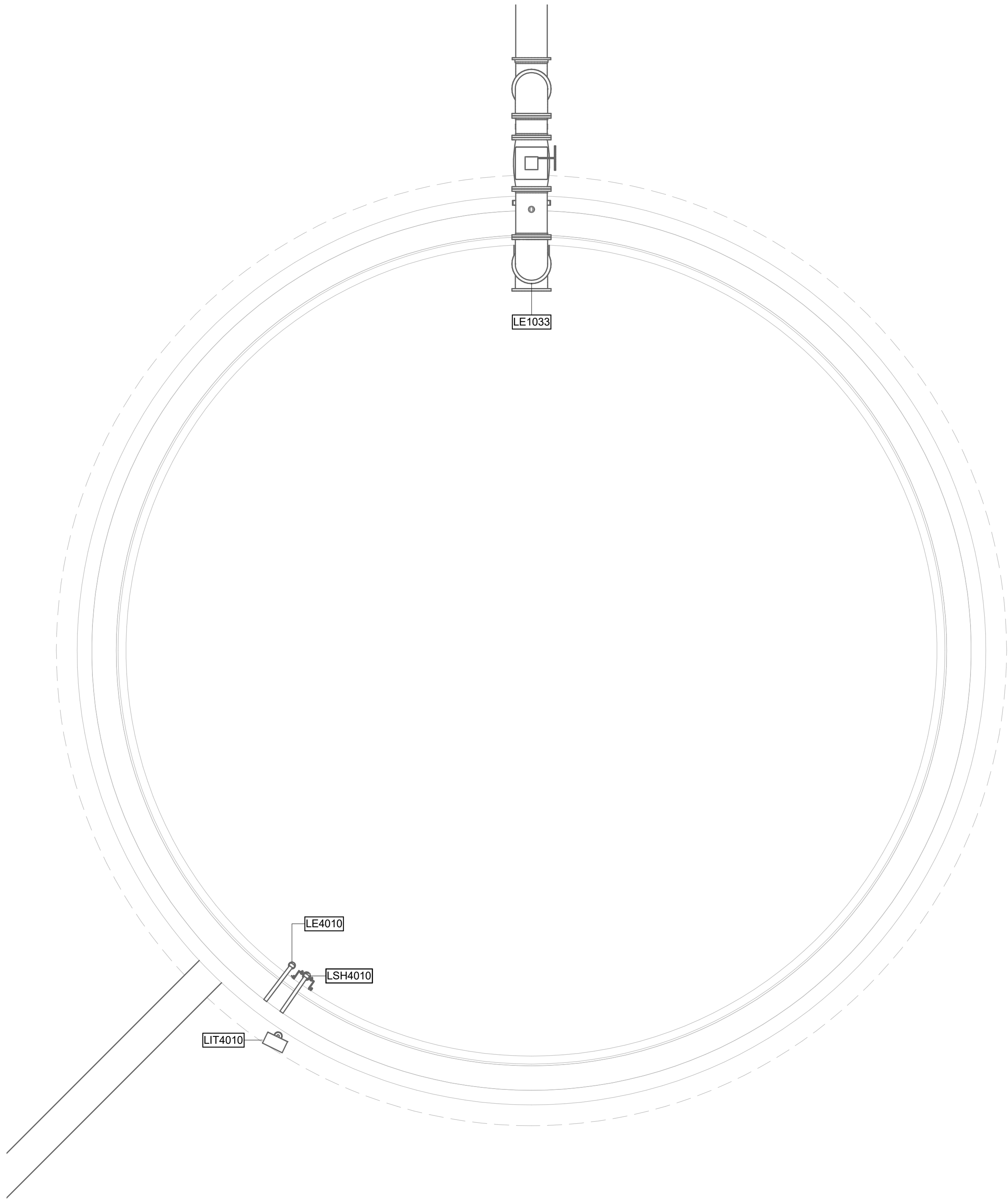
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1
E-401

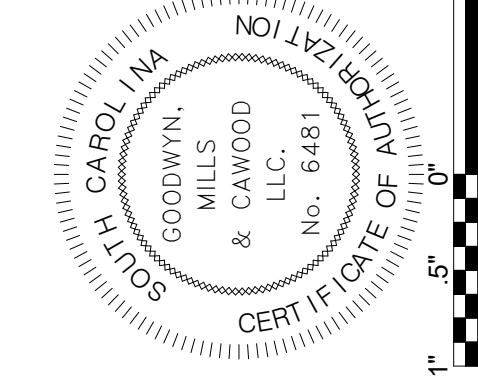
PLAN

SCALE: 3/16" = 1'-0"



GENERAL NOTES:

- SEE SCHEDULES FOR CONDUIT, WIRE, AND CONNECTION REQUIREMENTS FOR EQUIPMENT SHOWN.
- SEE WIRING SCHEDULES FOR CONNECTION DETAILS TO SHOWN FIELD INSTRUMENTS AND EQUIPMENT.



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Designer:	JB
Drawn By:	MBH

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Anderson County

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POST EQUALIZATION
BASIN - PLAN

E-401



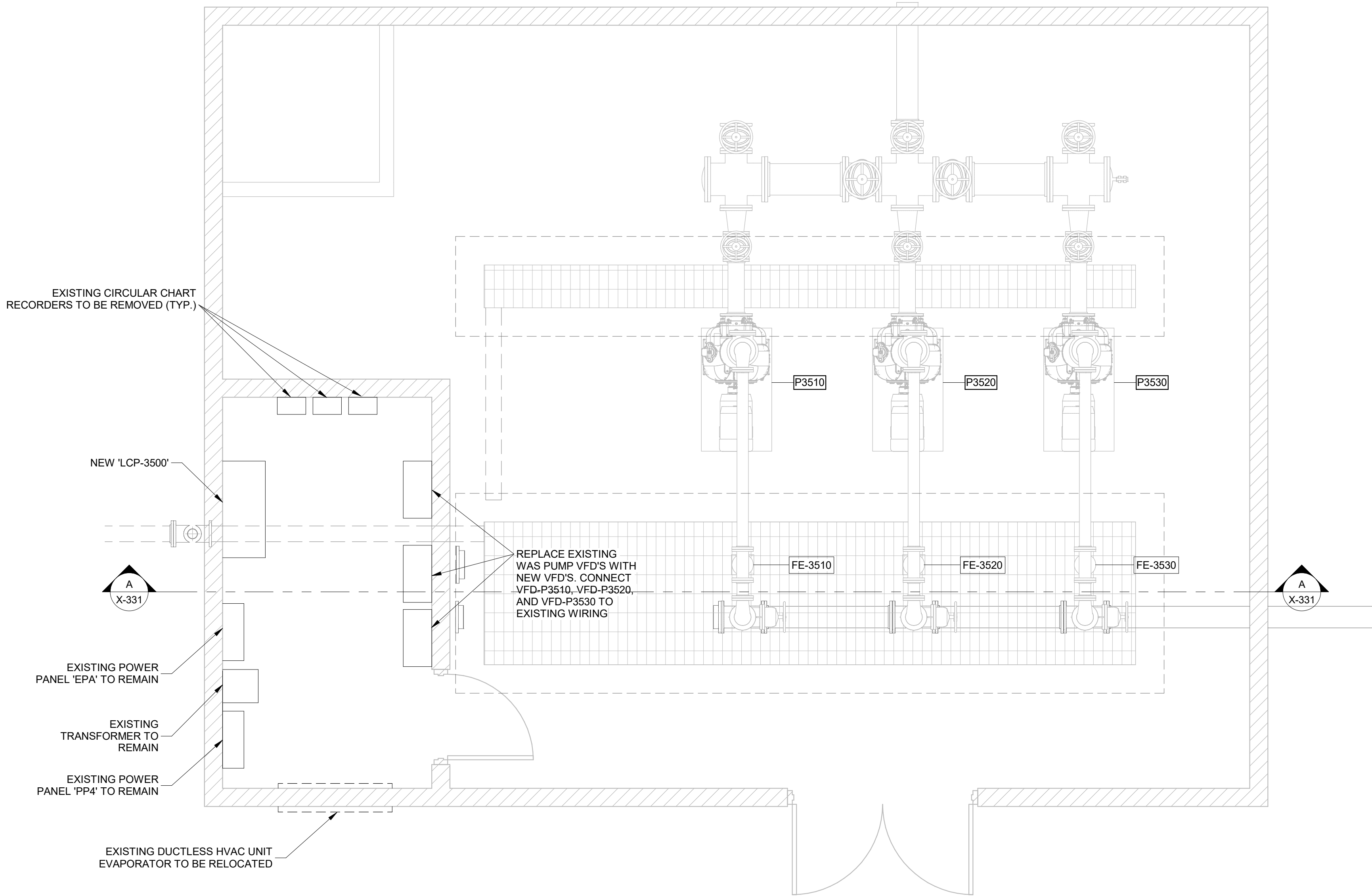
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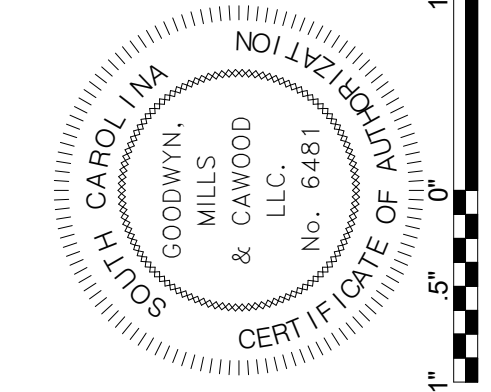
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E-441

PLAN

SCALE: 3/8" = 1'-0"



GENERAL NOTES:
1. SEE WIRING SCHEDULES FOR CONNECTION DETAILS TO SHOWN FIELD INSTRUMENTS AND EQUIPMENT.



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PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

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RAS/WAS PUMP
BUILDING -
DEMOLITION PLAN

E-441

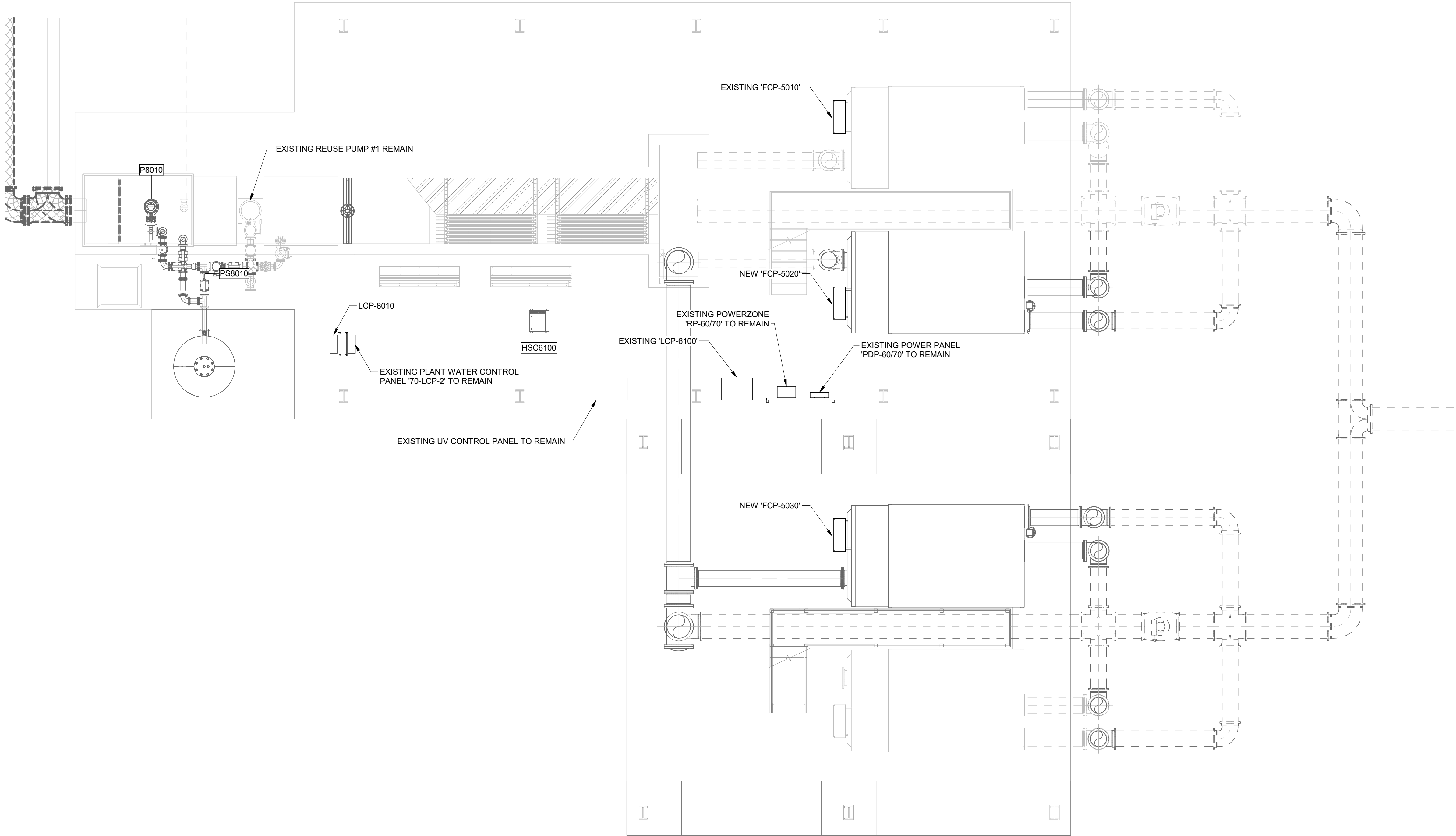
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3/13/2024 3:38:13 PM



1
E-501
PLAN
SCALE: 3/16" = 1'-0"

GENERAL NOTES:

1. SEE SCHEDULES FOR CONDUIT, WIRE, AND CONNECTION REQUIREMENTS TO EQUIPMENT SHOWN.
2. SEE WIRING SCHEDULES FOR CONNECTION DETAILS TO SHOWN FIELD INSTRUMENTS AND EQUIPMENT.



UV DISINFECTION -
PLAN

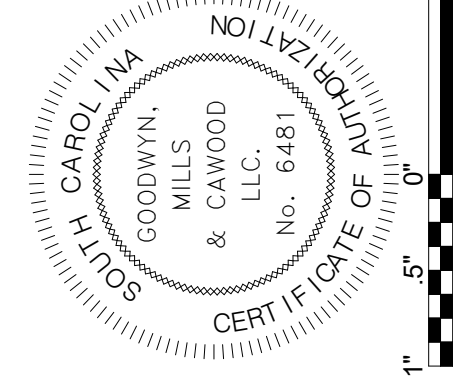
E-501

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REGIONAL WWTP EXPANSION

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City of Clemson
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DRAWING FILE: C:\Users\towens\AppData\Local\Temp\AcPublish_20672LE-611 - ELEC BUILDING EB-1.dwg
PLOTTED: Mar 03, 2024 - 3:55pm

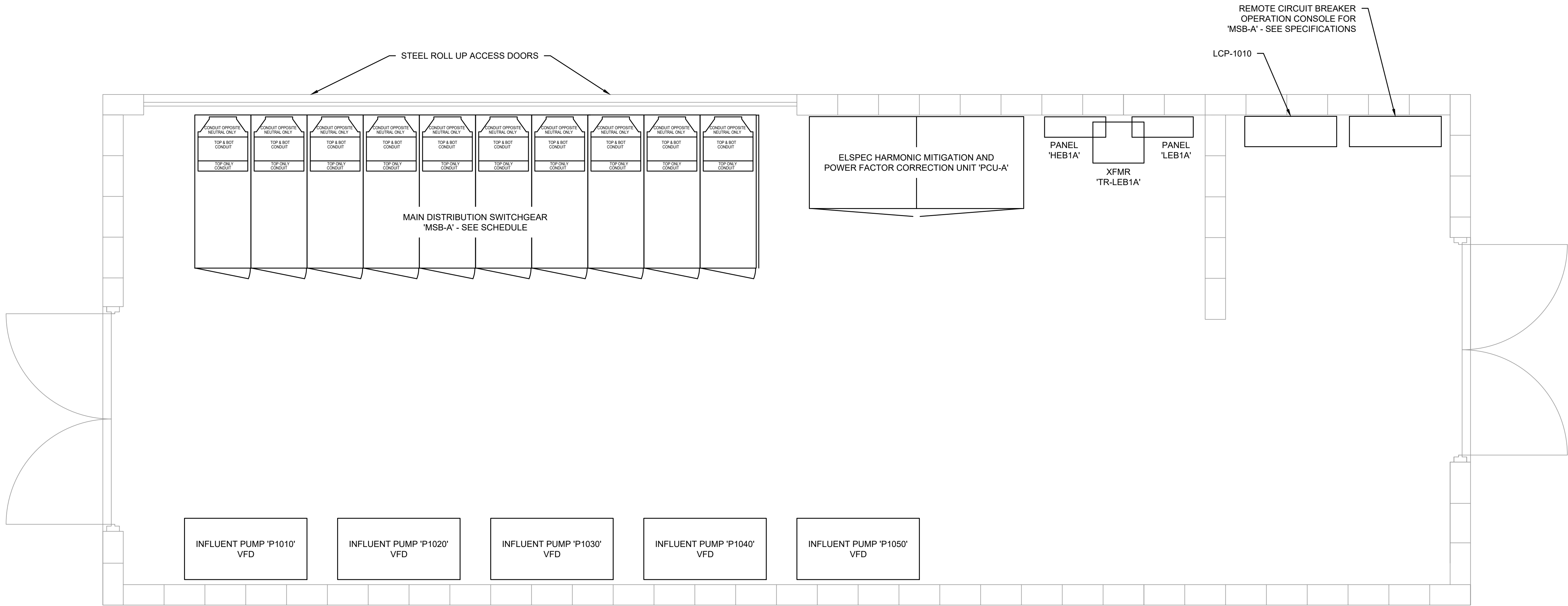


1

PLAN

E-611

SCALE: 1/2" = 1' - 0"



MAIN ELECTRICAL
BUILDING 'EB-1' PLAN

PENDLETON - CLEMSON

REGIONAL WWTP EXPANSION

PENDLETON, SOUTH CAROLINA

Town of Pendleton

City of Clemson

Anderson County

GMC PROJECT #CGRE220027

Engineer:

Designer:

Drawn By:

Project Manager:

JB

JEA

JB

MBH

ISSUE

DATE

30% Submittal 01/18/2023

60% Submittal 08/07/2023

90% Submittal 12/04/2023

100% Submittal 03/08/2024

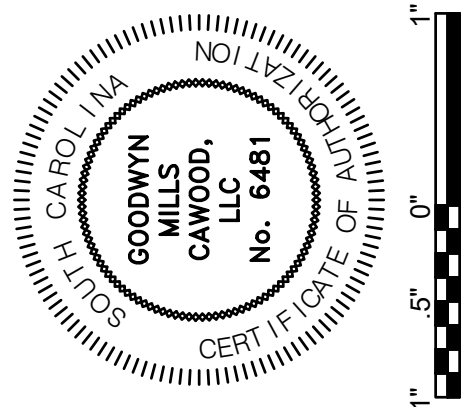
Conformed Set

Project Manager: JB

Engineer: JEA

Designer: JB

Drawn By: MBH



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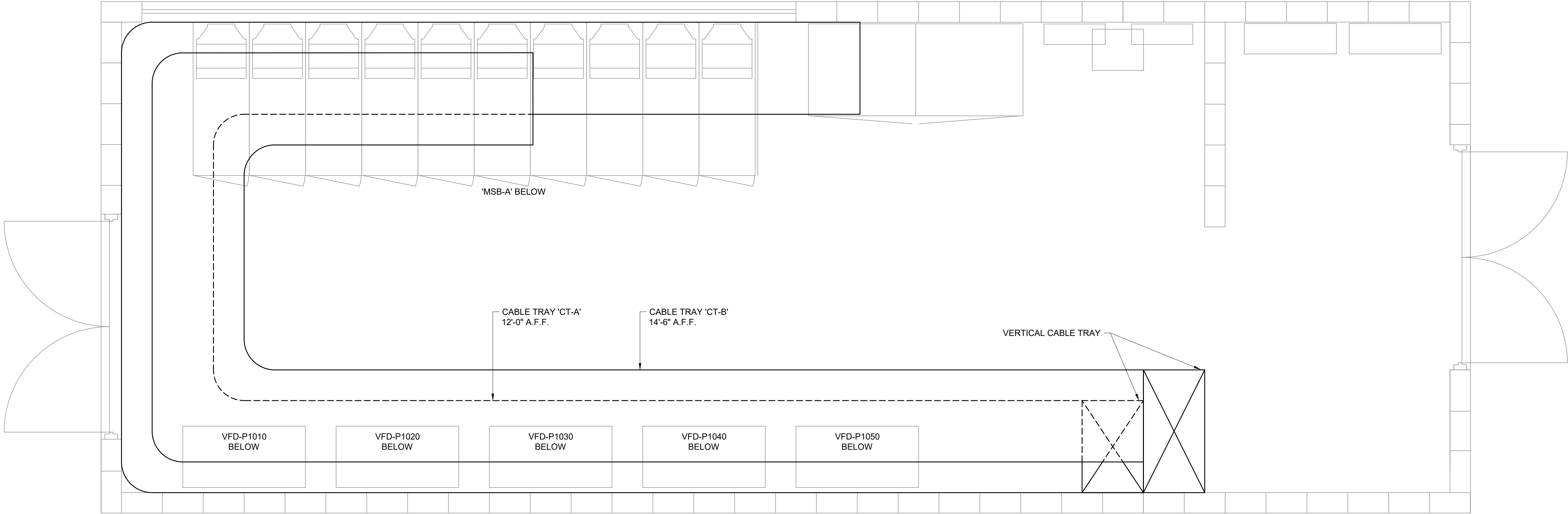
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PLOTTED: Mar 03, 2024 - 3:55pm



1
E-612

PLAN

SCALE: 1/2" = 1' - 0"



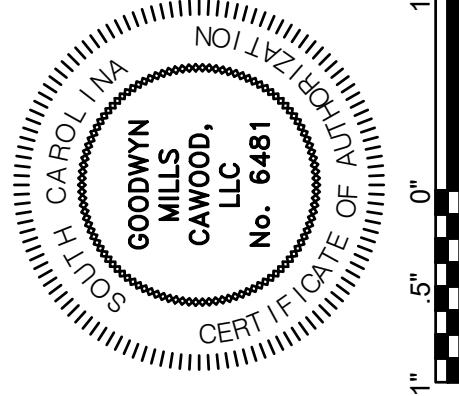
MAINELECTRICAL
BUILDING 'EB-1'
CABLE TRAY PLAN

E-612

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

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30% Submittal	01.18.2023
60% Submittal	08.07.2023
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Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH



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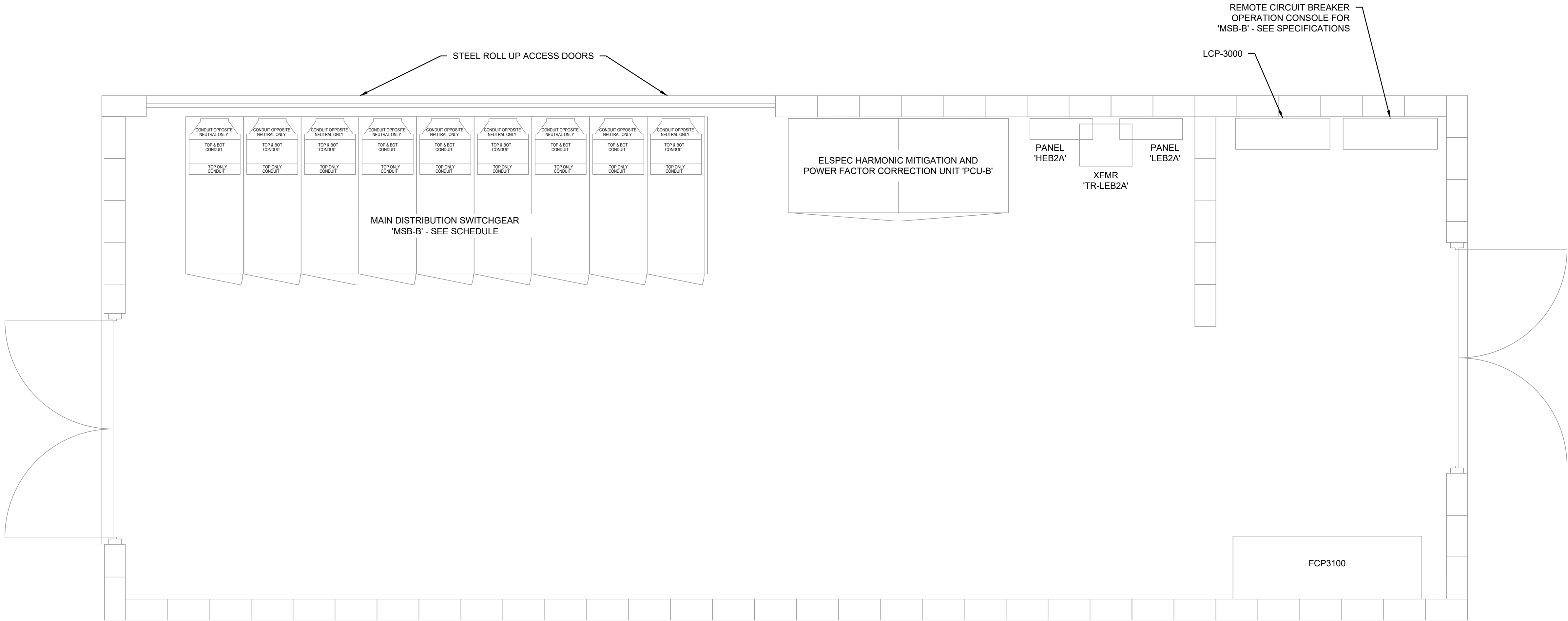
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PLOTTED: Mar 03, 2024 - 3:55pm



1
E-621

PLAN

SCALE: 1/2" = 1' - 0"



PROCESS ELECTRICAL
BUILDING 'EB-2' PLAN

PENDLETON - CLEMSON

REGIONAL WWTP EXPANSION

PENDLETON, SOUTH CAROLINA

Town of Pendleton

City of Clemson

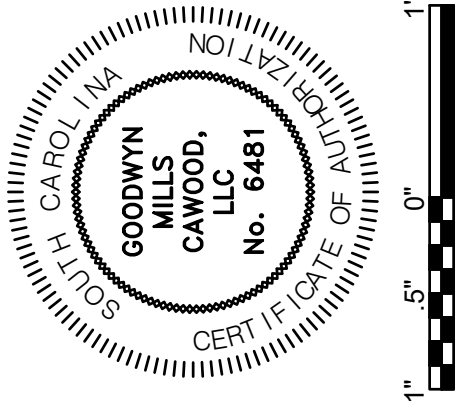
Anderson County

E-621

GMC PROJECT #CGRE220027

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ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
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Project Manager:	JB
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Designer:	JB
Drawn By:	MBH



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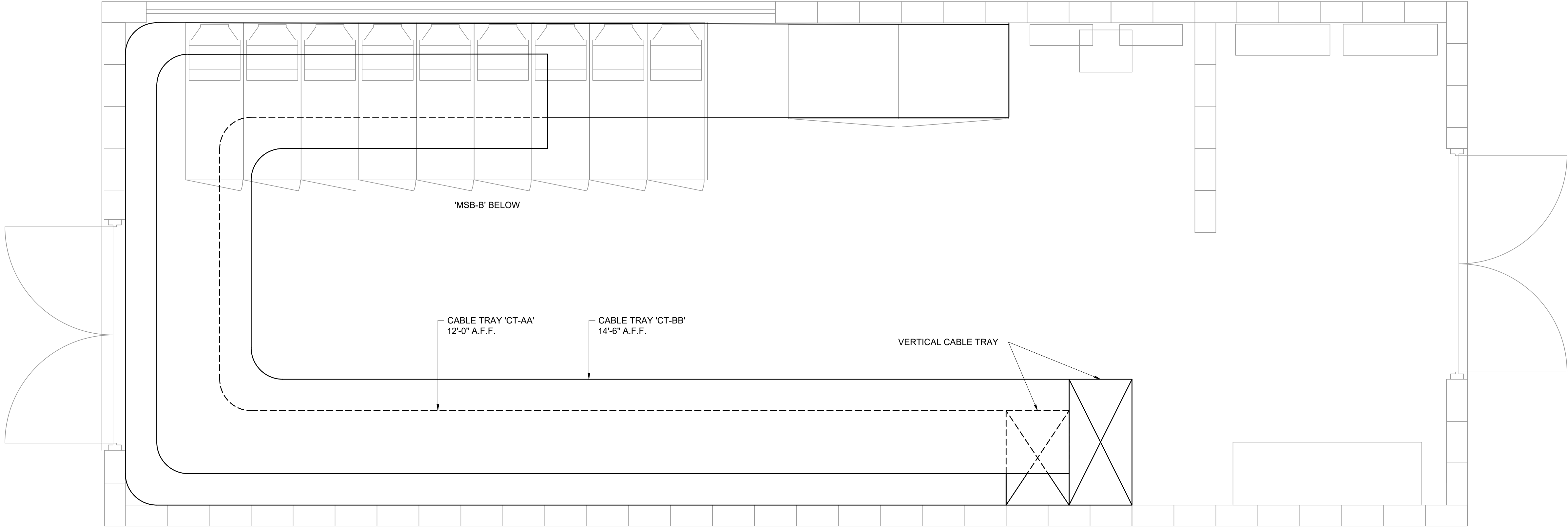
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PLOT FILE: Mar 13, 2024 - 3:55pm



1
E-622

PLAN

SCALE: 1/2" = 1' - 0"



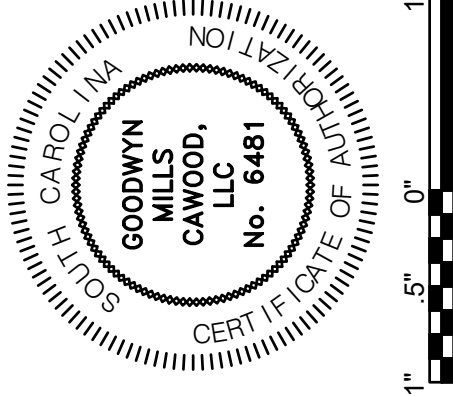
ELECTRICAL
BUILDING 'EB-2'
CABLE TRAY PLAN

E-622

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

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Project Manager:	JB
Engineer:	JEA
Designer:	JB
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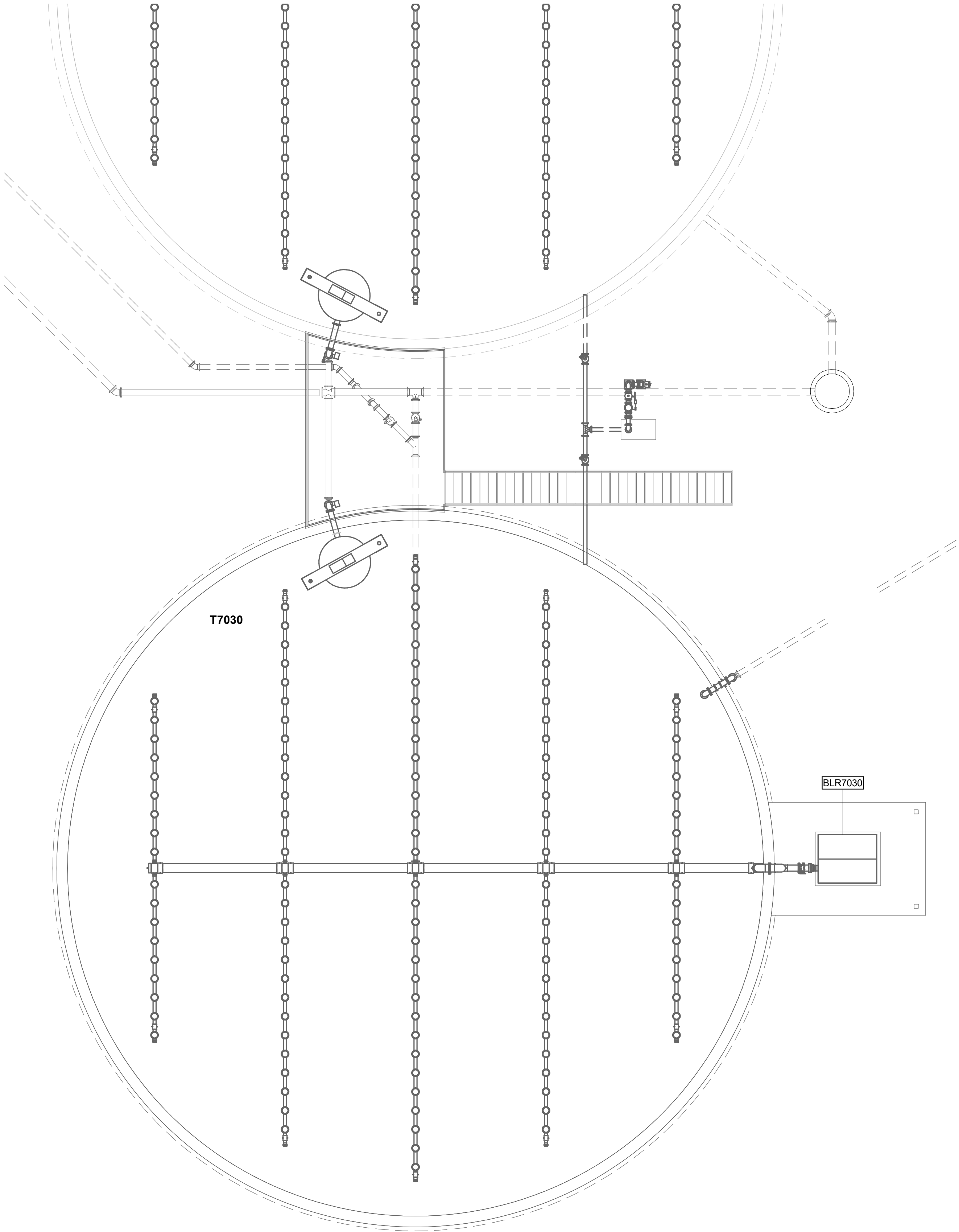
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3/13/2024 3:34:27 PM



1
E-701

PLAN

SCALE: 1/8" = 1'-0"



GENERAL NOTES:

- SEE SCHEDULES FOR CONDUIT, WIRE, AND CONNECTION REQUIREMENTS FOR EQUIPMENT SHOWN.
- SEE WIRING SCHEDULES FOR CONNECTION DETAILS TO SHOWN FIELD INSTRUMENTS AND EQUIPMENT.

**AEROBIC DIGESTER #3
- PLAN**

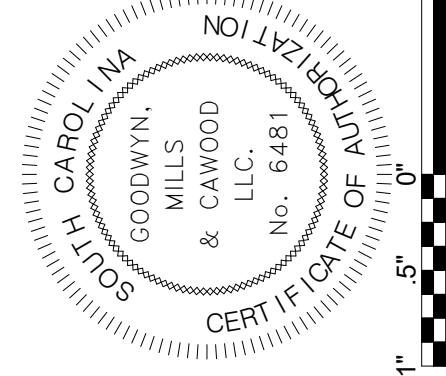
E-701

**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**

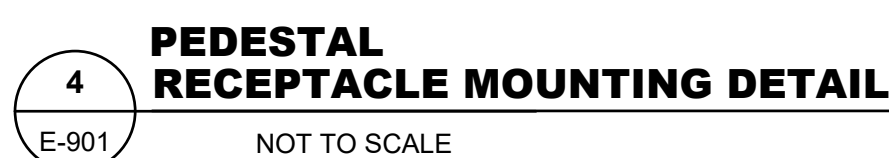
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

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ISSUE	DATE
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100% Submittal	03.08.2024
Conformed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH



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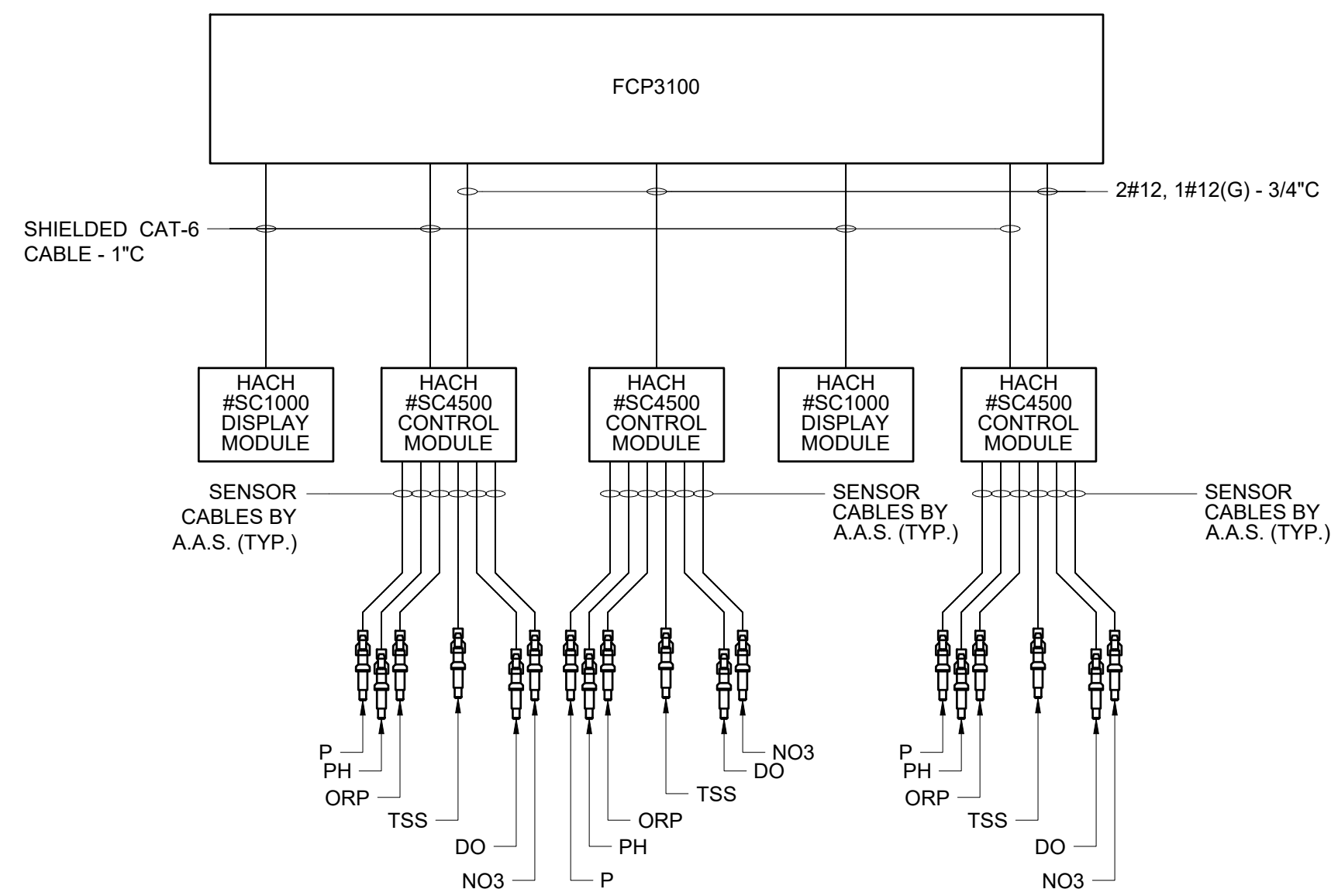
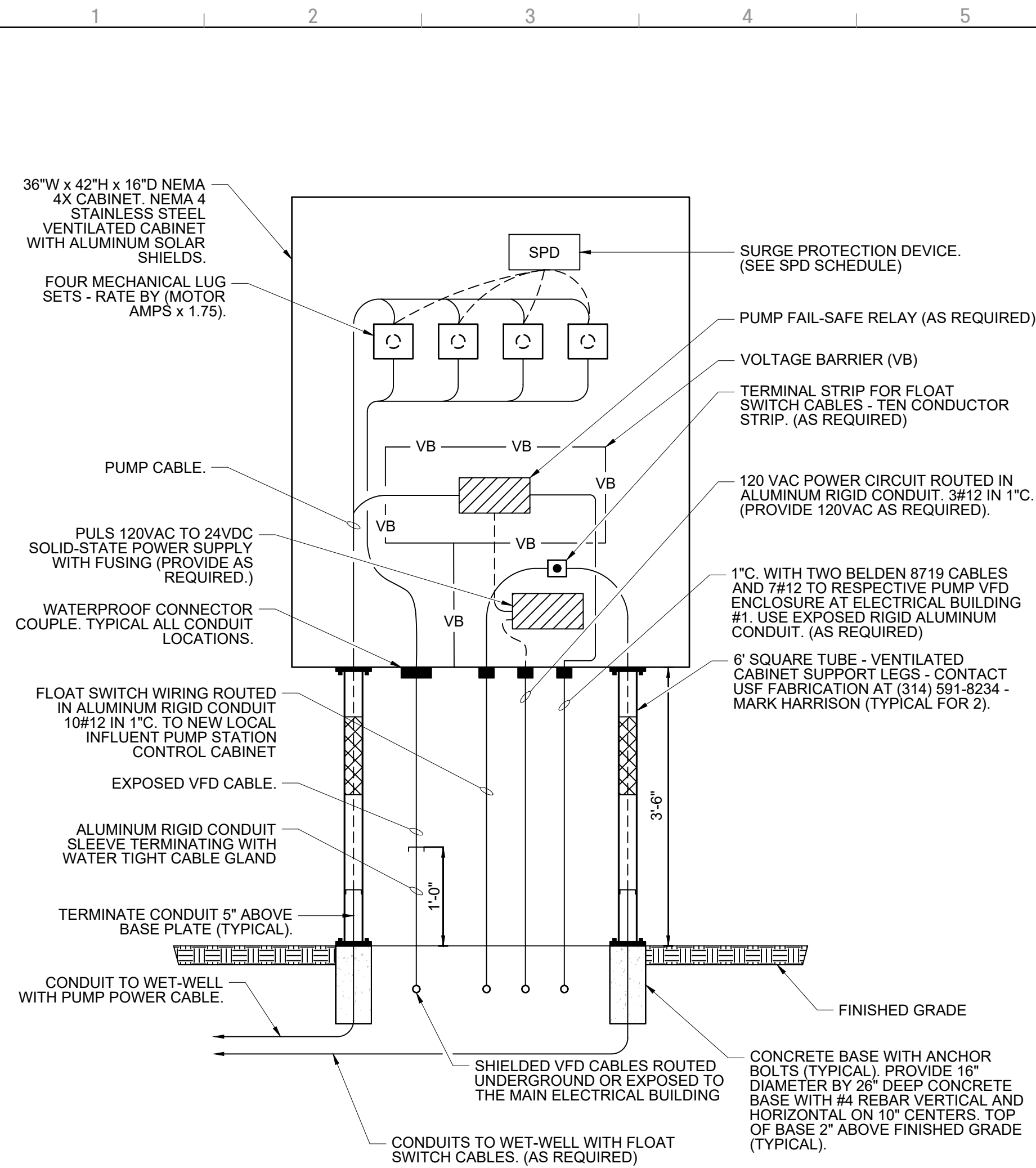


ISSUE	DATE
30% Submittal	01/18/2023
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100% Submittal	03/08/2024
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E-901

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1 WET-WELL JUNCTION BOX (TYPICAL FOR FIVE)

2 BNR ANALYZER CONNECTION DETAIL

DRAWING FILE: C:\Users\townes\AppData\Local\Temp\AcPublish_20612\E-901-904 - Electrical Details WWTP.dwg
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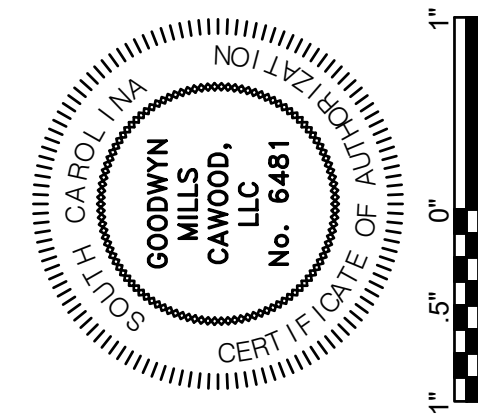
ELECTRICAL DETAILS

E-903

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REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

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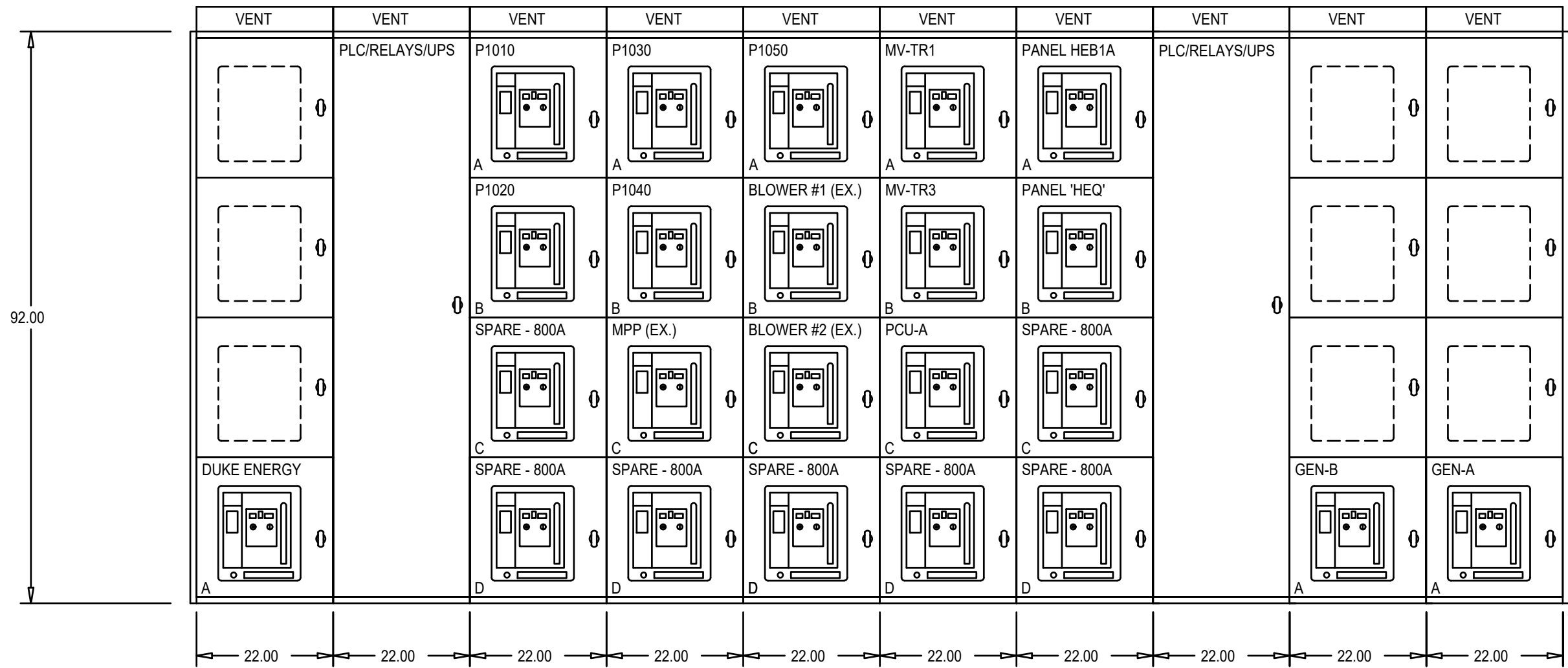
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30% Submittal	01.08.2023
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90% Submittal	12.04.2023
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Conformed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH



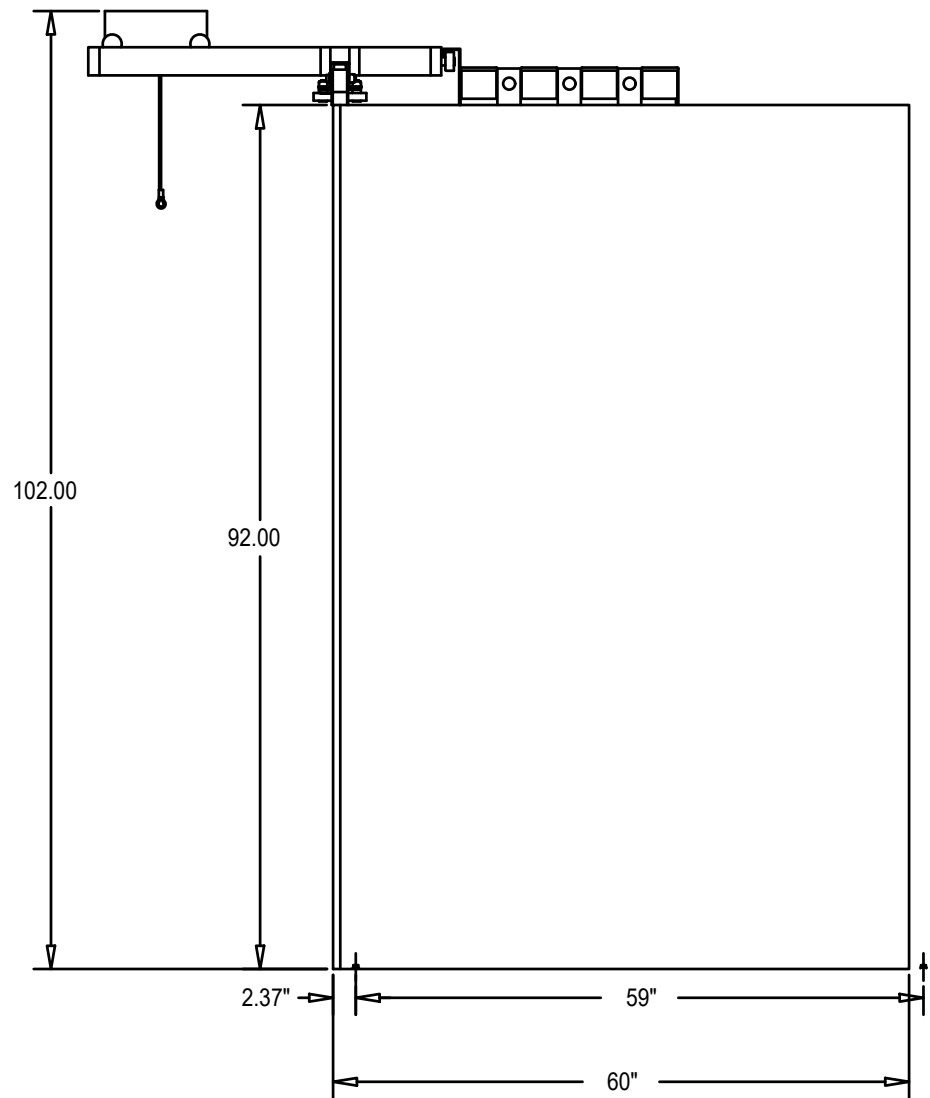
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PLOT FILE: Mar 13, 2024 2:15pm

1 LOW VOLTAGE DRAW-OUT SWITCHGEAR 'MSB-A'
E-911 NOT TO SCALE

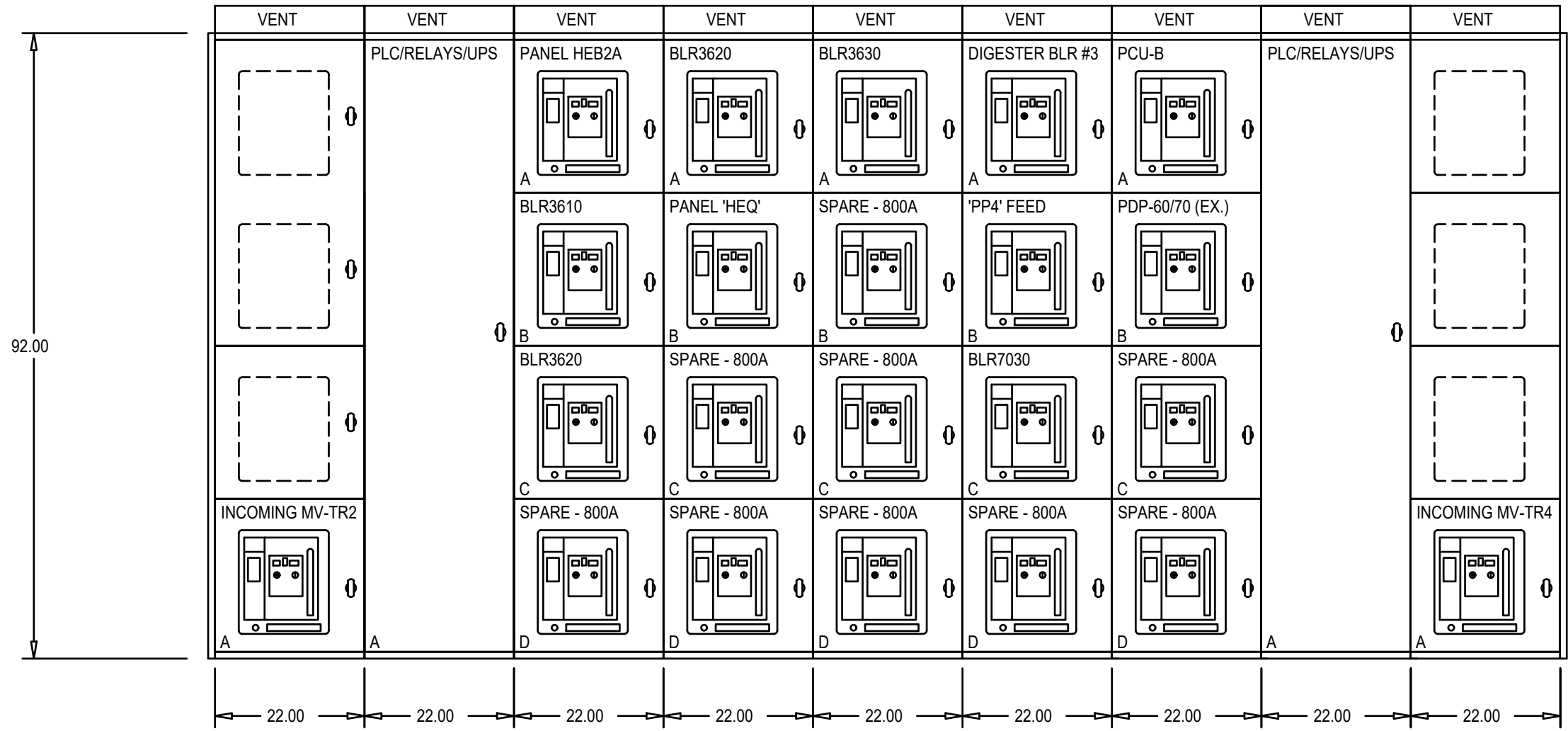


'MSB-A' FRONT ELEVATION

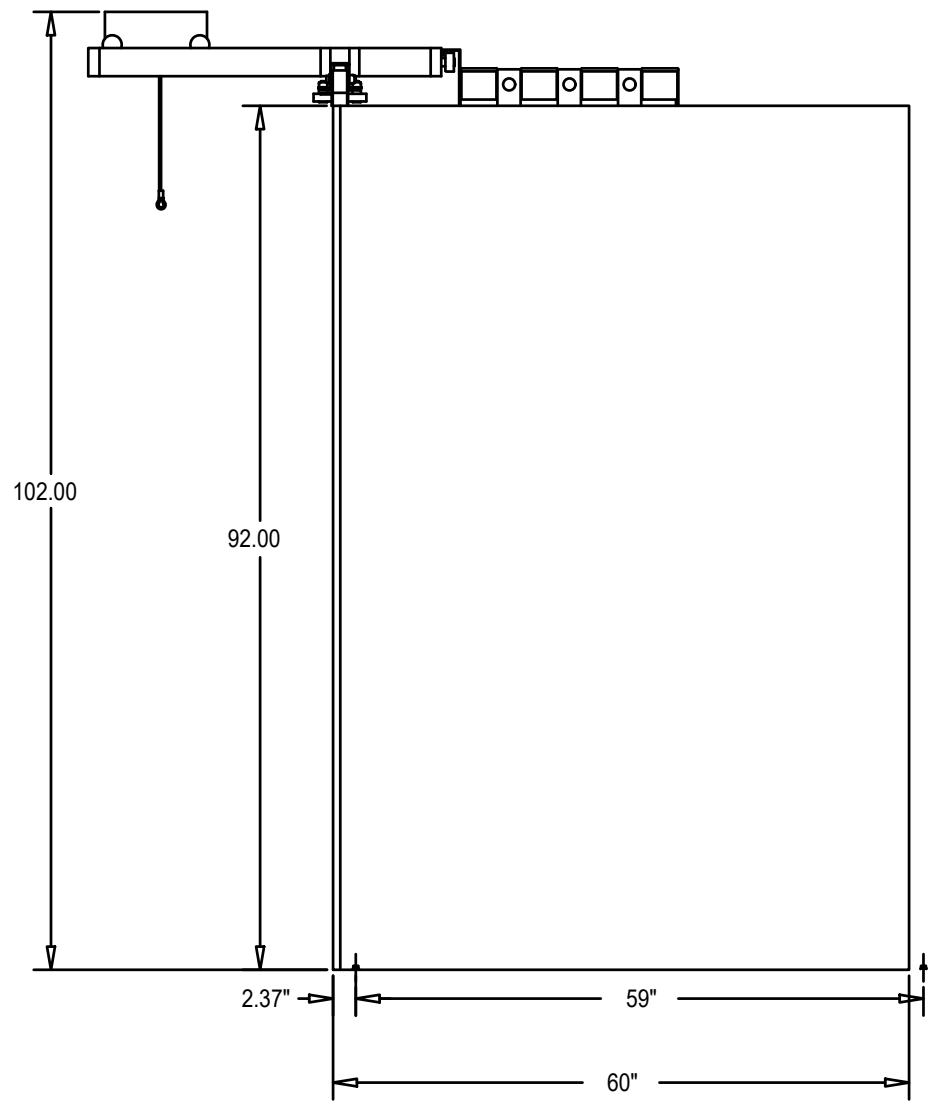


'MSB-A' SIDE ELEVATION

2 LOW VOLTAGE DRAW-OUT SWITCHGEAR 'MSB-B'
E-911 NOT TO SCALE



'MSB-B' FRONT ELEVATION



'MSB-B' SIDE ELEVATION

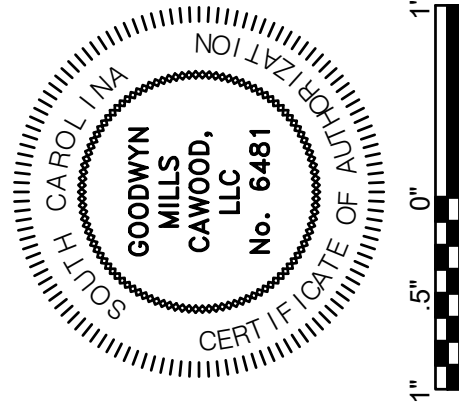
SWITCHGEAR
ELEVATED VIEWS

E-911

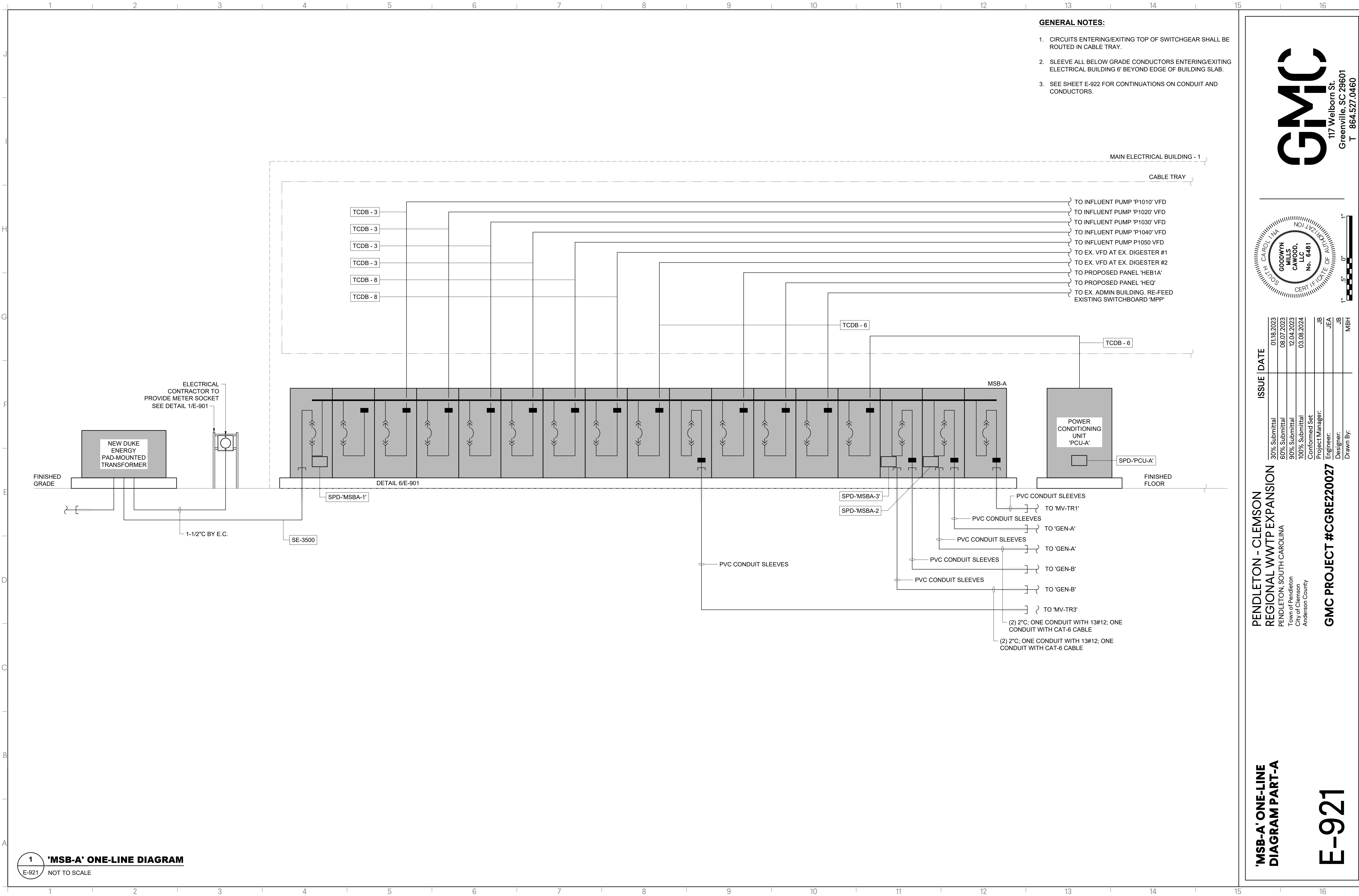
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REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

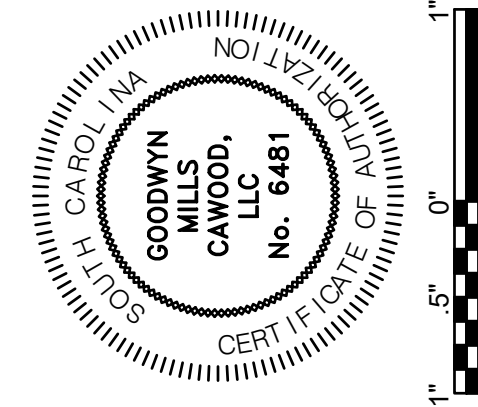
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Designer:	JB
Drawn By:	MBH



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1 'MSB-A' ONE-LINE DIAGRAM
E-921 NOT TO SCALE



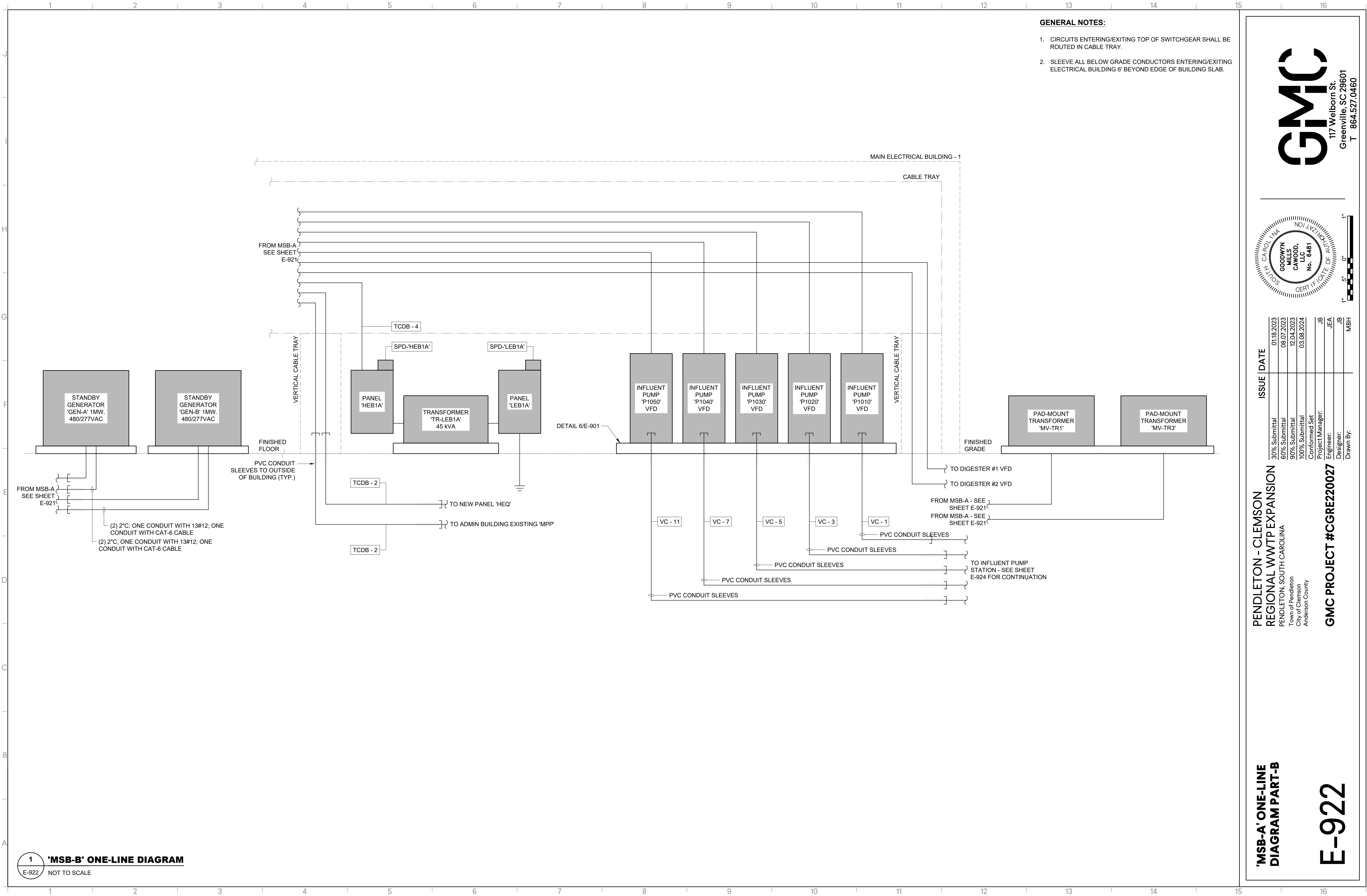
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Engineer:	JEA
Designer:	JB
Drawn By:	MBH

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REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
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GMC PROJECT #CGRE220027

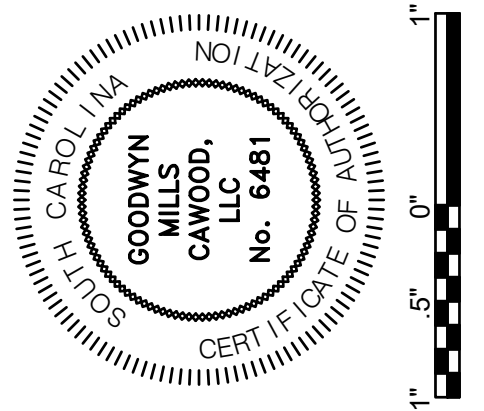
**'MSB-A' ONE-LINE
DIAGRAM PART-A**

E-921



GENERAL NOTES:

1. CIRCUITS ENTERING/EXITING TOP OF SWITCHGEAR SHALL BE ROUTED IN CABLE TRAY.
2. SLEEVE ALL BELOW GRADE CONDUCTORS ENTERING/EXITING ELECTRICAL BUILDING 6' BEYOND EDGE OF BUILDING SLAB.



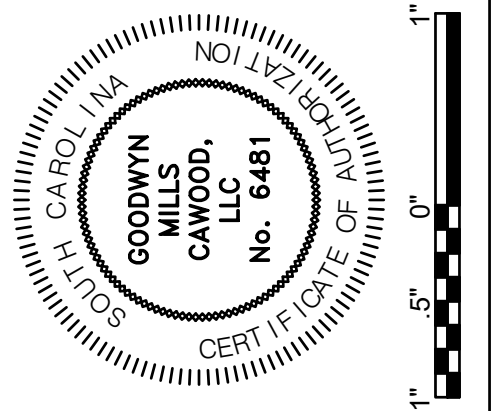
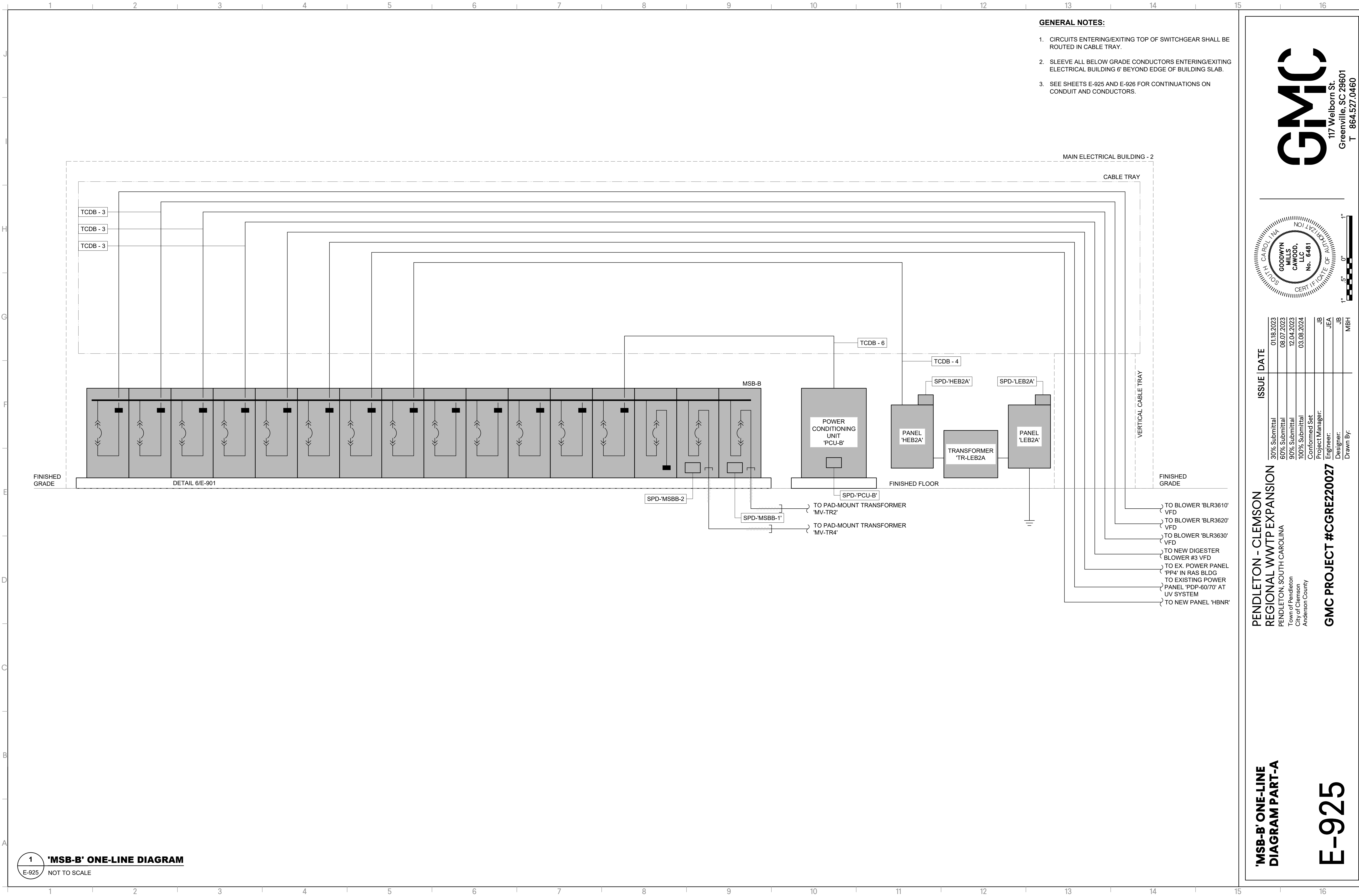
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Engineer:	JEA
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Drawn By:	MBH

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Anderson County

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'MSB-A ONE-LINE
DIAGRAM PART-B

E-922

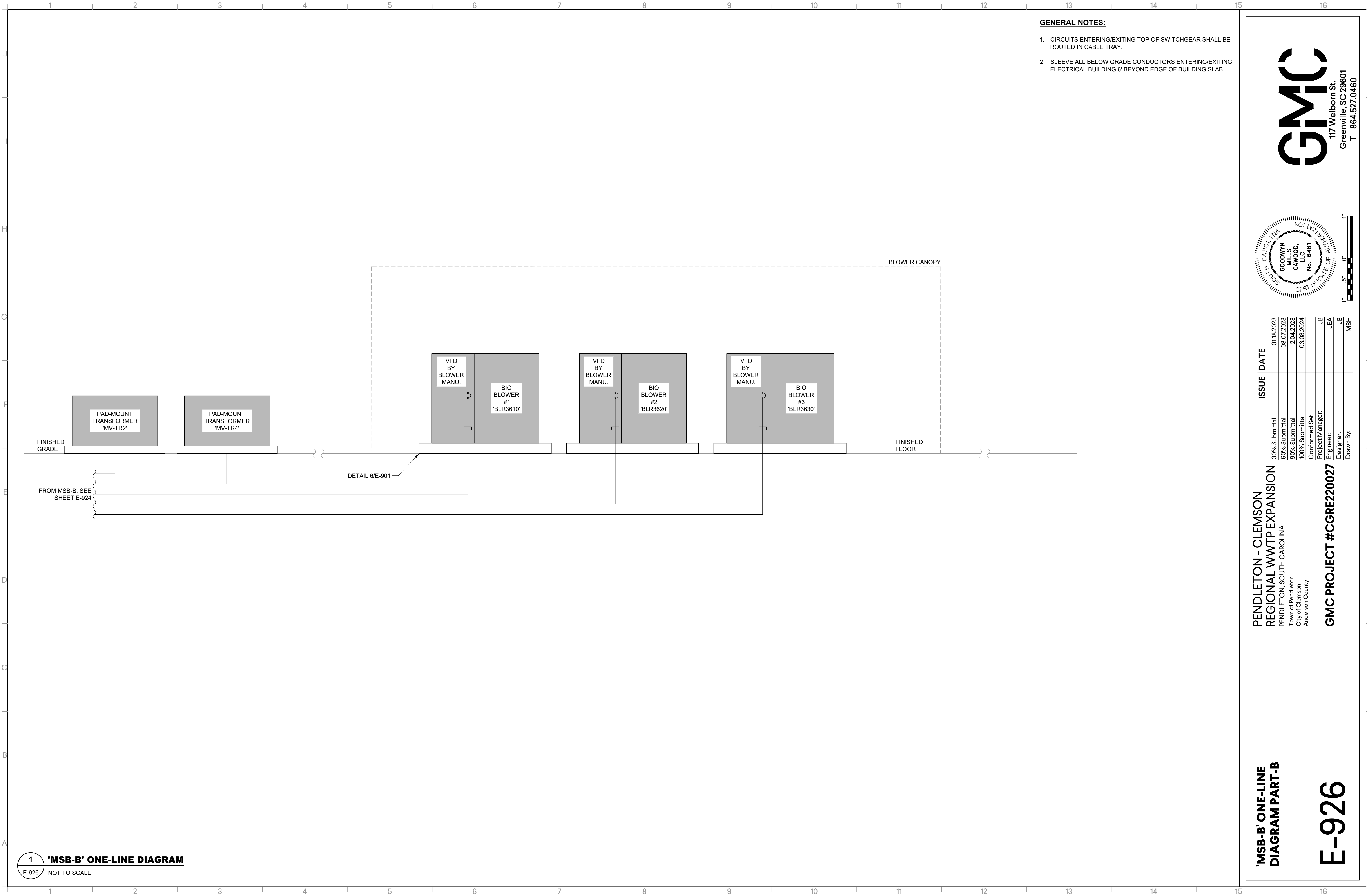


ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

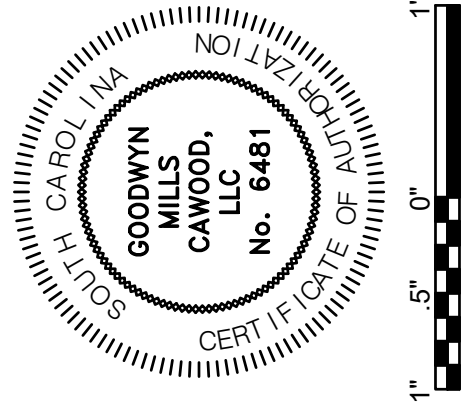
GMC PROJECT #CGRE220027

E-925



GENERAL NOTES:

1. CIRCUITS ENTERING/EXITING TOP OF SWITCHGEAR SHALL BE ROUTED IN CABLE TRAY.
2. SLEEVE ALL BELOW GRADE CONDUCTORS ENTERING/EXITING ELECTRICAL BUILDING 6' BEYOND EDGE OF BUILDING SLAB.



ISSUE	DATE
30% Submittal	01.18.2023
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90% Submittal	12.04.2023
100% Submittal	03.08.2024
Confirmed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
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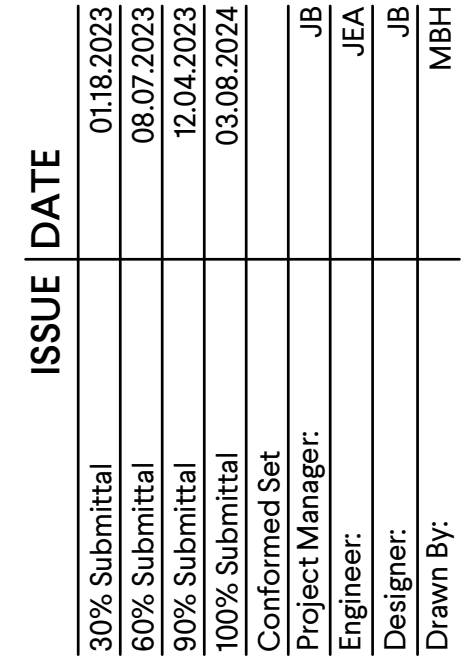
GMC PROJECT #CGRE220027

'MSB-B' ONE-LINE
DIAGRAM PART-B

E-926



1. CIRCUITS ENTERING/EXITING TOP OF SWITCHGEAR SHALL BE ROUTED IN CABLE TRAY.
2. SLEEVE ALL BELOW GRADE CONDUCTORS ENTERING/EXITING ELECTRICAL BUILDING 6' BEYOND EDGE OF BUILDING SLAB.



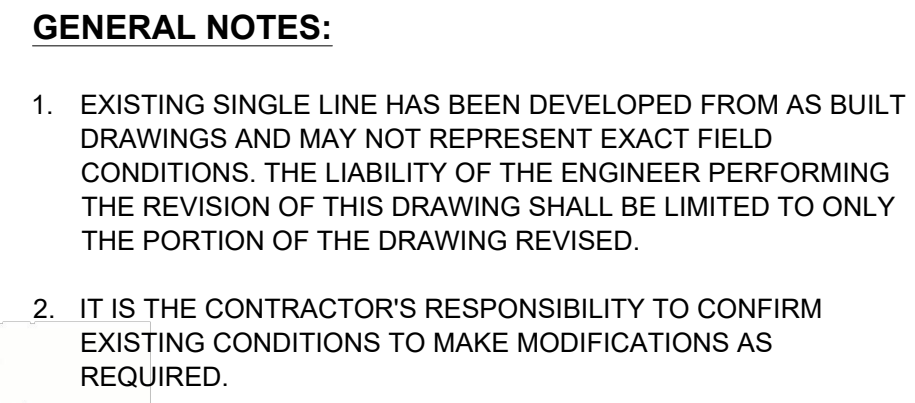
**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE22002

'MSB-B' ONE-LINE DIAGRAM PART-C

E-927

GMC
117 Welborn St.
Greenville, SC 29601
T 864.527.0460



ISSUE	DATE
30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
100% Submittal	03/08/2024
Conformed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH

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PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220021

**MODIFICATIONS TO
EXISTING POWER
DISTRIBUTION AT THE
ADMIN BUILDING**

E-928

DRAWING FILE: V:\Projects\2022\Projects\GRC\WGRC220008 - Pendleton-Clemson WWTP Expansion\Drawings\Electrical\E-931 - SCHEDULES.dwg
PLOTTER: Mar 18, 2022 2:15pm

LV SWITCHGEAR	
'MSB-A'	
LOCATION:	
ELECTRICAL BUILDING #1	
MINIMUM AIC:	
MINIMUM 100,000 AIC FOR 480VAC BUSS OR UPSIZED AS A RESULT OF THE ARC FLASH STUDY	

VOLTAGE:	
480Y277V; 3 PHASE; 4 WIRE	
MINIMUM BUS:	
4000 AMP TINNED COPPER	
MAIN:	
4000 AMP; FED WITH THREE SOURCE CIRCUITS	

VERTICAL SECTION #	COMPARTMENT #	DESCRIPTION	BUSS VOLTAGE/LOAD			FEEDER BREAKER			AUXILIARIES						SPECIFIC NOTES
			VOLT	PH	KW	FRAME AMP	TRIP AMP	POLES	1	2	3	4	5	6	
1	A	MAIN - FROM DUKE ENERGY TRANSFORMER	480	3	2485.0	4000	4000	3	X	X			X	X	1,2,3,5,6,7
2	A	REQUIRED POWER RELAYS/PLC/UPS1	480	3	-----	-----	-----	-----							1,2,5
3	A	INFLUENT PUMP #1 VFD	480	3	140.0	800	350	3	X	X	X		X	X	1,2,5,6
3	B	INFLUENT PUMP #2 VFD	480	3	140.0	800	350	3	X	X	X		X	X	1,2,5,6
3	C	SPARE CIRCUIT BREAKER	480	3	0.0	800	600	3	X	X	X		X	X	1,2,5,6
3	D	SPARE CIRCUIT BREAKER	480	3	0.0	800	600	3	X	X	X		X	X	1,2,5,6
4	A	INFLUENT PUMP #3 VFD	480	3	140.0	800	350	3	X	X	X		X	X	1,2,5,6
4	B	INFLUENT PUMP #4 VFD	480	3	90.0	800	250	3	X	X	X		X	X	1,2,5,6
4	C	ADMIN BUILDING - EXISTING 'MPP' FEED	480	3	45.0	800		3	X	X	X		X	X	1,2,5,6
4	D	SPARE CIRCUIT BREAKER	480	3	0.0	800	800	3	X	X	X		X	X	1,2,5,6
5	A	INFLUENT PUMP #5 VFD	480	3	90.0	800	400	3	X	X	X		X	X	1,2,5,6
5	B	DIGESTER #1 BLOWER	480	3	100.0	800	400	3	X	X	X		X	X	1,2,5,6
5	C	DIGESTER #2 BLOWER	480	3	150.0	800	800	3	X	X	X		X	X	1,2,5,6
5	D	SPARE CIRCUIT BREAKER	480	3	0.0	800	800	3	X	X	X		X	X	1,2,5,6
6	A	MSB-B' VIA MV-TR1/2	480	3	1304.0	800	400	3	X	X	X	X	X	X	1,2,5,6
6	B	MSB-B' VIA MV-TR3/4	480	3	0.0	800	800	3	X	X	X	X	X	X	1,2,5,6
6	C	POWER CONDITIONING UNIT 'PCU-A'	480	3	50.0	800	600	3	X	X	X		X	X	1,2,5,6
6	D	SPARE CIRCUIT BREAKER	480	3	0.0	800	400	3	X	X	X		X	X	1,2,5,6
7	A	PANEL 'HEB1A' FEED	480	3	36.0	800	400	3	X	X	X		X	X	1,2,5,6
7	B	EQ BASIN AREA - PANEL 'HEQ'	480	3	200.0	800	600	3	X	X	X		X	X	1,2,5,6
7	C	SPARE CIRCUIT BREAKER	480	3	0.0	800	600	3	X	X	X		X	X	1,2,5,6
7	D	SPARE CIRCUIT BREAKER	480	3	0.0	800	600	3	X	X	X		X	X	1,2,5,6
8	A	REQUIRED POWER RELAYS/PLC/UPS2	480	3	-----	-----	-----	-----							1,2,5
9	A	MAIN - FROM STANDBY GENERATOR 'GEN-A'	480	3	1242.5	4000	2500	3	X	X			X	X	1,2,4,5,6,7
10	A	MAIN - FROM STANDBY GENERATOR 'GEN-B'	480	3	1242.5	4000	2500	3	X	X			X	X	1,2,4,5,6,7

LV SWITCHGEAR	
'MSB-B'	
LOCATION:	
ELECTRICAL BUILDING #2	
MINIMUM AIC:	
MINIMUM 100,000 AIC FOR 480VAC BUSS OR UPSIZED AS A RESULT OF THE ARC FLASH STUDY	

VOLTAGE:	
480Y277V; 3 PHASE; 4 WIRE	
MINIMUM BUS:	
2500 AMP TINNED COPPER	
MAIN:	
2500 AMP - FED WITH TWO SOURCE CIRCUITS	

VERTICAL SECTION #	COMPARTMENT #	DESCRIPTION	BUSS VOLTAGE/LOAD			FEEDER BREAKER			AUXILIARIES						SPECIFIC NOTES
			VOLT	PH	KW	FRAME AMP	TRIP AMP	POLES	1	2	3	4	5	6	
1	A	MAIN - SERVICE FEEDER FROM 'MV-TR2'	480	3	1360.0	2000	2500	3	X	X		X	X	X	1,2,3,5,6,7
2	A	REQUIRED POWER RELAYS/PLC/UPS1	-----	-----	-----	-----	-----	-----							1,2,5
3	A	PANEL 'HEB2A' FEED	480	3	50.0	800	400	3	X	X	X		X	X	1,2,5,6
3	B	BIO BLOWER #1 VFD	480	3	225.0	800	600	3	X	X	X		X	X	1,2,5,6
3	C	SPARE CIRCUIT BREAKER	480	3	0.0	800	400	3	X	X	X		X	X	1,2,5,6
3	D	SPARE CIRCUIT BREAKER	480	3	0.0	800	800	3	X	X	X		X	X	1,2,5,6
4	A	BIO BLOWER #2 VFD	480	3	225.0	800	600	3	X	X	X		X	X	1,2,5,6
4	B	PANEL 'HEQ' FEED	480	3	195.0	800	600	3	X	X	X		X	X	1,2,5,6
4	C	SPARE CIRCUIT BREAKER	480	3	0.0	800	600	3	X	X	X		X	X	1,2,5,6
4	D	SPARE CIRCUIT BREAKER	480	3	0.0	800	800	3	X	X	X		X	X	1,2,5,6
5	A	BIO BLOWER #3 VFD	480	3	225.0	800	600	3	X	X	X		X	X	1,2,5,6
5	B	SPARE CIRCUIT BREAKER	480	3	0.0	800	400	3	X	X	X		X	X	1,2,5,6
5	C	SPARE CIRCUIT BREAKER	480	3	0.0	800	400	3	X	X	X		X	X	1,2,5,6
5	D	SPARE CIRCUIT BREAKER	480	3	0.0	800	600	3	X	X	X		X	X	1,2,5,6
6	A	DIGESTER BLOWER #3 VFD	480	3	120.0	800	600	3	X	X	X		X	X	1,2,5,6
6	B	RAS/WAS PUMP STAT - EXIST PANEL 'PP4' FEED	480	3	100.0	800	150	3	X	X	X		X	X	1,2,5,6
6	C	SPARE CIRCUIT BREAKER	480	3	0.0	800	250	3	X	X	X		X	X	1,2,5,6
6	D	SPARE CIRCUIT BREAKER	480	3	0.0	800	400	3	X	X	X		X	X	1,2,5,6
7	A	POWER CONDITIONING UNIT 'PCU-B'	480	3	50.0	800	600	3	X	X	X		X	X	1,2,5,6
7	B	UV DISINFECTION - EXIST PANEL 'PDP-60/70' FDR	480	3	170.0	800	250	3	X	X	X		X	X	1,2,5,6
7	C	SPARE CIRCUIT BREAKER	480	3	0.0	800	800	3	X	X	X		X	X	1,2,5,6
7	D	SPARE CIRCUIT BREAKER	480	3	0.0	800	800	3	X	X	X		X	X	1,2,5,6
8	A	REQUIRED POWER RELAYS/PLC/UPS2	-----	-----	-----	-----	-----	-----							1,2,5
9	A	MAIN - SERVICE FEEDER FROM 'MV-TR4'	480	3	1360.0	2000	2500	3	X	X		X	X	X	1,2,4,5,6,7

SERVICE ENTRANCE FEEDER SCHEDULE																		
AMPS	COPPER								ALUMINUM									
	(3W)		(4W)		GROUNDING ELECTRODE CONDUCTOR				(3W)		(4W)		GROUNDING ELECTRODE CONDUCTOR					
	1Ø, 3 WIRE		3Ø, 4 WIRE		W.P.	M.F.	C.E.C.	G.RING	G. ROD	1Ø, 3 WIRE		3Ø, 4 WIRE		W.P.	M.F.	C.E.C.	G.RING	G. ROD
SE-100	(3#1) 1 1/4"C		(4#1) 1 1/2"C		#6 CU	#6 CU	#6 CU	#6 CU	#6 CU	(3#1) 1 1/4"C		(4#1) 1 1/2"C		#8 CU	#8 CU	#8 CU	#8 CU	#6 CU
SE-110	(3#1) 1 1/4"C		(4#1) 1 1/2"C		#6 CU	#6 CU	#6 CU	#6 CU	#6 CU	(3#1/0) 1 1/2"C		(4#1/0) 2"C		#8 CU	#8 CU	#8 CU	#8 CU	#6 CU
SE-125	(3#1) 1 1/4"C		(4#1) 1 1/2"C		#6 CU	#6 CU	#6 CU	#6 CU	#6 CU	(3#2/0) 1 1/2"C		(4#2/0) 2"C		#6 CU	#6 CU	#6 CU	#6 CU	#6 CU
SE-150	(3#1/0) 1 1/2"C		(4#1/0) 2"C		#6 CU	#6 CU	#6 CU	#6 CU	#6 CU	(3#3/0) 2"C		(4#3/0) 2"C		#6 CU	#6 CU	#6 CU	#6 CU	#6 CU
SE-175	(3#2/0) 1 1/2"C		(4#2/0) 2"C		#4 CU	#4 CU	#4 CU	#4 CU	#6 CU	(3#4/0) 2"C		(4#4/0) 2 1/2"C		#4 CU	#4 CU	#4 CU	#4 CU	#6 CU
SE-200	(3#3/0) 2"C		(4#3/0) 2"C		#2 CU	#4 CU	#4 CU	#4 CU	#6 CU	(3-250 KCMIL) 2 1/2"C		(4-250 KCMIL) 2 1/2"C		#4 CU	#4 CU	#4 CU	#4 CU	#6 CU
SE-225	(3#4/0) 2"C		(4#4/0) 2 1/2"C		#2 CU	#2 CU	#2 CU	#2 CU	#6 CU	(3-300 KCMIL) 2 1/2"C		(4-300 KCMIL) 3"C		#2 CU	#2 CU	#2 CU	#2 CU	#6 CU
SE-250	(3-250 KCMIL) 2 1/2"C		(4-250 KCMIL) 2 1/2"C		#2 CU	#2 CU	#2 CU	#2 CU	#6 CU	(3-350 KCMIL) 2 1/2"C		(4-350 KCMIL) 3"C		#2 CU	#2 CU	#2 CU	#2 CU	#6 CU
SE-300	(3-350 KCMIL) 2 1/2"C		(4-350 KCMIL) 3"C		#2 CU	#2 CU	#2 CU	#2 CU	#6 CU	(3-500 KCMIL) 3"C		(4-500 KCMIL) 3 1/2"C		#2 CU	#2 CU	#2 CU	#2 CU	#6 CU
SE-380	(3-500 KCMIL) 3"C		(4-500 KCMIL) 3 1/2"C		#1/0 CU	#1/0 CU	#1/0 CU	#1/0 CU	#6 CU	(3-750 KCMIL) 3 1/2"		(4-750 KCMIL) 4"		#1/0 CU	#1/0 CU	#1/0 CU	#1/0 CU	#6 CU
SE-400	2[(3#3/0) 2"C]		2[(4#3/0) 2"C]		#1/0 CU	#1/0 CU	#1/0 CU	#1/0 CU	#6 CU	2[(3-250 KCMIL) 2 1/2"C]		2[(4-250 KCMIL) 2 1/2"C]		#1/0 CU	#1/0 CU	#1/0 CU	#1/0 CU	#6 CU
SE-450	2[(3#4/0) 2"C]		2[(4#4/0) 2 1/2"C]		#1/0 CU	#1/0 CU	#1/0 CU	#1/0 CU	#6 CU	2[(3-300 KCMIL) 2 1/2"C]		2[(4-300 KCMIL) 3"C]		#1/0 CU	#1/0 CU	#1/0 CU	#1/0 CU	#6 CU
SE-500	2[(3-250 KCMIL) 2 1/2"C]		2[(4-250 KCMIL) 2 1/2"C]		#1/0 CU	#1/0 CU	#1/0 CU	#1/0 CU	#6 CU	2[(3-350 KCMIL) 2 1/2"C]		2[(4-350 KCMIL) 3"C]		#1/0 CU	#1/0 CU	#1/0 CU	#1/0 CU	#6 CU
SE-600	2[(3-350 KCMIL) 2 1/2"C]		2[(4-350 KCMIL) 3"C]		#2/0 CU	#2/0 CU	#2/0 CU	#2/0 CU	#6 CU	2[(3-500 KCMIL) 3"C]		2[(4-500 KCMIL) 3 1/2"C]		#2/0 CU	#2/0 CU	#2/0 CU	#2/0 CU	#6 CU
SE-700	2[(3-500 KCMIL) 3"C]		2[(4-500 KCMIL) 3 1/2"C]		#2/0 CU	#2/0 CU	#2/0 CU	#2/0 CU	#6 CU	2[(3-700 KCMIL) 3 1/2"C]		2[(4-700 KCMIL) 4"C]		#2/0 CU	#2/0 CU	#2/0 CU	#2/0 CU	#6 CU
SE-760	2[(3-500 KCMIL) 3"C]		2[(4-500 KCMIL) 3 1/2"C]		#2/0 CU	#2/0 CU	#2/0 CU	#2/0 CU	#6 CU	2[(3-750 KCMIL) 3 1/2"C]		2[(4-750 KCMIL) 4"C]		#2/0 CU	#2/0 CU	#2/0 CU	#2/0 CU	#6 CU
SE-800	3[(3-300 KCMIL) 2 1/2"C]		3[(4-300 KCMIL) 3"C]		#2/0 CU	#2/0 CU	#2/0 CU	#2/0 CU	#6 CU	3[(3-400 KCMIL) 3"C]		3[(4-400 KCMIL) 3"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU
SE-1000	3[(3-400 KCMIL) 3"C]		3[(4-400 KCMIL) 3"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU	3[(3-600 KCMIL) 3 1/2"C]		3[(4-600 KCMIL) 3 1/2"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU
SE-1200	4[(3-350 KCMIL) 2 1/2"C]		4[(4-350 KCMIL) 3"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU	4[(3-500 KCMIL) 3"C]		4[(4-500 KCMIL) 3 1/2"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU
SE-1600	5[(3-400 KCMIL) 3"C]		5[(4-400 KCMIL) 3"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU	5[(3-600 KCMIL) 3 1/2"C]		5[(4-600 KCMIL) 3 1/2"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU
SE-2000	6[(3-400 KCMIL) 3"C]		6[(4-400 KCMIL) 3"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU	6[(3-600 KCMIL) 3 1/2"C]		6[(4-600 KCMIL) 3 1/2"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU
SE-2500	7[(3-500 KCMIL) 3"C]		7[(4-500 KCMIL) 3 1/2"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU	7[(3-700 KCMIL) 3 1/2"C]		7[(4-700 KCMIL) 4"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU
SE-3000	8[(3-500 KCMIL) 3"C]		8[(4-500 KCMIL) 3 1/2"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU	8[(3-700 KCMIL) 3 1/2"C]		8[(4-700 KCMIL) 4"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU
SE-3500	10[(3-500 KCMIL) 3"C]		10[(4-500 KCMIL) 3 1/2"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU	10[(3-700 KCMIL) 3 1/2"C]		10[(4-700 KCMIL) 4"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU
SE-4000	11[(3-500 KCMIL) 3"C]		11[(4-500 KCMIL) 3 1/2"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU	11[(3-700 KCMIL) 3 1/2"C]		11[(4-700 KCMIL) 4"C]		#3/0 CU	#3/0 CU	#3/0 CU	#3/0 CU	#6 CU
CONDUIT SIZES ARE BASED ON NEC TABLE 4 (RNC) AND TABLE 5 (THHN INSULATION).																		
ABBREVIATIONS: W.P. - WATER PIPE; M.F. - METAL FRAME OR STRUCTURE; C.E.C. - CONCRETE ENCASED ELECTRODE; G.RING. - GROUND RING; G. ROD - GROUND ROD, PIPE OR PLATE ELECTRODE																		

DRAWING FILE: V:\Projects\2022 Projects\CGRE\CGRE220008 - Pendleton-Clemson WWTP Expansion\Drawings\Electrical\E-931 - SCHEDULES.dwg
PLOTTER: Mar 13, 2022 2:15pm

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SHIELDED POWER CABLE SCHEDULE FOR VFD DRIVEN MOTORS							
SEQUENCE NUMBER	CONDUIT OR SLEEVE SIZE	CIRCUIT TYPE	ROUTING	WIRING	FROM	TO	NOTES
VC-1	3" PER CABLE	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	TWO SETS: BELDEN 1329529 WITH 3#1/0 + 3#2EG	ELECTRICAL BLDG 1: IP#1 (PID#1010) VFD	INFLUENT PUMP STATION: WET WELL JUNCTION BOX #1	PROVIDE LOCAL 3 POLE, HEAVY DUTY, NON-FUSED NEMA 4X SAFETY SWITCH IF REQUIRED. ROUTE VIA CABLE TRAY AT ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE. SLEEVE UP TO LOCAL SAFETY SWITCH. PROVIDE WATER-TIGHT COUPLINGS AT LOCAL SAFETY SWITCH. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
VC-2	3" PER CABLE	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	TWO SETS: BELDEN 1329529 WITH 3#1/0 + 3#2EG	ELECTRICAL BLDG 1: IP#2 (PID#1020) VFD	INFLUENT PUMP STATION: WET WELL JUNCTION BOX #2	PROVIDE LOCAL 3 POLE, HEAVY DUTY, NON-FUSED NEMA 4X SAFETY SWITCH IF REQUIRED. ROUTE VIA CABLE TRAY AT ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE. SLEEVE UP TO LOCAL SAFETY SWITCH. PROVIDE WATER-TIGHT COUPLINGS AT LOCAL SAFETY SWITCH. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
VC-3	3" PER CABLE	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	TWO SETS: BELDEN 1329529 WITH 3#1/0 + 3#2EG	ELECTRICAL BLDG 1: IP#3 (PID#1030) VFD	INFLUENT PUMP STATION: WET WELL JUNCTION BOX #3	PROVIDE LOCAL 3 POLE, HEAVY DUTY, NON-FUSED NEMA 4X SAFETY SWITCH IF REQUIRED. ROUTE VIA CABLE TRAY AT ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE. SLEEVE UP TO LOCAL SAFETY SWITCH. PROVIDE WATER-TIGHT COUPLINGS AT LOCAL SAFETY SWITCH. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
VC-4	3" PER CABLE	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	TWO SETS: BELDEN 1329507 WITH 3#2 + 3#8EG	ELECTRICAL BLDG 1: IP#4 (PID#1040) VFD	INFLUENT PUMP STATION: WET WELL JUNCTION BOX #4	PROVIDE LOCAL 3 POLE, HEAVY DUTY, NON-FUSED NEMA 4X SAFETY SWITCH IF REQUIRED. ROUTE VIA CABLE TRAY AT ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE. SLEEVE UP TO LOCAL SAFETY SWITCH. PROVIDE WATER-TIGHT COUPLINGS AT LOCAL SAFETY SWITCH. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
VC-5	3" PER CABLE	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	TWO SETS: BELDEN 1329507 WITH 3#2 + 3#8EG	ELECTRICAL BLDG 1: IP#5 (PID#1050) VFD	INFLUENT PUMP STATION: WET WELL JUNCTION BOX #5	PROVIDE LOCAL 3 POLE, HEAVY DUTY, NON-FUSED NEMA 4X SAFETY SWITCH IF REQUIRED. ROUTE VIA CABLE TRAY AT ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE. SLEEVE UP TO LOCAL SAFETY SWITCH. PROVIDE WATER-TIGHT COUPLINGS AT LOCAL SAFETY SWITCH. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
VC-6	3" PER CABLE	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	TWO SETS: BELDEN XXXXXX WITH 3#2/0 + 3#1EG	ELECTRICAL BLDG 1: BLOWER #1 VFD (PID#BLR3610)	BIO REACTOR: BLOWER #1 (PID#BLR3610) LOCAL SAFETY SWITCH	PROVIDE NEW LOCAL 3 POLE, HEAVY DUTY, NON-FUSED NEMA 4X SAFETY SWITCH AS REQUIRED ON ONE-LINE. ROUTE VIA CABLE TRAY AT ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE. SLEEVE UP TO LOCAL SAFETY SWITCH. PROVIDE WATER-TIGHT COUPLINGS AT LOCAL SAFETY SWITCH. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
VC-7	3" PER CABLE	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	TWO SETS: BELDEN XXXXXX WITH 3#2/0 + 3#1EG	BIO REACTOR: BLOWER #1 (PID#BLR3610) LOCAL SAFETY SWITCH	BIO REACTOR: BLOWER #1 (PID#BLR3610)	PROVIDE WATER-TIGHT COUPLINGS AT LOCAL SAFETY SWITCH.
VC-8	3" PER CABLE	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	TWO SETS: BELDEN XXXXXX WITH 3#2/0 + 3#1EG	ELECTRICAL BLDG 1: BLOWER #2 VFD (PID#BLR3620)	BIO REACTOR: BLOWER #2 (PID#BLR3620) LOCAL SAFETY SWITCH	PROVIDE NEW LOCAL 3 POLE, HEAVY DUTY, NON-FUSED NEMA 4X SAFETY SWITCH AS REQUIRED ON ONE-LINE. ROUTE VIA CABLE TRAY AT ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE. SLEEVE UP TO LOCAL SAFETY SWITCH. PROVIDE WATER-TIGHT COUPLINGS AT LOCAL SAFETY SWITCH. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
VC-9	3" PER CABLE	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	TWO SETS: BELDEN XXXXXX WITH 3#2/0 + 3#1EG	BIO REACTOR: BLOWER #2 (PID#BLR3620) LOCAL SAFETY SWITCH	BIO REACTOR: BLOWER #2 (PID#BLR3620)	PROVIDE WATER-TIGHT COUPLINGS AT LOCAL SAFETY SWITCH.
VC-10	3" PER CABLE	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	TWO SETS: BELDEN XXXXXX WITH 3#2/0 + 3#1EG	ELECTRICAL BLDG 1: BLOWER #3 VFD (PID#BLR3630)	BIO REACTOR: BLOWER #3 (PID#BLR3630) LOCAL SAFETY SWITCH	PROVIDE NEW LOCAL 3 POLE, HEAVY DUTY, NON-FUSED NEMA 4X SAFETY SWITCH AS REQUIRED ON ONE-LINE. ROUTE VIA CABLE TRAY AT ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE. SLEEVE UP TO LOCAL SAFETY SWITCH. PROVIDE WATER-TIGHT COUPLINGS AT LOCAL SAFETY SWITCH. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
VC-11	3" PER CABLE	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	TWO SETS: BELDEN XXXXXX WITH 3#2/0 + 3#1EG	BIO REACTOR: BLOWER #3 (PID#BLR3630) LOCAL SAFETY SWITCH	BIO REACTOR: BLOWER #3 (PID#BLR3630)	PROVIDE WATER-TIGHT COUPLINGS AT LOCAL SAFETY SWITCH.

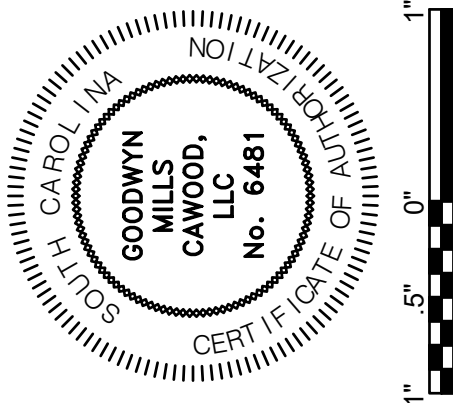
SHIELDED POWER
SCHEDULE

E-932

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Confirmed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH



GMC
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DRAWING FILE: V:\Projects\2022 Projects\CGRE\220008 - Pendleton-Clemson WWTP Expansion\Drawings\Electrical\E-931 - SCHEDULES.dwg
PLOTTER: Mar 18, 2022 11:54am

FEEDER SCHEDULE - ALUMINUM					
AMPS	(2WG)	(3WG)	(4WG)	(5WG)	IG
	1Ø, 2 WIRE, GROUND	1Ø, 3 WIRE, GROUND OR 3Ø, 3 WIRE, GROUND	3Ø, 4 WIRE, GROUND	3Ø, 5 WIRE, GROUND, 200% NEUTRAL	ISOLATED GROUND
100	(2#1 & 1#6 G) 1 1/4" C	(3#1 & 1#6 G) 1 1/2" C	(4#1 & 1#6 G) 1 1/2" C	(5#2/0 & 1#6 G) 2 1/2" C	1#6 IG
110	(2#1/0 & 1#4 G) 1 1/4" C	(3#1/0 & 1#4 G) 1 1/2" C	(4#1/0 & 1#4 G) 2" C	(5#3/0 & 1#4 G) 2 1/2" C	1#4 IG
125	(2#2/0 & 1#4 G) 1 1/2" C	(3#2/0 & 1#4 G) 2" C	(4#2/0 & 1#4 G) 2" C	(5#4/0 & 1#4 G) 3" C	1#4 IG
150	(2#3/0 & 1#4 G) 1 1/2" C	(3#3/0 & 1#4 G) 2" C	(4#3/0 & 1#4 G) 2 1/2" C	(5-250 KCMIL & 1#4 G) 3" C	1#4 IG
175	(2#4/0 & 1#4 G) 2" C	(3#4/0 & 1#4 G) 2" C	(4#4/0 & 1#4 G) 2 1/2" C	(5-300 KCMIL & 1#4 G) 3" C	1#4 IG
200	(2-250 KCMIL & 1#4 G) 2" C	(3-250 KCMIL & 1#4 G) 2 1/2" C	(4-250 KCMIL & 1#4 G) 3" C	(5-350 KCMIL & 1#4 G) 3 1/2" C	1#4 IG
225	(2-300 KCMIL & 1#2 G) 2" C	(3-300 KCMIL & 1#2 G) 2 1/2" C	(4-300 KCMIL & 1#2 G) 3" C	(5-500 KCMIL & 1#2 G) 4" C	1#2 IG
250	(2-350 KCMIL & 1#2 G) 2 1/2" C	(3-350 KCMIL & 1#2 G) 3" C	(4-350 KCMIL & 1#2 G) 3" C	(5-600 KCMIL & 1#2 G) 4" C	1#2 IG
300	(2-500 KCMIL & 1#2 G) 2 1/2" C	(3-500 KCMIL & 1#2 G) 3" C	(4-500 KCMIL & 1#2 G) 3 1/2" C	(5-700 KCMIL & 1#2 G) 5" C	1#2 IG
380	(2-750 KCMIL & 1#1 G) 3" C	(3-750 KCMIL & 1#1 G) 3 1/2"	(4-750 KCMIL & 1#1 G) 4"	2[(5-350 KCMIL & 1#1 G) 3 1/2" C]	1#1 IG
400	2[(2-250 KCMIL & 1#1 G) 2" C]	2[(3-250 KCMIL & 1#1 G) 2 1/2" C]	2[(4-250 KCMIL & 1#1 G) 3" C]	2[(5-350 KCMIL & 1#1 G) 3 1/2" C]	1#1 IG
450	2[(2-300 KCMIL & 1#1/0 G) 2" C]	2[(3-300 KCMIL & 1#1/0 G) 2 1/2" C]	2[(4-300 KCMIL & 1#1/0 G) 3" C]	2[(5-500 KCMIL & 1#1/0 G) 4" C]	1#1/0 IG
500	2[(2-350 KCMIL & 1#1/0 G) 2 1/2" C]	2[(3-350 KCMIL & 1#1/0 G) 3" C]	2[(4-350 KCMIL & 1#1/0 G) 3" C]	2[(5-600 KCMIL & 1#1/0 G) 5" C]	1#1/0 IG
600	2[(2-500 KCMIL & 1#2/0 G) 2 1/2" C]	2[(3-500 KCMIL & 1#2/0 G) 3" C]	2[(4-500 KCMIL & 1#2/0 G) 3 1/2" C]	2[(5-700 KCMIL & 1#2/0 G) 5" C]	1#2/0 IG
700	2[(2-700 KCMIL & 1#3/0 G) 3" C]	2[(3-700 KCMIL & 1#3/0 G) 3 1/2" C]	2[(4-700 KCMIL & 1#3/0 G) 4" C]	3[(5-500 KCMIL & 1#3/0 G) 4" C]	1#3/0 IG
760	2[(2-750 KCMIL & 1#3/0 G) 3" C]	2[(3-750 KCMIL & 1#3/0 G) 3 1/2" C]	2[(4-750 KCMIL & 1#3/0 G) 4" C]	3[(5-600 KCMIL & 1#3/0 G) 5" C]	1#3/0 IG
800	3[(2-400 KCMIL & 1#3/0 G) 2 1/2" C]	3[(3-400 KCMIL & 1#3/0 G) 3" C]	3[(4-400 KCMIL & 1#3/0 G) 3 1/2" C]	3[(5-600 KCMIL & 1#3/0 G) 5" C]	1#3/0 IG
1000	3[(2-600 KCMIL & 1#4/0 G) 3" C]	3[(3-600 KCMIL & 1#4/0 G) 3 1/2" C]	3[(4-600 KCMIL & 1#4/0 G) 4" C]	4[(5-600 KCMIL & 1#4/0 G) 5" C]	1#4/0 IG
1200	4[(2-500 KCMIL & 1-250 KCMIL G) 3" C]	4[(3-500 KCMIL & 1-250 KCMIL G) 3" C]	4[(4-500 KCMIL & 1-250 KCMIL G) 3 1/2" C]	4[(5-700 KCMIL & 1-250 KCMIL G) 5" C]	1-250 KCMIL IG
1600	5[(2-600 KCMIL & 1-350 KCMIL G) 3" C]	5[(3-600 KCMIL & 1-350 KCMIL G) 3 1/2" C]	5[(4-600 KCMIL & 1-350 KCMIL G) 4" C]	6[(5-600 KCMIL & 1-350 KCMIL G) 5" C]	1-350 KCMIL IG
2000	6[(2-600 KCMIL & 1-400 KCMIL G) 3" C]	6[(3-600 KCMIL & 1-400 KCMIL G) 3 1/2" C]	6[(4-600 KCMIL & 1-400 KCMIL G) 4" C]	7[(5-700 KCMIL & 1-400 KCMIL G) 5" C]	1-400 KCMIL IG
2500	7[(2-700 KCMIL & 1-600 KCMIL G) 3 1/2" C]	7[(3-700 KCMIL & 1-600 KCMIL G) 4" C]	7[(4-700 KCMIL & 1-600 KCMIL G) 5" C]	9[(5-700 KCMIL & 1-600 KCMIL G) 5" C]	1-600 KCMIL IG
3000	8[(2-700 KCMIL & 1-600 KCMIL G) 3 1/2" C]	8[(3-700 KCMIL & 1-600 KCMIL G) 4" C]	8[(4-700 KCMIL & 1-600 KCMIL G) 5" C]	10[(5-700 KCMIL & 1-600 KCMIL G) 5" C]	1-600 KCMIL IG
3500	10[(2-700 KCMIL & 1-800 KCMIL G) 3 1/2" C]	10[(3-700 KCMIL & 1-800 KCMIL G) 4" C]	10[(4-700 KCMIL & 1-800 KCMIL G) 5" C]	13[(5-600 KCMIL & 1-800 KCMIL G) 5" C]	1-800 KCMIL IG
4000	11[(2-700 KCMIL & 1-800 KCMIL G) 3 1/2" C]	11[(3-700 KCMIL & 1-800 KCMIL G) 4" C]	11[(4-700 KCMIL & 1-800 KCMIL G) 5" C]	15[(5-600 KCMIL & 1-800 KCMIL G) 5" C]	1-800 KCMIL IG
CONDUCTOR SIZES ARE BASED ON 75° TERMINATIONS. CONDUIT SIZES ARE BASED ON NEC TABLE 4 (RNC) AND TABLE 5 (THHN INSULATION).					

WIRING SCHEDULE - COPPER						
AMPS	(2WG)	(3WG)	(4WG)	4W-(IG)	(5WG)	5W-(IG)
	1Ø, 2 WIRE, GROUND	1Ø, 3 WIRE, GROUND OR 3Ø, 3 WIRE, GROUND	3Ø, 4 WIRE, GROUND	ISOLATED GROUND	3Ø, 5 WIRE, GROUND, 200% NEUTRAL	ISOLATED GROUND
20	(2#12 & 1#12 G) 3/4" C	(3#12 & 1#12 G) 3/4" C	(4#12 & 1#12 G) 3/4" C	1#12 IG, 3/4" C	(5#12 & 1#12 G) 3/4" C	1#12 IG, 3/4" C
30	(2#10 & 1#10 G) 3/4" C	(3#10 & 1#10 G) 3/4" C	(4#10 & 1#10 G) 3/4" C	1#10 IG, 3/4" C	(5#10 & 1#10 G) 3/4" C	1#10 IG, 3/4" C
40	(2#8 & 1#10 G) 3/4" C	(3#8 & 1#10 G) 3/4" C	(4#8 & 1#10 G) 1" C	1#10 IG, 1" C	(5#8 & 1#10 G) 1" C	1#10 IG, 1" C
50	(2#6 & 1#10 G) 3/4" C	(3#6 & 1#10 G) 1" C	(4#6 & 1#10 G) 1" C	1#10 IG, 1" C	(5#6 & 1#10 G) 1" C	1#10 IG, 1 1/4" C
60	(2#4 & 1#10 G) 1" C	(3#4 & 1#10 G) 1" C	(4#4 & 1#10 G) 1 1/4" C	1#10 IG, 1 1/4" C	(5#4 & 1#10 G) 1 1/4" C	1#10 IG, 1 1/4" C
70	(2#4 & 1#8 G) 1" C	(3#4 & 1#8 G) 1 1/4" C	(4#4 & 1#8 G) 1 1/4" C	1#8 IG, 1 1/4" C	(5#4 & 1#8 G) 1 1/4" C	1#8 IG, 1 1/4" C
80	(2#2 & 1#8 G) 1" C	(3#2 & 1#8 G) 1 1/4" C	(4#2 & 1#8 G) 1 1/2" C	1#8 IG, 1 1/2" C	(5#2 & 1#8 G) 1 1/2" C	1#8 IG, 1 1/2" C
90	(2#2 & 1#8 G) 1" C	(3#2 & 1#8 G) 1 1/4" C	(4#2 & 1#8 G) 1 1/2" C	1#8 IG, 1 1/2" C	(5#2 & 1#8 G) 1 1/2" C	1#8 IG, 1 1/2" C
100	(2#1 & 1#8 G) 1 1/4" C	(3#1 & 1#8 G) 1 1/2" C	(4#1 & 1#8 G) 1 1/2" C	1#8 IG, 2" C	(5#1 & 1#8 G) 2" C	1#8 IG, 2" C
110	(2#1 & 1#6 G) 1 1/4" C	(3#1 & 1#6 G) 1 1/2" C	(4#1 & 1#6 G) 1 1/2" C	1#6 IG, 2" C	(5#1 & 1#6 G) 2" C	1#6 IG, 2" C
125	(2#1 & 1#6 G) 1 1/4" C	(3#1 & 1#6 G) 1 1/2" C	(4#1 & 1#6 G) 1 1/2" C	1#6 IG, 2" C	(5#1/0 & 1#4 G) 2 1/2" C	1#4 IG, 2" C
150	(2#1/0 & 1#6 G) 1 1/4" C	(3#1/0 & 1#6 G) 1 1/2" C	(4#1/0 & 1#6 G) 2" C	1#6 IG, 2" C	(5#2/0 & 1#4 G) 2 1/2" C	1#4 IG, 2 1/2" C
175	(2#2/0 & 1#6 G) 1 1/2" C	(3#2/0 & 1#6 G) 2" C	(4#2/0 & 1#6 G) 2" C	1#6 IG, 2" C	(5#3/0 & 1#4 G) 2 1/2" C	1#4 IG, 2 1/2" C
200	(2#3/0 & 1#6 G) 1 1/2" C	(3#3/0 & 1#6 G) 2" C	(4#3/0 & 1#6 G) 2" C	1#6 IG, 2 1/2" C	(5#4/0 & 1#4 G) 3" C	1#4 IG, 3" C
225	(2#4/0 & 1#4 G) 2" C	(3#4/0 & 1#4 G) 2" C	(4#4/0 & 1#4 G) 2 1/2" C	1#4 IG, 2 1/2" C	(5-250 KCMIL & 1#3 G) 3" C	1#3 IG, 3" C
250	(2-250 KCMIL & 1#4 G) 2" C	(3-250 KCMIL & 1#4 G) 2 1/2" C	(4-250 KCMIL & 1#4 G) 3" C	1#4 IG, 3" C	(5-300 KCMIL & 1#3 G) 3" C	1#3 IG, 3" C
300	(2-350 KCMIL & 1#4 G) 2" C	(3-350 KCMIL & 1#4 G) 3" C	(4-350 KCMIL & 1#4 G) 3" C	1#4 IG, 3" C	(5-400 KCMIL & 1#3 G) 3 1/2" C	1#3 IG, 3 1/2" C
380	(2-500 KCMIL & 1#3 G) 2 1/2" C	(3-500 KCMIL & 1#3 G) 3" C	(4-500 KCMIL & 1#3 G) 3 1/2" C	1#3 IG, 3 1/2" C	2[(5#4/0 & 1#3 G) 3" C]	1#3 IG, 3" C
400	2[(2#3/0 & 1#3 G) 1 1/2" C]	2[(3#3/0 & 1#3 G) 2" C]	2[(4#3/0 & 1#3 G) 2 1/2" C]	1#3 IG, 3 1/2" C	2[(5#4/0 & 1#2 G) 3" C]	1#2 IG, 3" C
450	2[(2#4/0 & 1#2 G) 2" C]	2[(3#4/0 & 1#2 G) 2" C]	2[(4#4/0 & 1#2 G) 2 1/2" C]		2[(5-250 KCMIL & 1#1 G) 3" C]	
500	2[(2-250 KCMIL & 1#2 G) 2" C]	2[(3-250 KCMIL & 1#2 G) 2 1/2" C]	2[(4-250 KCMIL & 1#2 G) 3" C]		2[(5-300 KCMIL & 1#1 G) 3" C]	
600	2[(2-350 KCMIL & 1#1 G) 2 1/2" C]	2[(3-350 KCMIL & 1#1 G) 3" C]	2[(4-350 KCMIL & 1#1 G) 3" C]		2[(5-400 KCMIL & 1#1/0 G) 3 1/2" C]	
700	2[(2-500 KCMIL & 1#1/0 G) 2 1/2" C]	2[(3-500 KCMIL & 1#1/0 G) 3" C]	2[(4-500 KCMIL & 1#1/0 G) 3 1/2" C]		3[(5-300 KCMIL & 1#1/0 G) 3" C]	
760	2[(2-500 KCMIL & 1#1/0 G) 2 1/2" C]	2[(3-500 KCMIL & 1#1/0 G) 3" C]	2[(4-500 KCMIL & 1#1/0 G) 3 1/2" C]		3[(5-300 KCMIL & 1#1/0 G) 3" C]	
800	3[(2-300 KCMIL & 1#1/0 G) 2" C]	3[(3-300 KCMIL & 1#1/0 G) 2 1/2" C]	3[(4-300 KCMIL & 1#1/0 G) 3" C]		3[(5-350 KCMIL & 1#2/0 G) 3 1/2" C]	
1000	3[(2-400 KCMIL & 1#2/0 G) 2 1/2" C]	3[(3-400 KCMIL & 1#2/0 G) 3" C]	3[(4-400 KCMIL & 1#2/0 G) 3" C]		3[(5-500 KCMIL & 1#3/0 G) 4" C]	
1200	4[(2-350 KCMIL & 1#3/0 G) 2 1/2" C]	4[(3-350 KCMIL & 1#3/0 G) 3" C]	4[(4-350 KCMIL & 1#3/0 G) 3" C]			
1600	5[(2-400 KCMIL & 1#4/0 G) 2 1/2" C]	5[(3-400 KCMIL & 1#4/0 G) 3" C]	5[(4-400 KCMIL & 1#4/0 G) 3 1/2" C]			
2000	6[(2-400 KCMIL & 1-250 KCMIL G) 2 1/2" C]	6[(3-400 KCMIL & 1-250 KCMIL G) 3" C]	6[(4-400 KCMIL & 1-250 KCMIL G) 3 1/2" C]			
2500	7[(2-600 KCMIL & 1-350 KCMIL G) 3" C]	7[(3-500 KCMIL & 1-350 KCMIL G) 3 1/2" C]	7[(4-500 KCMIL & 1-350 KCMIL G) 3 1/2" C]			
3000	8[(2-500 KCMIL & 1-400 KCMIL G) 3" C]	8[(3-500 KCMIL & 1-400 KCMIL G) 3 1/2" C]	8[(4-500 KCMIL & 1-400 KCMIL G) 3 1/2" C]			
3500	10[(2-500 KCMIL & 1-500 KCMIL G) 3" C]	10[(3-500 KCMIL & 1-500 KCMIL G) 3 1/2" C]	10[(4-500 KCMIL & 1-500 KCMIL G) 4" C]			
4000	11[(2-500 KCMIL & 1-500 KCMIL G) 3" C]	11[(3-500 KCMIL & 1-500 KCMIL G) 3 1/2" C]	11[(4-500 KCMIL & 1-500 KCMIL G) 4" C]			
CONDUCTOR SIZES ARE BASED ON 60° TERMINATIONS LESS THAN 100A AND 75° TERMINATIONS GREATER THAN 100A PER NEC 110.14 ADJUSTMENT FACTORS ARE BASED ON 90° TEMPERATURE RATINGS PER NEC 110.14 CONDUIT SIZES ARE BASED ON NEC CH.9 TABLE 4 (RNC SCHED 80) FOR WORST CASE AND TABLE 5 (THHN INSULATION).						

FEEDER
SCHEDULE

E-933

PENDLETON - CLEMSON

REGIONAL WWTP EXPANSION

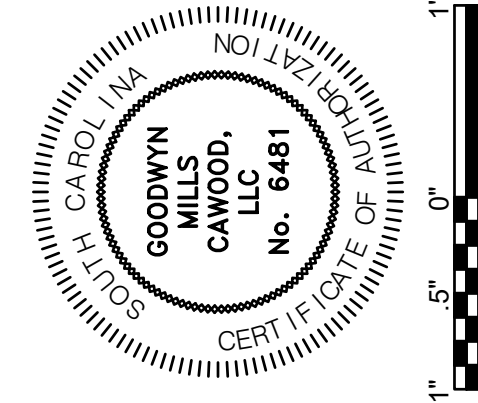
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

ISSUE

DATE

30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
100% Submittal	03/08/2024
Confirmed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH



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T 864.527.0460

DRAWING FILE: V:\Projects\2022 Projects\CGRE\GRE220008 - Pendleton-Clemson WWTP Expansion\Drawings\Electrical\E-931 - SCHEDULES.dwg
PLOTTER: Mar 13, 2022 2:15pm

<TCDB> TRAY CABLE DIRECT-BURIED FEEDER AND MOTOR CIRCUIT CABLES							
TAG	SLEEVE SIZE PER CABLE	CIRCUIT TYPE	ROUTING	MANUFACTURER CATALOG NUMBER	DESCRIPTION OF WIRING	3 PHASE/3 WIRE OR 3 PHASE/4 WIRE ALUMINUM ALLOY OR COPPER CONDUCTOR	NOTES
TCDB-1 920	3"	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	SOUTHWIRE #56076099	FOUR CABLES EACH CONTAINING 4#300KCM WITH GROUND	3 PHASE 4 WIRE ALUMAFLEX	ROUTE VIA CABLE TRAY IN ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE WHERE APPLICABLE. SLEEVE UNDER FLOOR SLAB OR THROUGH WALLS. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS. COORDINATE EXACT FEEDER SIZE WITH POWER FACTOR CORRECTION MANUFACTURER.
TCDB-2 1380	3"	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	SOUTHWIRE #56076099	SIX CABLES EACH CONTAINING 4#300KCM WITH GROUND	3 PHASE 4 WIRE ALUMAFLEX	ROUTE VIA CABLE TRAY IN ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE WHERE APPLICABLE. SLEEVE UNDER FLOOR SLAB OR THROUGH WALLS. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
TCDB-3 410	3"	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	SOUTHWIRE #56075399	TWO CABLES EACH CONTAINING 3#3/0AWG WITH GROUND	3 PHASE 3 WIRE ALUMAFLEX	ROUTE VIA CABLE TRAY IN ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE WHERE APPLICABLE. SLEEVE UNDER FLOOR SLAB OR THROUGH WALLS. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
TCDB-4 460	3"	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	SOUTHWIRE #56076099	TWO CABLES EACH CONTAINING 4#300KCM WITH GROUND	3 PHASE 4 WIRE ALUMAFLEX	ROUTE VIA CABLE TRAY IN ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE WHERE APPLICABLE. SLEEVE UNDER FLOOR SLAB OR THROUGH WALLS. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
TCDB-5 310	3"	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	SOUTHWIRE #56075799	TWO CABLES EACH CONTAINING 4#3/0AWG WITH GROUND	3 PHASE 4 WIRE ALUMAFLEX	ROUTE VIA CABLE TRAY IN ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE WHERE APPLICABLE. SLEEVE UNDER FLOOR SLAB OR THROUGH WALLS. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
TCDB-6 155	3"	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	SOUTHWIRE #56075399	ONE CABLE EACH CONTAINING 3#3/0AWG WITH GROUND	3 PHASE 3 WIRE ALUMAFLEX	ROUTE VIA CABLE TRAY IN ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE WHERE APPLICABLE. SLEEVE UNDER FLOOR SLAB OR THROUGH WALLS. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
TCDB-7 155	3"	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	SOUTHWIRE #56075799	ONE CABLE EACH CONTAINING 4#3/0AWG WITH GROUND	3 PHASE 4 WIRE ALUMAFLEX	ROUTE VIA CABLE TRAY IN ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE WHERE APPLICABLE. SLEEVE UNDER FLOOR SLAB OR THROUGH WALLS. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
TCDB-8 180	3"	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	SOUTHWIRE #56075499	ONE CABLE EACH CONTAINING 3#4/0AWG WITH GROUND	3 PHASE 3 WIRE ALUMAFLEX	ROUTE VIA CABLE TRAY IN ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE WHERE APPLICABLE. SLEEVE UNDER FLOOR SLAB OR THROUGH WALLS. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
TCDB-9 460	3"	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	SOUTHWIRE #58751899	TWO CABLES EACH CONTAINING 3#300KCM WITH GROUND	3 PHASE 3 WIRE ALUMAFLEX	ROUTE VIA CABLE TRAY IN ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE WHERE APPLICABLE. SLEEVE UNDER FLOOR SLAB OR THROUGH WALLS. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
TCDB-10 360	3"	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	SOUTHWIRE #56075899	TWO CABLES EACH CONTAINING 4#4/0AWG WITH GROUND	3 PHASE 4 WIRE ALUMAFLEX	ROUTE VIA CABLE TRAY IN ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE WHERE APPLICABLE. SLEEVE UNDER FLOOR SLAB OR THROUGH WALLS. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
TCDB-11	1-1/2"	POWER	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	SOUTHWIRE #55295402	ONE CABLE EACH CONTAINING 3#10AWG WITH GROUND	3 PHASE 3 WIRE COPPER	ROUTE VIA CABLE TRAY IN ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE WHERE APPLICABLE. SLEEVE UNDER FLOOR SLAB OR THROUGH WALLS. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS.
TCDB-12	1-1/2"	DATA	TRAY/DIRECT BURIED UNDER GRADE/SLEEVED	SOUTHWIRE #69005402	ONE CABLE EACH CONTAINING 3#12AWG WITH GROUND	120VAC CONTROL COPPER	ROUTE VIA CABLE TRAY IN ELECTRICAL BLDG. DIRECT BURIED ACROSS SITE WHERE APPLICABLE. SLEEVE UNDER FLOOR SLAB OR THROUGH WALLS. PROVIDE ENGRAVED METAL NAMEPLATE WITH CIRCUIT DESCRIPTION IN ALL EXPOSED AND TRAY LOCATIONS. CONNECT TORQUE SWITCH AT CLARIFIER. CONNECT THERMOSTAT AT EXHAUST FAN.

TCDB FEEDER AND
MOTOR CIRCUIT
SCHEDULE

E-934

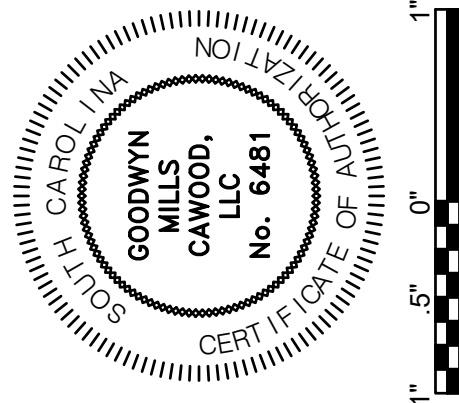
PENDLETON - CLEMSON

REGIONAL WWTP EXPANSION

PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

ISSUE DATE	
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Confirmed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH



GMC
117 Welborn St.
Greenville, SC 29601
T 864.527.0460

PANEL:				EXISTING 'PP4'				VOLTAGE:				277/480V, 3PH, 4W						
LOCATION:				RAS/WAS PUMP STATION				MINIMUM BUS:				250						
MOUNTING:				SURFACE				MAIN:				MAIN BREAKER						
								MINIMUM AIC:				N/A						
NO.	LOAD			TYPE	LOAD DESCRIPTION	BREAKER POLE	TRIP	BUS			BREAKER TRIP	POLE	TYPE	LOAD DESCRIPTION	LOAD			NO.
	A	B	C					A	B	C					A	B	C	
1				E	HEATER (TO REMAIN)	3	15	+			15	3	E	HEATER (TO REMAIN)				2
3				E					+				E					4
5				E						+			E					6
7				M	WAS PUMP #1 (REPLACE BKR)	3	40	+			40		M	WAS PUMP #3 (REPLACE BKR)				8
9				M					+				M					10
11				M						+			M					12
13				M	WAS PUMP #2 (REPLACE BKR)	3	40	+			40			COMPLETELY REMOVE CIRCUIT				14
15				M					+									16
17				M						+								18
19					COMPLETELY REMOVE CIRCUIT	3	15	+			15			COMPLETELY REMOVE CIRCUIT				20
21									+									22
23										+								24
25					COMPLETELY REMOVE CIRCUIT	3	15	+			15			COMPLETELY REMOVE CIRCUIT				26
27									+									28
29										+								30
31					COMPLETELY REMOVE CIRCUIT	3	40	+			40		E	TRANSFORMER (TO REMAIN)				32
33									+				E					34
35										+			E					36
37					SPACE AND BUSS			+			30	3	E	'SPD-PP4' (NEW CIRCUIT BKR)	100			38
39									+				E			100		40
41									+				E				100	42

LOAD TYPE	PANEL TOTAL	FEED THRU TOTAL	SUBFEED TOTAL	FEEDER SUBTOTAL	DEMAND	FEEDER TOTAL
(L) LIGHTING	0			0	125%	0
(R) RECEPTACLES	0			0	NEC 220	0
(LM) LARGEST MOTOR	0			0	25%	0
(M) MOTORS (ALL)	0			0	100%	0
(E) EQUIPMENT	300			300	100%	300
(A) APPLIANCES	0			0		0
				PANEL TOTAL (KVA): 0.3		
				PANEL TOTAL (A): 0.4		

GENERAL NOTES:	
A.	EXISTING PANEL IS WESTINGHOUSE C-H PRLA3.
B.	PROVIDE NEW BKRS AS INDICATED.
C.	PROVIDE NEW BKRS AS REQUIRED FOR PUMP VFD MOTORS.
D.	
E.	
SPECIFIC NOTES:	
(1)	
(2)	
(3)	
(4)	
(5)	

PANEL:				EXISTING 'PDP-60/70'				VOLTAGE:				277/480V, 3PH, 4W						
LOCATION:				UV DISINFECTION				MINIMUM BUS:				250						
MOUNTING:				METAL FRAMING				MAIN:				MAIN BREAKER						
								MINIMUM AIC:				N/A						
No.	VA LOAD			TYPE	LOAD DESCRIPTION	BREAKER		BUS			BREAKER		TYPE	LOAD DESCRIPTION	VA LOAD			No.
	A	B	C			POLE	TRIP	A	B	C	TRIP	POLE			A	B	C	
1					SPACE AND BUSS			+					SPACE AND BUSS				2	
3									+								4	
5										+							6	
7					SPACE AND BUSS			+					SPACE AND BUSS				8	
9										+							10	
11											+						12	
13					SPACE AND BUSS			+					SPACE AND BUSS				14	
15										+							16	
17											+						18	
19					SPACE AND BUSS			+					SPACE AND BUSS				20	
21										+							22	
23											+						24	
25					SPACE AND BUSS			+					SPACE AND BUSS				26	
27										+							28	
29											+						30	
31					SPACE AND BUSS			+					SPACE AND BUSS				32	
33										+							34	
35											+						36	
37					SPACE AND BUSS			+					SPACE AND BUSS				38	
39										+							40	
41											+						42	
43					SPACE AND BUSS			+					SPACE AND BUSS				44	
45										+							46	
47											+						48	
49	2000			M	TERTIARY FILTER #3 (NEW BKR)	3	30	+			50	3	M	NEW REUSE PUMP #2	10000		50	
51		2000		M					+				M			10000	52	
53			2000	M						+			M				54	
55	2000			M	TERTIARY FILTER #2 (NEW BKR)	3	30	+			30	3	E	'SPD-PP4' (NEW CIRCUIT BKR)	200		56	
57		2000		M					+				E		200		58	
59			2000	M						+			E			200	60	
61	2000			M	TERTIARY FILTER #1 (NEW BKR)	3	20	+			70	3	E	UV BANK B (REPLACE CIR BKR)			62	
63		2000		M					+				E				64	
65			2000	M						+			E				66	
67				M	SPARE	3	25	+			20	3	E	SPARE			68	
69										+							70	
71											+						72	
73				E	UV BANK A (REPLACE CIR BKR)	3	70	+			50	3	E	RP-60/70 FEEDER			74	
75				E						+			E				76	
77				E							+		E				78	
79					MAIN	3	250	+			100	3	E	70-LCP-2			80	
81										+			E				82	
83										+			E				84	
LOAD TYPE		PANEL TOTAL		FEED THRU TOTAL		SUBFEED TOTAL		FEEDER SUBTOTAL		DEMAND		FEEDER TOTAL		GENERAL NOTES:				
(L) LIGHTING		0						0		125%		0		A. EXISTING PANEL IS SQUARE-D H-LINE				
(R) RECEPTACLES		0						0		NEC 220		0		B. PROVIDE NEW BKR FOR NEW SPD.				
(LM) LARGEST MOTOR		0						0		25%		0		C. PROVIDE NEW BKRS AS REQUIRED FOR REUSE PUMP #2 VFD.				
(M) MOTORS (ALL)		48000						48000		100%		48000		D. PROVIDE NEW BKRS FOR ALL THREE TERTIARY FILTER FEEDS.				
(E) EQUIPMENT		600						600		100%		600		E.				
(A) APPLIANCES		0						0		0		0		SPECIFIC NOTES:				
														(1)				
														(2)				
														(3)				
														(4)				
														(5)				
								NEW LOADS (KVA):		48.6								
								NEW LOADS (A):		58.5								

PANELBOARD SCHEDULES		E-935	
PENDLETON - CLEMSON REGIONAL WWTP EXPANSION		GMC PROJECT #CGRE220027	
PENDLETON, SOUTH CAROLINA Town of Pendleton City of Clemson Anderson County			
ISSUE	DATE		
30% Submittal	01.18.2023		
60% Submittal	08.07.2023		
90% Submittal	12.04.2023		
100% Submittal	03.08.2024		
Conformed Set			
Project Manager:		JB	
Engineer:		JFA	
Designer:		JB	
Drawn By:		MBH	

PANEL:				'HEB1A'				VOLTAGE:				277/480V, 3PH, 4W			
LOCATION:				ELECTRICAL BUILDING #1				MINIMUM BUS:				400			
MOUNTING:				SURFACE				MAIN:				MLO			
								MINIMUM AIC:				42,000			

NO.	LOAD			TYPE	LOAD DESCRIPTION	BREAKER		BUS			BREAKER		TYPE	LOAD DESCRIPTION	LOAD			NG
	A	B	C			POLE	TRIP	A	B	C	TRIP	POLE			A	B	C	
1	8000			A	PANEL 'LEB1A' VIA 'TR-LEB1A'	3	50	+			30	3	M	COARSE SCREEN 'SCR1000'	1800			2
3		8000		A				+					M			1800		4
5			8000	A					+				M				1800	6
7					SPARE	3	30	+										8
9									+									10
11										+								12
13					SPARE	3	30	+										14
15									+									16
17										+								18
19					SPARE	3	60	+										20
21									+									22
23										+								24
25					SPARE	3	60	+										26
27									+									28
29											+							30
31								+										32
33									+									34
35										+								36
37								+			30	3	E	'SPD-HEB1A'	100			38
39									+				E			100		40
41									+				E				100	42

LOAD TYPE	PANEL TOTAL	FEED THRU TOTAL	SUBFEED TOTAL	FEEDER SUBTOTAL	DEMAND	FEEDER TOTAL
(L) LIGHTING	0			0	125%	0
(R) RECEPTACLES	0			0	NEC 220	0
(LM) LARGEST MOTOR	0			0	25%	0
(M) MOTORS (ALL)	5400			5400	100%	5400
(E) EQUIPMENT	300			300	100%	300
(A) APPLIANCES	24000			24000	0	24000
PANEL TOTAL (KVA):				29.7		
PANEL TOTAL (A):				35.7		

GENERAL NOTES:	
A	PROVIDE NEMA 1 GASKETED ENCLOSURE
B	PROVIDE MINIMUM AIC SHOWN OR UPSIZE PER THE SYSTEM STUDY
C	
D	
E	
SPECIFIC NOTES:	
(1)	CIRCUITS ____ TO HAVE BREAKER LOCK-ON
(2)	CIRCUITS ____ TO HAVE GFCI TRIP
(3)	
(4)	
(5)	

PANEL:		'HEB2A'	
LOCATION:		ELECTRICAL BUILDING #2	
MOUNTING:		SURFACE	

VOLTAGE:		277/480V, 3PH, 4W	
MINIMUM BUS:		400	
MAIN:		MLO	
MINIMUM AIC:		42,000	

NO.	LOAD			TYPE	LOAD DESCRIPTION	BREAKER		BUS			BREAKER		TYPE	LOAD DESCRIPTION	LOAD			NO.
	A	B	C			POLE	TRIP	A	B	C	TRIP	POLE			A	B	C	
1	8000			E	PANEL 'LEB2A' VIA 'TR-LEB2A'	3	50	+	+									2
3		8000		E														4
5			8000	E					+									6
7					SPARE	3	30	+										8
9									+									10
11										+								12
13					SPARE	3	30	+										14
15									+									16
17										+								18
19					SPARE	3	60	+										20
21									+									22
23										+								24
25					SPARE	3	60	+										26
27									+									28
29										+								30
31									+									32
33										+								34
35											+							36
37									+			30	3	E	'SPD-HEB2A'	100		38
39									+					E		100		40
41										+							100	42

LOAD TYPE	PANEL TOTAL	FEED THRU TOTAL	SURFEED TOTAL	FEEDER SUBTOTAL	DEMAND	FEEDER TOTAL
(L) LIGHTING	0			0	125%	0
(R) RECEPTACLES	0			0	NEC 220	0
(LM) LARGEST MOTOR	0			0	25%	0
(M) MOTORS (ALL)	0			0	100%	0
(B) EQUIPMENT	24300			24300	100%	24300
(A) APPLIANCES	0			0	0	0
				PANEL TOTAL (KVA):		24.3
				PANEL TOTAL (A):		29.2

GENERAL NOTES:	
A.	PROVIDE NEMA 1 GASKETED ENCLOSURE
B.	PROVIDE MINIMUM AIC SHOWN OR UPSIZE PER THE SYSTEM STUDY
C.	
D.	
E.	
SPECIFIC NOTES:	
(1)	CIRCUITS ____ TO HAVE BREAKER LOCK-ON
(2)	CIRCUITS ____ TO HAVE GFCI TRIP
(3)	
(4)	
(5)	

PANEL:				'HEQ'			
LOCATION:				EQUALIZATION BASIN AREA			
MOUNTING:				METAL FRAMING			

VOLTAGE:				277/480V, 3PH, 4W			
MINIMUM BUS:				600			
MAIN:				MAIN BREAKER			
MINIMUM AIC:				35,000			

NO.	LOAD			TYPE	LOAD DESCRIPTION	BREAKER POLE	TRIP	BUS			BREAKER TRIP	POLE	TYPE	LOAD DESCRIPTION	LOAD			NO.	
	A	B	C					A	B	C					A	B	C		
1	28000			E	PANEL 'HHW' FEED	3	400	+				250	3	E	EXISTING PANEL 'PDP-20 FEED	46000			2
3		28000		E					+					E			46000		4
5			28000	E						+				E				46000	6
7						3	30	+											8
9									+										10
11										+									12
13						3	30	+											14
15									+										16
17										+									18
19						3	30	+											20
21									+										22
23										+									24
25						3	30	+											26
27									+										28
29										+									30
31						3	30	+											32
33									+										34
35										+									36
37						3	30	+				30	3	E	'SPD-HEQ'	100			38
39									+					E			100		40
41									+					E				100	42

LOAD TYPE	PANEL TOTAL	FEED THRU TOTAL	SUBFEED TOTAL	FEEDER SUBTOTAL	DEMAND	FEEDER TOTAL
(L) LIGHTING	0			0	125%	0
(R) RECEPTACLES	0			0	NEC 220	0
(LM) LARGEST MOTOR	0			0	25%	0
(M) MOTORS (ALL)	0			0	100%	0
(E) EQUIPMENT	222300			222300	100%	222300
(A) APPLIANCES	0			0	0	0
				PANEL TOTAL (KVA): 222.3		
				PANEL TOTAL (A): 267.5		

GENERAL NOTES:	
A.	PROVIDE NEMA 4 STAINLESS ENCLOSURE
B.	PROVIDE MINIMUM AIC SHOWN OR UPSIZE PER THE SYSTEM STUDY
C.	
D.	
E.	
SPECIFIC NOTES:	
(1)	CIRCUITS ____ TO HAVE BREAKER LOCK-ON
(2)	CIRCUITS ____ TO HAVE GFCI TRIP
(3)	
(4)	
(5)	

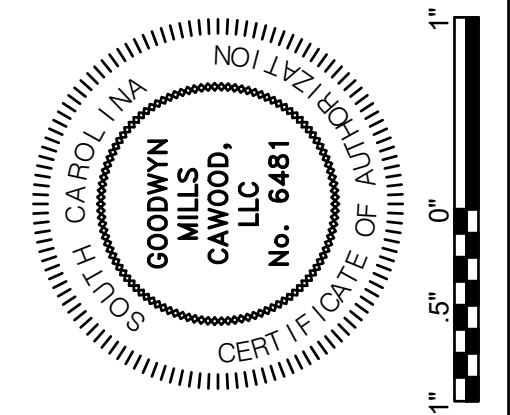
PANEL:		'HHW'				VOLTAGE:		277/480V, 3PH, 4W	
LOCATION:		HEADWORKS PLATFORM				MINIMUM BUS:		400	
MOUNTING:		METAL FRAMING				MAIN:		MAIN BREAKER	
						MINIMUM AIC:		42,000	

NO.	LOAD			TYPE	LOAD DESCRIPTION	BREAKER POLE	TRIP	BUS			BREAKER POLE	TRIP	TYPE	LOAD DESCRIPTION	LOAD			NO.
	A	B	C					A	B	C					A	B	C	
1	4000			A	PANEL 'LHW' VIA 'TR-LHW'	3	50	+			30	3		SPARE				2
4		4000		A					+									4
5			4000	A						+								6
7	2500			M	SCREEN 1110	3	30	+			30	3	M	WASH COMPACTOR SWC1112	2000			8
9		2500		M						+			M			2000		10
11			2500	M									M				2000	12
13	2500			M	SCREEN 1120	3	30	+			30	3	M	CONVEYOR SCY1111	2000			14
15		2500		M						+			M			2000		16
17			2500	M									M				2000	18
19	2500			M	SCREEN 1130	3	30	+			30	3	M	GRIT PUMP 1210	2000			20
21		2500		M						+			M			2000		22
23			2500	M									M				2000	24
25	2500			M	FUTURE SCREEN 1140	3	30	+			30	3	M	GRIT PUMP 1220	2000			26
27		2500		M						+			M			2000		28
29			2500	M									M				2000	30
31	2000			M	GRIT CLASSIFIER 1213	3	30	+			30	3		SPARE				32
33		2000		M						+								34
35			2000	M							+							36
37	2000			M	GRIT CLASSIFIER 1223	3	30	+			30	3	E	'SPD-HHW'	100			38
39		2000		M						+			E			100		40
41			2000	M						+							100	42

LOAD TYPE	PANEL TOTAL	FEED THRU TOTAL	SUBFEED TOTAL	FEEDER SUBTOTAL	DEMAND	FEEDER TOTAL
(L) LIGHTING	0			0	125%	0
(R) RECEPTACLES	0			0	NEC 220	0
(LM) LARGEST MOTOR	0			0	25%	0
(M) MOTORS (ALL)	66000			66000	100%	66000
(B) EQUIPMENT	300			300	100%	300
(A) APPLIANCES	12000			12000	0	12000
				PANEL TOTAL (KVA):	78.3	
				PANEL TOTAL (A):	94.2	

GENERAL NOTES:	
A	PROVIDE NEMA 4 STAINLESS ENCLOSURE
B	PROVIDE MINIMUM AIC SHOWN OR UPSIZE PER THE SYSTEM STUDY
C	
D	
E	
SPECIFIC NOTES:	
(1)	CIRCUITS ____ TO HAVE BREAKER LOCK-ON.
(2)	CIRCUITS ____ TO HAVE GFCI TRIP
(3)	
(4)	
(5)	

GMC
117 Welborn St.
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ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH

**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

639-E

PANELBOARD SCHEDULES

DRAWING FILE: V:\Projects\2022 Projects\GRC\VE220008 - Pendleton-Clemson WWTP Expansion\Drawings\Electrical\E-931 - SCHEDULES.dwg
PLOTTER: Mar 13, 2022 11:54am

PANEL:				'LEB1A'				VOLTAGE:				120/208V, 3PH, 4W			
LOCATION:				ELECTRICAL BUILDING #1				MINIMUM BUS:				225			
MOUNTING:				SURFACE				MAIN:				150A			
								MINIMUM AIC:				10,000			

NO.	LOAD			TYPE	LOAD DESCRIPTION	BREAKER		BUS			BREAKER		TYPE	LOAD DESCRIPTION	LOAD			NO.
	A	B	C			POLE	TRIP	A	B	C	TRIP	POLE			A	B	C	
1	1000			L	LGT - INTERIOR	1	20	+			20	1	R	REC - INTERIOR	600			2
3		1000		L	LGT - EXTERIOR VIA 'PC-LEB2A'	1	20		+		20	1	R	REC - EXTERIOR		600		4
5						1	20			+	20	1	E	'LCP-1010'			1000	6
7						1	20	+			20	1						8
9						1	20		+		20	1						10
11						1	20			+	20	1						12
13						1	20	+			20	1						14
15						1	20		+		20	1						16
17						1	20			+	20	1						18
19						1	20	+			20	1						20
21						1	20		+		20	1						22
23						1	20			+	20	1						24
25					SPARE	1	20	+			20	1		SPARE				26
27					SPARE	1	20		+		20	1		SPARE				28
29					SPARE	1	20			+	20	1		SPARE				30
31					SPARE	1	20	+			20	1		SPARE				32
33					SPARE	1	20		+		20	1		SPARE				34
35					SPARE	1	20			+	20	1		SPARE				36
37					SPARE	1	20	+			30	3	E	'SPD-LEB1A'	100			38
39					SPARE	1	30		+				E			100		40
41					SPARE	1	30			+			E				100	42

LOAD TYPE	PANEL TOTAL	FEED THRU TOTAL	SUBFEED TOTAL	FEEDER SUBTOTAL	DEMAND	FEEDER TOTAL
(L) LIGHTING	2000			2000	125%	2500
(R) RECEPTACLES	1200			1200	NEC 220	1200
(LM) LARGEST MOTOR	0			0	25%	0
(M) MOTORS (ALL)	0			0	100%	0
(E) EQUIPMENT	1300			1300	100%	1300
(A) APPLIANCES	0			0	0	0
				PANEL TOTAL (KVA):	5.0	
				PANEL TOTAL (A):	6.0	

GENERAL NOTES:	
A.	PROVIDE NEMA 1 GASKETED ENCLOSURE
B.	PROVIDE MINIMUM AIC SHOWN OR UPSIZE PER THE SYSTEM STUDY
C.	
D.	
E.	
SPECIFIC NOTES:	
(1)	CIRCUIT(S) 6 TO HAVE BREAKER LOCK-ON
(2)	CIRCUIT(S) 4 TO HAVE GFCI TRIP
(3)	
(4)	
(5)	

PANEL:				'HBNR'						VOLTAGE:		277/480V, 3PH, 4W			
LOCATION:				BIO NUTRIENT BIOREACTOR						MINIMUM BUS:		400			
MOUNTING:				METAL FRAMING						MAIN:		MAIN BREAKER			
										MINIMUM AIC:		42,000			

NO.	LOAD			TYPE	LOAD DESCRIPTION	BREAKER POLE	TRIP	BUS			BREAKER TRIP	POLE	TYPE	LOAD DESCRIPTION	LOAD			NO.
	A	B	C					A	B	C					A	B	C	
1	2500			M	ACTUATOR VE3112 VE3104	3	30	+			125	3	E	PANEL 'LBNR' VIA 'TR-LBNR'	36000			2
3		2500		M					+				E			36000		4
5			2500	M						+			E				36000	6
7	2500			M	ACTUATOR VE3106 VE3108	3	30	+										8
9		2500		M					+									10
11			2500	M						+								12
13	2500			M	ACTUATOR VE3212 VE3204	3	30	+										14
15		2500		M						+								16
17			2500	M							+							18
19	2500			M	ACTUATOR VE3206 VE3208	3	30	+										20
21		2500		M						+								22
23			2500	M							+							24
25	2500			M	ACTUATOR VE3312 VE3304	3	30	+										26
27		2500		M							+							28
29			2500	M								+						30
31	2500			M	ACTUATOR VE3306 VE3308	3	30	+										32
33		2500		M							+							34
35			2500	M							+							36
37					SPARE	3	30	+			30	3	E	'SPD-HBNR'	100			38
39									+				E			100		40
41										+			E				100	42

LOAD TYPE	PANEL TOTAL	FEED THRU TOTAL	SUBFEED TOTAL	FEEDER SUBTOTAL	DEMAND	FEEDER TOTAL
(L) LIGHTING	0			0	125%	0
(R) RECEPTACLES	0			0	NEC 220	0
(LM) LARGEST MOTOR	0			0	25%	0
(M) MOTORS (ALL)	45000			45000	100%	45000
(E) EQUIPMENT	108300			108300	100%	108300
(A) APPLIANCES	0			0	0	0
				PANEL TOTAL (KVA): 153.3		
				PANEL TOTAL (A): 184.5		

GENERAL NOTES:	
A.	PROVIDE NEMA 4 STAINLESS ENCLOSURE
B.	PROVIDE MINIMUM AIC SHOWN OR UPSIZE PER THE SYSTEM STUDY
C.	
D.	
E.	
SPECIFIC NOTES:	
(1)	CIRCUITS ____ TO HAVE BREAKER LOCK-ON
(2)	CIRCUITS ____ TO HAVE GFCI TRIP
(3)	
(4)	
(5)	

PANEL:				'LEB2A'								VOLTAGE:				120/208V, 3PH, 4W			
LOCATION:				ELECTRICAL BUILDING #2								MINIMUM BUS:				225			
MOUNTING:				SURFACE								MAIN:				150A			
												MINIMUM AIC:				10,000			
NO	LOAD			TYPE	LOAD DESCRIPTION	BREAKER		BUS			BREAKER		TYPE	LOAD DESCRIPTION	LOAD			NO.	
	A	B	C			POLE	TRIP	A	B	C	TRIP	POLE			A	B	C		
1	1000			L	LGT - INTERIOR	1	20		+			20	1	R	REC - INTERIOR	600		2	
3		800		L	LGT - EXTERIOR VIA 'PC-LEB2A'	1	20			+		20	1	R	REC - EXTERIOR		600	4	
5						1	20				+	20	1	E	'LCP-3000'			6	
7						1	20		+			50	2	E	'FCP-3100	4500		8	
9						1	20			+						4500		10	
11						1	20				+	20	1					12	
13						1	20		+									14	
15						1	20			+		20	1					16	
17						1	20				+	20	1					18	
19						1	20		+			20	1					20	
21						1	20			+		20	1					22	
23						1	20				+	20	1					24	
25						1	20		+			20	1					26	
27					SPARE	1	20			+		20	1		SPARE			28	
29					SPARE	1	20				+	20	1		SPARE			30	
31					SPARE	1	20		+			20	1		SPARE			32	
33					SPARE	1	20			+		20	1		SPARE			34	
35					SPARE	1	20				+	20	1		SPARE			36	
37					SPARE	1	20		+			30	3	E	'SPD-LEB2A'	100		38	
39					SPARE	1	30			+				E		100		40	
41					SPARE	1	30				+			E			100	42	

LOAD TYPE		PANEL TOTAL	FEED THRU TOTAL	SUBFEED TOTAL	FEEDER SUBTOTAL	DEMAND	FEEDER TOTAL
(L) LIGHTING		1800			1800	125%	2250
(R) RECEPTACLES		1200			1200	NEC 220	1200
(LM) LARGEST MOTOR		0			0	25%	0
(M) MOTORS (ALL)		0			0	100%	0
(E) EQUIPMENT		10700			10700	100%	10700
(A) APPLIANCES		0			0	0	0
					PANEL TOTAL (KVA):		14.2
					PANEL TOTAL (A):		17.0

GENERAL NOTES:	
A. PROVIDE NEMA 1 GASKETED ENCLOSURE.	
B. PROVIDE MINIMUM AIC SHOWN OR UPSIZE PER THE SYSTEM STUDY.	
C.	
D.	
E.	
SPECIFIC NOTES:	
(1) CIRCUIT(S) 6 TO HAVE BREAKER LOCK-ON.	
(2) CIRCUIT(S) 4 TO HAVE GFCI TRIP	
(3)	
(4)	
(5)	

PANEL:				'LHW'				VOLTAGE:				120/208V, 3PH, 4W						
LOCATION:				HEADWORKS PLATFORM				MINIMUM BUS:				100						
MOUNTING:				METAL FRAMING				MAIN:				MAIN BREAKER						
								MINIMUM AIC:				10,000						
NO.	LOAD			TYPE	LOAD DESCRIPTION	BREAKER		BUS			BREAKER		TYPE	LOAD DESCRIPTION	LOAD			NO.
	A	B	C			POLE	TRIP	A	B	C	TRIP	POLE			A	B	C	
1	1200			A	REC - GENERAL PURPOSE	1	20	+			20	1		SPARE				2
3		1200		A	REC - GENERAL PURPOSE	1	20		+		20	1		SPARE				4
5			1200	A	REC - GENERAL PURPOSE	1	20			+	20	1		SPARE				6
7	1500			M	'LCP-1110'	1	20	+										8
9				M		1	20		+									10
11				M		1	20			+								12
13				M		1	20	+										14
15				M					+									16
17				M						+								18
19				M				+										20
21				M					+									22
23				M						+								24
25				M				+										26
27				M					+									28
29				M						+								30
31				M				+										32
33				M					+									34
35				M						+								36
37				M				+			30	3	E	'SPD-LHW'	100			38
39				M					+				E			100		40
41				M						+			E				100	42
LOAD TYPE		PANEL TOTAL		FEED THRU TOTAL		SUBFEED TOTAL		FEEDER SUBTOTAL		DEMAND		FEEDER TOTAL		GENERAL NOTES:				
(L) LIGHTING		0						0		125%		0		A. PROVIDE NEMA 4 STAINLESS ENCLOSURE				
(R) RECEPTACLES		0						0		NEC 220		0		B. PROVIDE MINIMUM AIC SHOWN OR UPSIZE PER THE SYSTEM STUDY				
(LM) LARGEST MOTOR		0						0		25%		0		C.				
(M) MOTORS (ALL)		1500						1500		100%		1500		D.				
(E) EQUIPMENT		300						300		100%		300		E.				
(A) APPLIANCES		3600						3600		0		3600		SPECIFIC NOTES:				
														(1) CIRCUIT(S) 7 TO HAVE BREAKER LOCK-ON.				
														(2) CIRCUIT(S) 1,3,5 TO HAVE GFCI TRIP				
														(3)				
														(4)				
														(5)				
				</														

DRAWING FILE: V:\Projects\2022 Projects\CGRE\CGRE220008 - Pendleton-Clemson WWTP Expansion\Drawings\Electrical\E-931 - SCHEDULES.dwg
PLOTTER: Mar 18, 2022 11:15am

LUMINAIRE SCHEDULE										
<FT> FIXTURE TYPE	DESCRIPTION	MOUNTING	RECESS DEPTH	LED ENGINE		INPUT WATTS	VOLT	MANUFACTURE R	CATALOG NUMBER	SPECIFIC NOTES
				LUMENS	COLOR TEMP					
A	LED ENCLOSED AND GASKETED SURFACE MOUNT	CHAIN AND UNISTRUT	N/A	6000	4000K	40	120	LITHONIA	FEX-L48-6000LM-FGFL-MD-MVOLT-GX10-40K-80CRI-RMBK-SPD10KV-DBLXD	1
AE	LED ENCLOSED AND GASKETED SURFACE MOUNT	CHAIN AND UNISTRUT	N/A	6000	4000K	40	120	LITHONIA	FEX-L48-6000LM-FGFL-MD-MVOLT-GX10-40K-80CRI-RMBK-SPD10KV-DBLXD-BE6WCP	1,4
B	LED WEATHER-PROOF WALL-MOUNTED FIXTURE	SURFACE/WALL	N/A	2000	5000K	25	120	LITHONIA	OLAW23-53K-120-PE-BZ	
C	LED ENCLOSED AND GASKETED SURFACE MOUNT	CHAIN AND UNISTRUT	N/A	6000	4000K	50	120	LITHONIA	FEM-L48-6000LM-LPPFL-WD-MVOLT-GZ10-40K-80CRI-SPD	1
CE	LED ENCLOSED AND GASKETED SURFACE MOUNT	CHAIN AND UNISTRUT	N/A	6000	4000K	50	120	LITHONIA	FEM-L48-6000LM-LPPFL-WD-MVOLT-GZ10-40K-80CRI-SPD-BE6WCP	1,4
D	LED POST TOP SITE LIGHTING FIXTURE	POLE TOP	N/A	5604	4000K	90	480	SUN VALLEY LIGHTING	VNDLF-LED-VPA.V-80LED-NW-480-PT-RAL9003.T-CP-20SP POLE: RNTA-145-188-PT27-RAL.9003S	2,3
X	WALL MOUNTED LED EXIT	SURFACE/WALL	N/A	N/A	N/A	10	120	LITHONIA	LVS-AB-1-G-120/277-ELN-SD	4
GENERAL NOTES: A. THE LUMINAIRE SCHEDULE CAN NOT BE USED INDEPENDENTLY OF THE DRAWINGS AND SPECIFICATIONS TO OBTAIN LUMINAIRE COSTS. THE INDIVIDUAL ESTABLISHING LUMINAIRE COSTS SHALL NOT QUOTE PRICING WITHOUT FIRST SEEING APPLICABLE ELECTRICAL DRAWINGS AND ELECTRICAL DIVISION SPECIFICATIONS. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING NECESSARY DRAWINGS AND SPECIFICATIONS TO THE INDIVIDUAL QUOTING LUMINAIRE PRICING. B. REFER TO DRAWINGS FOR FIXTURES REQUIRING EMERGENCY BATTERY BACKUP OPTION (SHOWN BY HATCH IN/OVER SYMBOL). MINIMUM LIGHT OUTPUT FOR EM BALLAST SHALL BE 600 LUMENS. C. ALL LED ENGINES ARE TO BE 4000° KELVIN COLOR TEMPERATURE (EXCEPT WHERE NOTED)										
SPECIFIC NOTES: (1) CHAIN TO UNISTRUT CHANNEL. MOUNT FIXTURE TO BOTTOM OF CHANNEL. (2) PROVIDE SURGE PROTECTION EXTERNAL TO LIGHTING FIXTURE AND ASSOCIATED DRIVER AS SCHEDULED. (3) PROVIDE CONCRETE POLE BASE AS REQUIRED - SEE DRAWING DETAIL. (4) PROVIDE 90 MIN INTEGRAL BATTERY DRIVER AS REQUIRED.										

TRANSFORMER SCHEDULE													
SIZE (KVA)	PRIMARY (480V, 3Ø, 3W)			SECONDARY (208V, 3Ø, 4W)			Designation	GROUNDING	DIMENSIONS (IN.)			HEAT LOSS (W)	WEIGHT (LBS.)
	FLA	OCPD	FEEDER	FLA	OCPD	FEEDER			HEIGHT	WIDTH	DEPTH		
3	4	15A 3P	(3-#12 + 1-#12G) 3/4"C	8	15A 3P	(4-#12 + 1-#12G) 3/4"C		1-#8	15	15	11	165	140
6	7	15A 3P	(3-#12 + 1-#12G) 3/4"C	17	20A 3P	(4-#12 + 1-#12G) 3/4"C		1-#8	15	15	11	275	145
9	11	15A 3P	(3-#8 + 1-#12G) 3/4"C	25	30A 3P	(4-#10 + 1-#10G) 3/4"C		1-#8	20	20	13	375	245
15	18	30A 3P	(3-#8 + 1-#12G) 3/4"C	42	50A 3P	(4-#6 + 1-#10G) 1"C	TR-LEB	1-#8	28	23	17	665	285
30	36	50A 3P	(3-#6 + 1-#10G) 1"C	83	100A 3P	(4-#1 + 1-#8G) 1 1/4"C		1-#6	33	24	18	1795	369
45	54	70A 3P	(3-#4 + 1-#8G) 1 1/4"C	125	150A 3P	(4-1/0 + 1-#6G) 2"C	TR-LCB	1-#6	33	30	20	1685	590
75	90	125A 3P	(3-#1 + 1-#6G) 1 1/2"C	208	250A 3P	(4-250 + 1-#4G) 2 1/2"C	TR-LAB	1-#2	37	32	24	2535	750
112.5	135	175A 3P	(3-2/0 + 1-#6G) 2"C	313	400A 3P	(4-500 + 1-#3G) 3 1/2"C		1-#1/0	42	36	24	3830	1050
150	181	225A 3P	(3-4/0 + 1-#4G) 2"C	417	500A 3P	2[(4-250 + 1-#2G) 3"C]		1-#1/0	46	36	24	4430	1350
225	271	350A 3P	(3-500 + 1-#3G) 3"C	625	800A 3P	2[(4-500 + 1-1/0G) 3 1/2"C]		1-#2/0	48	48	30	5795	2000
300	361	450A 3P	2[(3-4/0 + 1-#2G) 2"C]	833	1000A 3P	3[(4-500 + 1-2/0G) 3 1/2"C]		1-#3/0	52	48	31	7065	2350
500	602	750A 3P	2[(3-500 + 1-1/0G) 3"C]	1389	1600A 3P	5[(4-400 + 1-250G) 3 1/2"C]		1-#3/0	60	56	36	6875	2450
750	903	1200A 3P	2[(3-350 + 1-3/0G) 3"C]	2083	2500A 3P	7[(4-500 + 1-450G) 3 1/2"C]		1-#3/0	74	56	41	10090	3950
GENERAL NOTES:													
A. PRIMARY OVERCURRENT PROTECTION PER N.E.C. TABLE 450.3(B).													
B. SECONDARY OVERCURRENT PROTECTION PER N.E.C. TABLE 450.3(B).													
C. BONDING AND GROUNDING CONDUCTOR PER N.E.C. TABLE 250.66.													
D. ALL CONDUCTORS ARE COPPER. SEE PLANS FOR INCREASED CONDUCTOR SIZES DUE TO VOLTAGE DROP.													

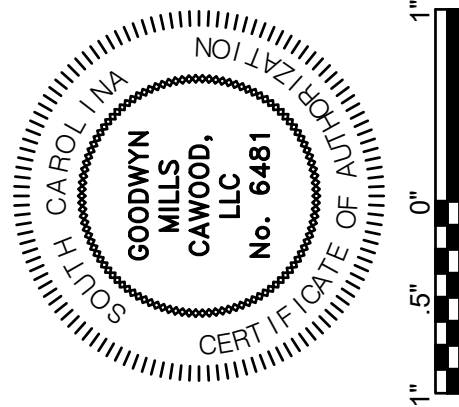
LUMINAIRE AND
TRANSFORMER
SCHEDULES

E-938

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH



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DRAWING FILE: V:\Projects\2022\Projects\CGRE220028 - Pendleton-Clemson WWTP Expansion\Drawings\Electrical\E-931 - SCHEDULES.dwg
PLOTTER: Mar 13, 2022 2:15:40pm

Schedule Of Surge Suppression Devices For Power Distribution												
Location	Rating In Amps Of Connected Bus or Main Circuit Breaker	Voltage	SPD Designation	Surge Suppression Incorporated Model Number (No Substitutions):	Peak Surge Current per Phase (kA)	Warranty Details (No Exceptions)	Remote Indicator Light Kit	Responsible Purchasing And Installing Party (No Exceptions)	Frequency Responsive Circuitry	Enclosure Rating (NEMA #)	SPD Mounted Integral To Panelboard/Switchboard/MCC/Cabinet/ Lgt Pole	Connection
Utility Main Circuit Breaker Within 'MSBA'	4000	480Y277V 3P/4W	'SPD-MSBA-1'	SMLD3Y2-LP-21	300	25 Year Replacement - Excluding Installation	Yes	Electrical Contractor and/or Gear Manufacturer	No	1	Yes	Line Side Of Utility Main 'MSBA' Circuit Breaker
GEN-A Source Circuit Breaker Within 'MSBA'	2500	480Y277V 3P/4W	'SPD-MSBA-2'	SMLD3Y2-LP-21	300	25 Year Replacement - Excluding Installation	Yes	Electrical Contractor and/or Gear Manufacturer	No	1	Yes	Load Side Of MSBA Circuit Breaker Connecting GEN-A
GEN-B Source Circuit Breaker Within 'MSBA'	2500	480Y277V 3P/4W	'SPD-MSBA-3'	SMLD3Y2-LP-21	300	25 Year Replacement - Excluding Installation	Yes	Electrical Contractor and/or Gear Manufacturer	No	1	Yes	Load Side Of MSBA Circuit Breaker Connecting GEN-B
Power Conditioning Unit-A	1200	480Y277V 3P/4W	'SPD-PCU-A'	LSEB3Y2-LP-21	240	25 Year Replacement - Excluding Installation	Yes	Electrical Contractor	No	1	Yes	Mount To Lugs Provided In The Conditioning Unit
New Panel 'HEB1A'	400	480Y277V 3P/4W	'SPD-HEB1A'	CSEB3Y2-21	240	25 Year Replacement - Excluding Installation	No	Electrical Contractor	Yes	1	No	Load Side Of Branch Circuit Breaker-Provide 3 Pole 30 Amp Breaker As Required
New Panel 'LEB1A'	225	120Y208V 3P/4W	'SPD-LEB1A'	CDLA3Y1-LP-21	180	25 Year Replacement - Excluding Installation	No	Electrical Contractor	Yes	1	No	Load Side Of Branch Circuit Breaker-Provide 3 Pole 30 Amp Breaker As Required
New Panel 'HEQ'	600	480Y277V 3P/4W	SPD-HEQ	CSEB3Y2-21	240	25 Year Replacement - Excluding Installation	No	Electrical Contractor	Yes	1	No	Load Side Of Branch Circuit Breaker-Provide 3 Pole 30 Amp Breaker As Required
New Panel 'HHW'	400	480Y277V 3P/4W	'SPD-HHW'	CSEB3Y2-21	240	25 Year Replacement - Excluding Installation	No	Electrical Contractor	Yes	1	No	Load Side Of Branch Circuit Breaker-Provide 3 Pole 30 Amp Breaker As Required
New Panel 'LHW'	100	120Y208V 3P/4W	'SPD-LHW'	CDLA3Y1-21	180	25 Year Replacement - Excluding Installation	No	Electrical Contractor	Yes	1	No	Load Side Of Branch Circuit Breaker-Provide 3 Pole 30 Amp Breaker As Required
Source #1 Circuit Breaker Within 'MSBB'	2000	480Y277V 3P/4W	'SPD-MSBB-1'	CMLD3Y2-LP-21	300	25 Year Replacement - Excluding Installation	Yes	Electrical Contractor and/or Gear Manufacturer	Yes	1	Yes	Line Side Of Source #1 Main Circuit Breaker
Source #2 Circuit Breaker Within 'MSBB'	2000	480Y277V 3P/4W	'SPD-MSBB-2'	CMLD3Y2-LP-21	300	25 Year Replacement - Excluding Installation	Yes	Electrical Contractor and/or Gear Manufacturer	Yes	1	Yes	Line Side Of Source #2 Main Circuit Breaker
Power Conditioning Unit-B	1200	480Y277V 3P/4W	'SPD-PCU-B'	LSEB3Y2-LP-21	240	25 Year Replacement - Excluding Installation	Yes	Electrical Contractor	No	1	Yes	Mount To Lugs Provided In The Conditioning Unit
New Panel 'HEB2A'	400	480Y277V 3P/4W	'SPD-HEB2A'	CSEB3Y2-21	240	25 Year Replacement - Excluding Installation	No	Electrical Contractor	Yes	1	No	Load Side Of Branch Circuit Breaker-Provide 3 Pole 30 Amp Breaker As Required
New Panel 'LEB2A'	225	120Y208V 3P/4W	'SPD-LEB2A'	CSEB3Y1-21	240	25 Year Replacement - Excluding Installation	No	Electrical Contractor	Yes	1	No	Load Side Of Branch Circuit Breaker-Provide 3 Pole 30 Amp Breaker As Required
Existing Panel 'PP4'	250	480Y277V 3P/4W	'SPD-PP4'	CSEB3Y2-21	240	25 Year Replacement - Excluding Installation	No	Electrical Contractor	Yes	1	No	Load Side Of Branch Circuit Breaker-Provide 3 Pole 30 Amp Breaker As Required
Existing Panel 'EPA'	100	120Y208V 3P/4W	'SPD-EPA'	CDLA3Y1-21	180	25 Year Replacement - Excluding Installation	No	Electrical Contractor	Yes	1	No	Load Side Of Branch Circuit Breaker-Provide 3 Pole 30 Amp Breaker As Required
Existing Panel 'PDP-60/70'	250	480Y277V 3P/4W	'SPD-PDP-60/70'	CSEB3Y2-21	240	25 Year Replacement - Excluding Installation	No	Electrical Contractor	Yes	1	No	Load Side Of Branch Circuit Breaker-Provide 3 Pole 30 Amp Breaker As Required
Existing Power Zone 'RP-60/70'	100	120Y208V 3P/4W	'SPD-RP-60/70'	CSEB3Y1-21	240	25 Year Replacement - Excluding Installation	No	Electrical Contractor	Yes	1	No	Load Side Of Branch Circuit Breaker-Provide 3 Pole 30 Amp Breaker As Required
New Panel 'HBNR'	400	480Y277V 3P/4W	'SPD-HBNR'	CDLA3Y2-21	180	25 Year Replacement - Excluding Installation	No	Electrical Contractor	Yes	1	No	Load Side Of Branch Circuit Breaker-Provide 3 Pole 30 Amp Breaker As Required
New Panel 'LBNR'	250	120Y208V 3P/4W	'SPD-LBNR'	CDLA3Y1-21	180	25 Year Replacement - Excluding Installation	No	Electrical Contractor	Yes	1	No	Load Side Of Branch Circuit Breaker-Provide 3 Pole 30 Amp Breaker As Required
Wet Well Junction Box P1010	400	4803P/3W	'SDP-P1010'	SDLA3N4-21	180	25 Year Replacement - Excluding Installation	No	Electrical Contractor	No	1	Yes	Connect Directly to the Mechanical Lugs
Wet Well Junction Box P1020	400	4803P/3W	'SDP-P1020'	SDLA3N4-21	180	25 Year Replacement - Excluding Installation	No	Electrical Contractor	No	1	Yes	Connect Directly to the Mechanical Lugs
Wet Well Junction Box P1030	400	4803P/3W	'SDP-P1030'	SDLA3N4-21	180	25 Year Replacement - Excluding Installation	No	Electrical Contractor	No	1	Yes	Connect Directly to the Mechanical Lugs
Wet Well Junction Box P1040	400	4803P/3W	'SDP-P1040'	SDLA3N4-21	180	25 Year Replacement - Excluding Installation	No	Electrical Contractor	No	1	Yes	Connect Directly to the Mechanical Lugs
Wet Well Junction Box P1050	400	4803P/3W	'SDP-P1050'	SDLA3N4-21	180	25 Year Replacement - Excluding Installation	No	Electrical Contractor	No	1	Yes	Connect Directly to the Mechanical Lugs
Existing Switchboard 'MPP'	1000 AMP	480Y277V 3P/4W	'SPD-MPP'	CMLD3Y2-LP-21	300	25 Year Replacement - Excluding Installation	Yes	Electrical Contractor	Yes	1	Yes	Connect Directly to the Bus

**SURGE PROTECTIVE
DEVICE SCHEDULE**

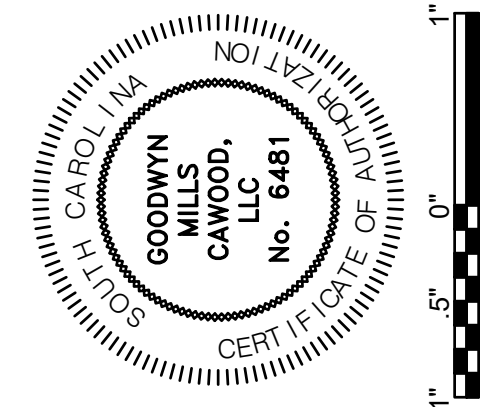
**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**

PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

E-939

GMC PROJECT #CGRE220027

ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH



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DRAWING FILE: V:\Projects\2022\Projects\CGRE\CGRE220008 - Pendleton-Clemson WWTP Expansion\Drawings\Electrical\E-941 - SCHEDULES.dwg
PLOTTER: Mar 18, 2022 2:15pm

POWER NETWORK AND INSTRUMENTATION WIRE AND CONDUIT SCHEDULE FOR <u>BNR AGS BASIN #1</u>							
SEQUENCE NUMBER	CONDUIT/SLEEVE SIZE	CIRCUIT TYPE	ROUTING	CABLING/WIRING	FROM	TO	NOTES
1	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-1: HACH SC1000-1	AGS BASIN #1: ORP SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
2	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-1: HACH SC1000-1	AGS BASIN #1: PH/TEMP SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
3	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-1: HACH SC1000-1	AGS BASIN #1: DO SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
4	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-1: HACH SC1000-1	AGS BASIN #1: PHOSPHATE SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
5	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-1: HACH SC1000-1	AGS BASIN #1: TOTAL SUSPENDED SOLIDS SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
6	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-1: HACH SC1000-1	AGS BASIN #1: NITRATE SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
7	N/A	LV DATA	N/A	N/A	N/A	N/A	N/A
8	1"	LV DATA	AS REQUIRED/ EXPOSED	TWO CAT 6 ETHERNET CABLES	BNR AGS BASIN-1: HACH SC1000-1	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
9	1"	LV DATA	AS REQUIRED/ EXPOSED	TWO CAT 6 ETHERNET CABLES	BNR AGS BASIN-1: HACH SC1000-1 DISPLAY	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
10	1"	LV DATA	AS REQUIRED/ EXPOSED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	BNR AGS BASIN-1: AQUANEREDA JBOX	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
11	1"	LV DATA	AS REQUIRED/ EXPOSED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	BNR: PRE-EQ JBOX	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
12	1"	LV DATA	AS REQUIRED/ EXPOSED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	BNR: POST-EQ JBOX	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
13	1"	POWER	AS REQUIRED/ EXPOSED	4#12 + 1#12EG	BNR AGS BASIN-1: AQUANEREDA JBOX	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
14	1"	POWER	AS REQUIRED/ EXPOSED	4#12 + 1#12EG	BNR: PRE-EQ JBOX	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
15	1"	POWER	AS REQUIRED/ EXPOSED	4#12 + 1#12EG	BNR: POST-EQ JBOX	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
16	1"	POWER	AS REQUIRED/ EXPOSED	4#12 + 1#12EG	BNR AGS BASIN-1: HACH SC1000-1	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
17	1"	120V DATA	AS REQUIRED/ EXPOSED	2#12 + 1#12EG CONNECT AQUANEREDA FLOAT SWITCH	BNR AGS BASIN-1: AQUANEREDA JBOX	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
18	1"	120V DATA	AS REQUIRED/ EXPOSED	2#12 + 1#12EG CONNECT POST EQ FLOAT SWITCH	BNR: PRE-EQ JBOX	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
19	1"	120V DATA	AS REQUIRED/ EXPOSED	2#12 + 1#12EG CONNECT PRE EQ FLOAT SWITCH	BNR: POST-EQ JBOX	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
20	1"	120V DATA	AS REQUIRED/ EXPOSED	2#12 + 1#12EG CONNECT AQUANEREDA FLOAT SWITCH	LSH-3100	BNR AGS BASIN-1: AQUANEREDA JBOX	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
21	N/A	N/A	N/A	VIA NETWORK LCP-3000	LSH-1310	BNR: PRE-EQ JBOX	N/A
22	1"	120V DATA	AS REQUIRED/ EXPOSED	2#12 + 1#12EG CONNECT POST EQ FLOAT SWITCH	LSH-4010	BNR: POST-EQ JBOX	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
23	1"	LV DATA	AS REQUIRED/ EXPOSED	TWO BELDEN 8719 TWIST SHIELD PAIRS	LE-3100	BNR AGS BASIN-1: AQUANEREDA JBOX	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
24	N/A	N/A	N/A	VIA NETWORK LCP-3000	LE1310	BNR: PRE-EQ JBOX	N/A
25	1"	LV DATA	AS REQUIRED/ EXPOSED	TWO BELDEN 8719 TWIST SHIELD PAIRS	LE4010	BNR: POST-EQ JBOX	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
26	1"	POWER	AS REQUIRED/ EXPOSED	2#10 VDC	FE-3110	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
27	1"	LV DATA	AS REQUIRED/ EXPOSED	TWO BELDEN 8719 TWIST SHIELD PAIRS	FE-3110	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
28	1"	POWER	AS REQUIRED/ EXPOSED	2#10 + 1#12EG	VE-3113	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
29	1"	LV DATA	AS REQUIRED/ EXPOSED	7#14	VE-3113	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
30	1"	POWER	AS REQUIRED/ EXPOSED	2#10 + 1#12EG	VE-3114	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
31	1"	LV DATA	AS REQUIRED/ EXPOSED	7#14	VE-3114	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
32	1"	LV DATA	AS REQUIRED/ EXPOSED	2#14 + 1#14EG	GS BASIN #1: AMMONIA TRANSMITTER AE-3100E	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
33	1"	LV DATA	AS REQUIRED/ EXPOSED	TWO BELDEN 8719 TWIST SHIELD PAIRS	GS BASIN #1: AMMONIA TRANSMITTER AE-3100E	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
34	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	GS BASIN #1: AMMONIA TRANSMITTER AE-3100E	AGS BASIN #1: AMMONIA SENSOR AE-3100E	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
35	3/4"	LV DATA	AS REQUIRED/ EXPOSED	TWO BELDEN 8719 TWIST SHIELD PAIRS	AGS BASIN #1: AMMONIA INDICATOR AE-3100E	AGS BASIN #1: AMMONIA TRANSMITTER AE-3100E	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
36	N/A	N/A	N/A	VIA NETWORK LCP-3000	AVG (AE-1310A + AE1320A) = DO AT PRE-EQ	ELECTRICAL BUILDING #2: FCP-3100	N/A
37	N/A	N/A	N/A	VIA NETWORK LCP-3000	AVG (AE-1310B + AE1320B) = ORP AT PRE-EQ	ELECTRICAL BUILDING #2: FCP-3100	N/A

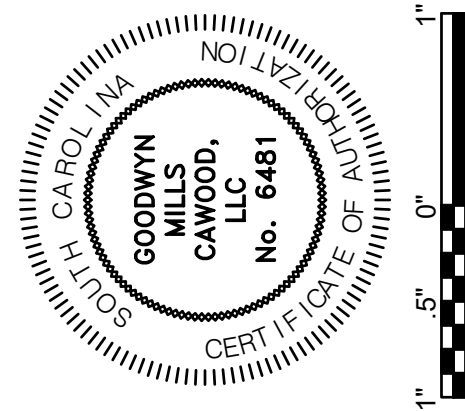
BNR AGS BASIN #1
WIRE & CONDUIT
SCHEDULE

E-941

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH



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PLOTTER: Mar 13, 2022 2:15pm

POWER NETWORK AND INSTRUMENTATION WIRE AND CONDUIT SCHEDULE FOR BNR AGS BASIN #2							
SEQUENCE NUMBER	CONDUIT/SLEEVE SIZE	CIRCUIT TYPE	ROUTING	CABLING/WIRING	FROM	TO	NOTES
1	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-2: HACH SC1000-2	AGS BASIN #2: ORP SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
2	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-2: HACH SC1000-2	AGS BASIN #2: PH/TEMP SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
3	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-2: HACH SC1000-2	AGS BASIN #2: DO SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
4	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-2: HACH SC1000-2	AGS BASIN #2: PHOSPHATE SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
5	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-2: HACH SC1000-2	AGS BASIN #2: TOTAL SUSPENDED SOLIDS SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
6	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-2: HACH SC1000-2	AGS BASIN #2: NITRATE SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
7	N/A	LV DATA	N/A	N/A	N/A	N/A	N/A
8	1"	LV DATA	AS REQUIRED/ EXPOSED	TWO CAT 6 ETHERNET CABLES	BNR AGS BASIN-2: HACH SC1000-2	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
9	1"	LV DATA	AS REQUIRED/ EXPOSED	TWO CAT 6 ETHERNET CABLES	BNR AGS BASIN-2: HACH SC1000-2 DISPLAY	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
10	1"	LV DATA	AS REQUIRED/ EXPOSED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	BNR AGS BASIN-2: AQUANEREDA JBOX	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
11	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	1"	POWER	AS REQUIRED/ EXPOSED	4#12 + 1#12EG	BNR AGS BASIN-2: AQUANEREDA JBOX	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
14	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16	1"	POWER	AS REQUIRED/ EXPOSED	4#12 + 1#12EG	BNR AGS BASIN-2: HACH SC1000-2	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
17	1"	120V DATA	AS REQUIRED/ EXPOSED	2#12 + 1#12EG CONNECT AQUANEREDA FLOAT SWITCH	BNR AGS BASIN-2: AQUANEREDA JBOX	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
18	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20	1"	120V DATA	AS REQUIRED/ EXPOSED	2#12 + 1#12EG CONNECT AQUANEREDA FLOAT SWITCH	LSH-3200	BNR AGS BASIN-2: AQUANEREDA JBOX	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
21	N/A	N/A	N/A	VIA NETWORK LCP-3000	LSH-1310	BNR: PRE-EQ JBOX	N/A
22	N/A	N/A	N/A	VIA NETWORK LCP-3000	LSH-4010	BNR: POST-EQ JBOX	N/A
23	1"	LV DATA	AS REQUIRED/ EXPOSED	TWO BELDEN 8719 TWIST SHIELD PAIRS	LE-3200	BNR AGS BASIN-2: AQUANEREDA JBOX	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
24	N/A	N/A	N/A	VIA NETWORK LCP-3000	LE1310	BNR: PRE-EQ JBOX	N/A
25	N/A	N/A	N/A	VIA NETWORK LCP-3000	LE4010	BNR: POST-EQ JBOX	N/A
26	1"	POWER	AS REQUIRED/ EXPOSED	2#10 VDC	FE-3210	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
27	1"	LV DATA	AS REQUIRED/ EXPOSED	TWO BELDEN 8719 TWIST SHIELD PAIRS	FE-3210	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
28	1"	POWER	AS REQUIRED/ EXPOSED	2#10 + 1#12EG	VE-3213	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
29	1"	LV DATA	AS REQUIRED/ EXPOSED	7#14	VE-3213	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
30	1"	POWER	AS REQUIRED/ EXPOSED	2#10 + 1#12EG	VE-3214	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
31	1"	LV DATA	AS REQUIRED/ EXPOSED	7#14	VE-3214	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
32	1"	LV DATA	AS REQUIRED/ EXPOSED	2#14 + 1#14EG	GS BASIN #2: AMMONIA TRANSMITTER AE-3200E	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
33	1"	LV DATA	AS REQUIRED/ EXPOSED	TWO BELDEN 8719 TWIST SHIELD PAIRS	GS BASIN #2: AMMONIA TRANSMITTER AE-3200E	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
34	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	GS BASIN #2: AMMONIA TRANSMITTER AE-3200E	AGS BASIN #2: AMMONIA SENSOR AE-3200E	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
35	3/4"	LV DATA	AS REQUIRED/ EXPOSED	TWO BELDEN 8719 TWIST SHIELD PAIRS	AGS BASIN #2: AMMONIA INDICATOR AE-3200E	AGS BASIN #2: AMMONIA TRANSMITTER AE-3200E	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
36	N/A	N/A	N/A	VIA NETWORK LCP-3000	AVG (AE-1310A + AE1320A) = DO AT PRE-EQ	ELECTRICAL BUILDING #2: FCP-3100	N/A
37	N/A	N/A	N/A	VIA NETWORK LCP-3000	AVG (AE-1310B + AE1320B) = ORP AT PRE-EQ	ELECTRICAL BUILDING #2: FCP-3100	N/A

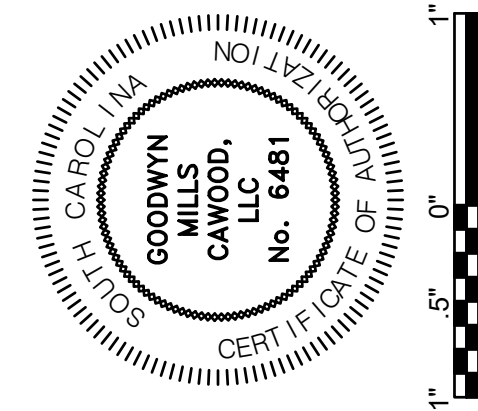
**BNR AGS BASIN #2
WIRE & CONDUIT
SCHEDULE**

E-942

**PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION**
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

ISSUE DATE	
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Confirmed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
Drawn By:	MBH



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DRAWING FILE: V:\Projects\2022 Projects\CGRE\220008 - Pendleton-Clemson WWTP Expansion\Drawings\Electrical\E-941 - SCHEDULES.dwg
PLOTTER: Mar 13, 2024 2:15pm

POWER NETWORK AND INSTRUMENTATION WIRE AND CONDUIT SCHEDULE FOR BNR AGS BASIN #3							
SEQUENCE NUMBER	CONDUIT/SLEEVE SIZE	CIRCUIT TYPE	ROUTING	CABLING/WIRING	FROM	TO	NOTES
1	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-3: HACH SC1000-3	AGS BASIN #3: ORP SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
2	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-3: HACH SC1000-3	AGS BASIN #3: PH/TEMP SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
3	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-3: HACH SC1000-3	AGS BASIN #3: DO SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
4	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-3: HACH SC1000-3	AGS BASIN #3: PHOSPHATE SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
5	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-3: HACH SC1000-3	AGS BASIN #3: TOTAL SUSPENDED SOLIDS SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
6	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	BNR AGS BASIN-3: HACH SC1000-3	AGS BASIN #3: NITRATE SENSOR	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
7	N/A	LV DATA	N/A	N/A	N/A	AGS BASIN #3: AMMONIA SENSOR	N/A
8	1"	LV DATA	AS REQUIRED/ EXPOSED	TWO CAT 6 ETHERNET CABLES	BNR AGS BASIN-3: HACH SC1000-3	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	1"	LV DATA	AS REQUIRED/ EXPOSED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	BNR AGS BASIN-3: AQUANEREDA JBOX	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
11	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	1"	POWER	AS REQUIRED/ EXPOSED	4#12 + 1#12EG	BNR AGS BASIN-3: AQUANEREDA JBOX	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
14	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16	1"	POWER	AS REQUIRED/ EXPOSED	4#12 + 1#12EG	BNR AGS BASIN-3: HACH SC1000-3	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
17	1"	120V DATA	AS REQUIRED/ EXPOSED	2#12 + 1#12EG CONNECT AQUANEREDA FLOAT SWITCH	BNR AGS BASIN-3: AQUANEREDA JBOX	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
18	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20	1"	120V DATA	AS REQUIRED/ EXPOSED	2#12 + 1#12EG CONNECT AQUANEREDA FLOAT SWITCH	LSH-3100	BNR AGS BASIN-1: AQUANEREDA JBOX	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
21	N/A	N/A	N/A	VIA NETWORK LCP-3000	LSH-1310	BNR: PRE-EQ JBOX	N/A
22	1"	120V DATA	AS REQUIRED/ EXPOSED	2#12 + 1#12EG CONNECT POST EQ FLOAT SWITCH	LSH-4010	BNR: POST-EQ JBOX	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
23	1"	LV DATA	AS REQUIRED/ EXPOSED	TWO BELDEN 8719 TWIST SHIELD PAIRS	LE-3300	BNR AGS BASIN-1: AQUANEREDA JBOX	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
24	N/A	N/A	N/A	VIA NETWORK LCP-3000	LE1310	BNR: PRE-EQ JBOX	N/A
25	N/A	N/A	N/A	VIA NETWORK LCP-3000	LE4010	BNR: POST-EQ JBOX	N/A
26	1"	POWER	AS REQUIRED/ EXPOSED	2#10 VDC	FE-3310	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
27	1"	LV DATA	AS REQUIRED/ EXPOSED	TWO BELDEN 8719 TWIST SHIELD PAIRS	FE-3310	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
28	1"	POWER	AS REQUIRED/ EXPOSED	2#10 + 1#12EG	VE-3313	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
29	1"	LV DATA	AS REQUIRED/ EXPOSED	7#14	VE-3313	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
30	1"	POWER	AS REQUIRED/ EXPOSED	2#10 + 1#12EG	VE-3314	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
31	1"	LV DATA	AS REQUIRED/ EXPOSED	7#14	VE-3314	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
32	1"	LV DATA	AS REQUIRED/ EXPOSED	2#14 + 1#14EG	GS BASIN #3: AMMONIA TRANSMITTER AE-3300E	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
33	1"	LV DATA	AS REQUIRED/ EXPOSED	TWO BELDEN 8719 TWIST SHIELD PAIRS	GS BASIN #3: AMMONIA TRANSMITTER AE-3300E	ELECTRICAL BUILDING #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
34	3/4"	LV DATA	AS REQUIRED/ EXPOSED	PROVIDED BY AQUA AEROBIC	GS BASIN #3: AMMONIA TRANSMITTER AE-3300E	AGS BASIN #3: AMMONIA SENSOR AE-3300E	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
35	3/4"	LV DATA	AS REQUIRED/ EXPOSED	TWO BELDEN 8719 TWIST SHIELD PAIRS	AGS BASIN #3: AMMONIA INDICATOR AE-3300E	AGS BASIN #3: AMMONIA TRANSMITTER AE-3300E	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
36	N/A	N/A	N/A	VIA NETWORK LCP-3000	AVG (AE-1310A + AE1320A) = DO AT PRE-EQ	ELECTRICAL BUILDING #2: FCP-3100	N/A
37	N/A	N/A	N/A	VIA NETWORK LCP-3000	AVG (AE-1310B + AE1320B) = ORP AT PRE-EQ	ELECTRICAL BUILDING #2: FCP-3100	N/A

BNR AGS BASIN #3
WIRE & CONDUIT
SCHEDULE

E-943

PENDLETON - CLEMSON

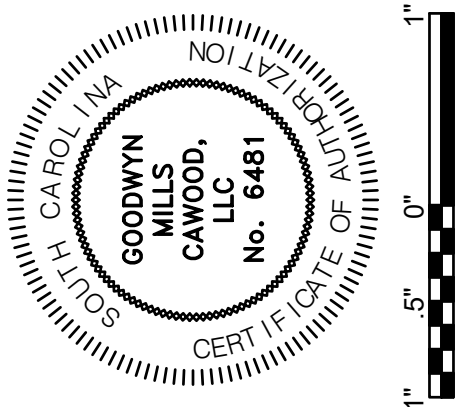
REGIONAL WWTP EXPANSION

PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

ISSUE

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08.07.2023	30% Submittal
12.04.2023	60% Submittal
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	Confirmed Set
	Project Manager:
	Engineer:
	Designer:
	Drawn By:



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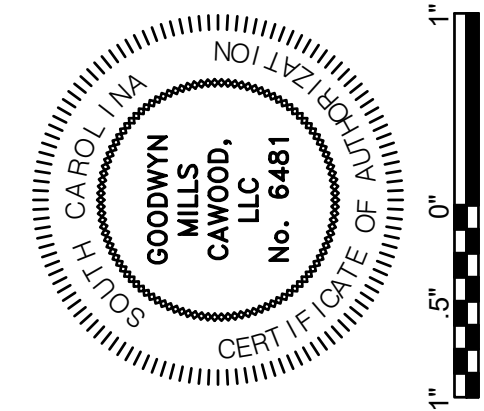
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PLOTTER: Mar 18, 2022 2:45pm

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POWER NETWORK AND INSTRUMENTATION WIRE AND CONDUIT SCHEDULE FOR BNR LARGE VALVE ACTUATORS							
SEQUENCE NUMBER	CONDUIT/SLEEVE SIZE	CIRCUIT TYPE	ROUTING	CABLING/WIRING	FROM	TO	NOTES
1	1"	POWER	AS REQUIRED/EXPOSED/BURIED	3#8 + 1#10EG	BNR: PANEL 'HBNR'	ACTUATOR VE3112 AND VE3104	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
2	1"	POWER	AS REQUIRED/EXPOSED/BURIED	3#8 + 1#10EG	BNR: PANEL 'HBNR'	ACTUATOR VE3106 AND VE3108	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
3	1"	POWER	AS REQUIRED/EXPOSED/BURIED	3#8 + 1#10EG	BNR: PANEL 'HBNR'	ACTUATOR VE3212 AND VE3204	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
4	1"	POWER	AS REQUIRED/EXPOSED/BURIED	3#8 + 1#10EG	BNR: PANEL 'HBNR'	ACTUATOR VE3206 AND VE3208	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
5	1"	POWER	AS REQUIRED/EXPOSED/BURIED	3#8 + 1#10EG	BNR: PANEL 'HBNR'	ACTUATOR VE3312 AND VE3304	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
6	1"	POWER	AS REQUIRED/EXPOSED/BURIED	3#8 + 1#10EG	BNR: PANEL 'HBNR'	ACTUATOR VE3306 AND VE3308	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
7	1"	DATA	AS REQUIRED/EXPOSED/BURIED	9#12	ELEC BLDG #2: FCP-3100	ACTUATOR VE3112	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
8	1"	DATA	AS REQUIRED/EXPOSED/BURIED	9#12	ELEC BLDG #2: FCP-3100	ACTUATOR VE3106	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
9	1"	DATA	AS REQUIRED/EXPOSED/BURIED	9#12	ELEC BLDG #2: FCP-3100	ACTUATOR VE3212	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
10	1"	DATA	AS REQUIRED/EXPOSED/BURIED	9#12	ELEC BLDG #2: FCP-3100	ACTUATOR VE3206	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
11	1"	DATA	AS REQUIRED/EXPOSED/BURIED	9#12	ELEC BLDG #2: FCP-3100	ACTUATOR VE3312	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
12	1"	DATA	AS REQUIRED/EXPOSED/BURIED	9#12	ELEC BLDG #2: FCP-3100	ACTUATOR VE3306	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
13	1"	DATA	AS REQUIRED/EXPOSED/BURIED	9#12	ELEC BLDG #2: FCP-3100	ACTUATOR VE3104	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
14	1"	DATA	AS REQUIRED/EXPOSED/BURIED	9#12	ELEC BLDG #2: FCP-3100	ACTUATOR VE3108	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
15	1"	DATA	AS REQUIRED/EXPOSED/BURIED	9#12	ELEC BLDG #2: FCP-3100	ACTUATOR VE3204	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
16	1"	DATA	AS REQUIRED/EXPOSED/BURIED	9#12	ELEC BLDG #2: FCP-3100	ACTUATOR VE3208	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
17	1"	DATA	AS REQUIRED/EXPOSED/BURIED	9#12	ELEC BLDG #2: FCP-3100	ACTUATOR VE3304	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
18	1"	DATA	AS REQUIRED/EXPOSED/BURIED	9#12	ELEC BLDG #2: FCP-3100	ACTUATOR VE3308	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
19	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	ELEC BLDG #2: FCP-3100	ACTUATOR VE3112	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
20	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	ELEC BLDG #2: FCP-3100	ACTUATOR VE3106	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
21	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	ELEC BLDG #2: FCP-3100	ACTUATOR VE3212	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
22	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	ELEC BLDG #2: FCP-3100	ACTUATOR VE3206	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
23	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	ELEC BLDG #2: FCP-3100	ACTUATOR VE3312	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
24	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	ELEC BLDG #2: FCP-3100	ACTUATOR VE3306	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
25	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	ELEC BLDG #2: FCP-3100	ACTUATOR VE3104	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
26	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	ELEC BLDG #2: FCP-3100	ACTUATOR VE3108	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
27	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	ELEC BLDG #2: FCP-3100	ACTUATOR VE3204	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
28	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	ELEC BLDG #2: FCP-3100	ACTUATOR VE3208	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
29	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	ELEC BLDG #2: FCP-3100	ACTUATOR VE3304	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
30	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED	FOUR BELDEN 8719 TWIST SHIELD PAIRS	ELEC BLDG #2: FCP-3100	ACTUATOR VE3308	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
31	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
32	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
33	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.
34	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE SEAL-OFF FITTINGS AS REQUIRED BY NFPA 820.

POWER NETWORK AND INSTRUMENTATION WIRE AND CONDUIT SCHEDULE FOR BNR BLOWERS							
SEQUENCE NUMBER	CONDUIT/SLEEVE SIZE	CIRCUIT TYPE	ROUTING	CABLING/WIRING	FROM	TO	NOTES
1	1.1/2"	LV DATA	AS REQUIRED/EXPOSED/BURIED	EIGHT BELDEN 8719 TWIST SHIELD PAIRS WITH 7#14	BNR: BLR3610	ELEC BLDG #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
2	1.1/2"	LV DATA	AS REQUIRED/EXPOSED/BURIED	TWO CAT 6 ETHERNET CABLES WITH 9#14	BNR: BLR3610 VFD	ELEC BLDG #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
3	1.1/2"	LV DATA	AS REQUIRED/EXPOSED/BURIED	EIGHT BELDEN 8719 TWIST SHIELD PAIRS WITH 7#14	ELEC BLDG #2: FCP-3100	ELEC BLDG #2: LCP-3000	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
4	1.1/2"	LV DATA	AS REQUIRED/EXPOSED/BURIED	TWO CAT 6 ETHERNET CABLES WITH 9#14	ELEC BLDG #2: FCP-3100	ELEC BLDG #2: LCP-3000	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
5	1.1/2"	LV DATA	AS REQUIRED/EXPOSED/BURIED	EIGHT BELDEN 8719 TWIST SHIELD PAIRS WITH 7#14	BNR: BLR3620	ELEC BLDG #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
6	1.1/2"	LV DATA	AS REQUIRED/EXPOSED/BURIED	TWO CAT 6 ETHERNET CABLES WITH 9#14	BNR: BLR3620 VFD	ELEC BLDG #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
7	1.1/2"	LV DATA	AS REQUIRED/EXPOSED/BURIED	EIGHT BELDEN 8719 TWIST SHIELD PAIRS WITH 7#14	ELEC BLDG #2: FCP-3100	ELEC BLDG #2: LCP-3000	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
8	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED	9#14	ELEC BLDG #2: FCP-3100	ELEC BLDG #2: LCP-3000	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
9	1.1/2"	LV DATA	AS REQUIRED/EXPOSED/BURIED	EIGHT BELDEN 8719 TWIST SHIELD PAIRS WITH 7#14	BNR: BLR3630	ELEC BLDG #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
10	1.1/2"	LV DATA	AS REQUIRED/EXPOSED/BURIED	TWO CAT 6 ETHERNET CABLES WITH 9#14	BNR: BLR3630 VFD	ELEC BLDG #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
11	1.1/2"	LV DATA	AS REQUIRED/EXPOSED/BURIED	EIGHT BELDEN 8719 TWIST SHIELD PAIRS WITH 7#14	ELEC BLDG #2: FCP-3100	ELEC BLDG #2: LCP-3000	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
12	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED	9#14	ELEC BLDG #2: FCP-3100	ELEC BLDG #2: LCP-3000	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
13	1"	POWER	AS REQUIRED/EXPOSED/BURIED	2#8 + 1#10EG	ELEC BLDG #2: PANEL 'LEB2A'	ELEC BLDG #2: FCP-3100	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
14	3/4"	POWER	AS REQUIRED/EXPOSED/BURIED	2#12 + 1#12EG	ELEC BLDG #2: PANEL 'LEB2A'	ELEC BLDG #2: LCP-3000	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
15	1"	POWER	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
16	1"	POWER	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
17	1"	POWER	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
18	1"	POWER	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
19	1"	POWER	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
20	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.



ISSUE		DATE
30% Submittal	01/18/2023	
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90% Submittal	12/04/2023	
100% Submittal	03/08/2024	
Conformed Set		
Project Manager:	JB	
Engineer:	JEA	
Designer:	JB	
Drawn By:	MBH	

PENDLETON - CLEMSON
REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
Town of Pendleton
City of Clemson
Anderson County

GMC PROJECT #CGRE220027

BNR VALVE ACT. & BLOWER WIRE & CONDUIT SCHEDULES
E-944

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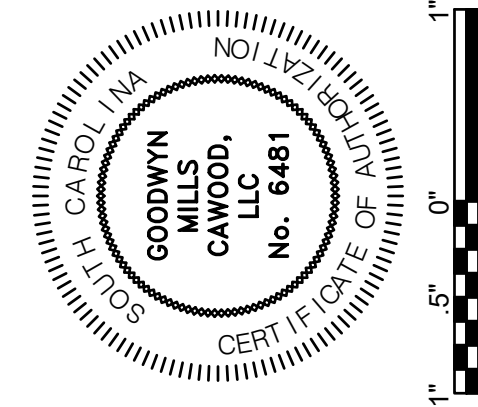
POWER NETWORK AND INSTRUMENTATION WIRE AND CONDUIT SCHEDULE FOR RAS/WAS PUMP STATION LCP-3500							
SEQUENCE NUMBER	CONDUIT/SLEEVE SIZE	CIRCUIT TYPE	ROUTING	CABLING/WIRING	FROM	TO	NOTES
1	3/4"	POWER	AS REQUIRED/EXPOSED/BURIED	2#12 + 1#12EG	RAS/WAS BLDG: PANEL 'EPA'	RAS/WAS BLDG: LCP-3500	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE 20 AMP/1 POLE CIRCUIT BREAKER IN EXISTING PANEL 'EPA'
2	3/4"	LV DATA	AS REQUIRED/EXPOSED/BURIED	2#12 + 1#12EG	RAS/WAS BLDG: PANEL 'EPA'	RAS/WAS BLDG: FE/FIT3510	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE 20 AMP/1 POLE CIRCUIT BREAKER IN EXISTING PANEL 'EPA'
3	3/4"	LV DATA	AS REQUIRED/EXPOSED/BURIED	2#12 + 1#12EG	RAS/WAS BLDG: PANEL 'EPA'	RAS/WAS BLDG: FE/FIT3520	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE 20 AMP/1 POLE CIRCUIT BREAKER IN EXISTING PANEL 'EPA'
4	3/4"	LV DATA	AS REQUIRED/EXPOSED/BURIED	2#12 + 1#12EG	RAS/WAS BLDG: PANEL 'EPA'	RAS/WAS BLDG: FE/FIT3530	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED. PROVIDE 20 AMP/1 POLE CIRCUIT BREAKER IN EXISTING PANEL 'EPA'
5	3/4"	LV DATA	AS REQUIRED/EXPOSED/BURIED	THREE BELDEN 8719 TWIST SHIELD PAIRS	RAS/WAS BLDG: FE/FIT3510	RAS/WAS BLDG: LCP-3500	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
6	3/4"	LV DATA	AS REQUIRED/EXPOSED/BURIED	THREE BELDEN 8719 TWIST SHIELD PAIRS	RAS/WAS BLDG: FE/FIT3520	RAS/WAS BLDG: LCP-3500	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
7	3/4"	LV DATA	AS REQUIRED/EXPOSED/BURIED	THREE BELDEN 8719 TWIST SHIELD PAIRS	RAS/WAS BLDG: FE/FIT3530	RAS/WAS BLDG: LCP-3500	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
8	3/4"	LV DATA	AS REQUIRED/EXPOSED/BURIED	TWO CAT 6 ETHERNET CABLES WITH 9#14	RAS/WAS BLDG: LCP-3500	RAS/WAS BLDG: P3510 VFD CABINET	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
9	3/4"	LV DATA	AS REQUIRED/EXPOSED/BURIED	TWO CAT 6 ETHERNET CABLES WITH 9#14	RAS/WAS BLDG: LCP-3500	RAS/WAS BLDG: P3520 VFD CABINET	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
10	3/4"	LV DATA	AS REQUIRED/EXPOSED/BURIED	TWO CAT 6 ETHERNET CABLES WITH 9#14	RAS/WAS BLDG: LCP-3500	RAS/WAS BLDG: P3530 VFD CABINET	PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
11	3/4"	LV DATA	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
12	3/4"	LV DATA	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
13	3/4"	POWER	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
14	3/4"	POWER	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
15	3/4"	POWER	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
16	3/4"	POWER	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
17	3/4"	POWER	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
18	3/4"	POWER	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
19	1"	POWER	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.
20	1"	LV DATA	AS REQUIRED/EXPOSED/BURIED				PROVIDE LIMITED FLEXIBLE CONDUIT AS REQUIRED.

RAS/WAS PUMP
STATION LCP-3500
WIRE & CONDUIT
SCHEDULE
E-945

PENDLETON - CLEMSON
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ISSUE	DATE
30% Submittal	01.18.2023
60% Submittal	08.07.2023
90% Submittal	12.04.2023
100% Submittal	03.08.2024
Conformed Set	
Project Manager:	JB
Engineer:	JEA
Designer:	JB
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HEADWORKS LCP-1110 WIRE & CONDUIT SCHEDULE

E-946

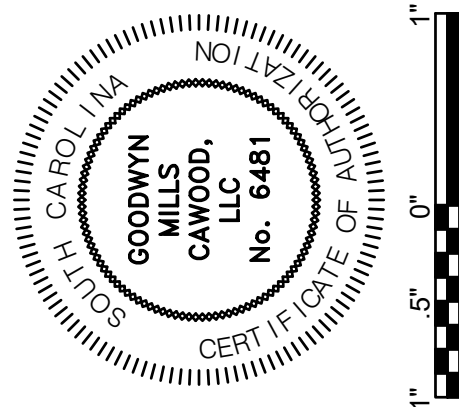
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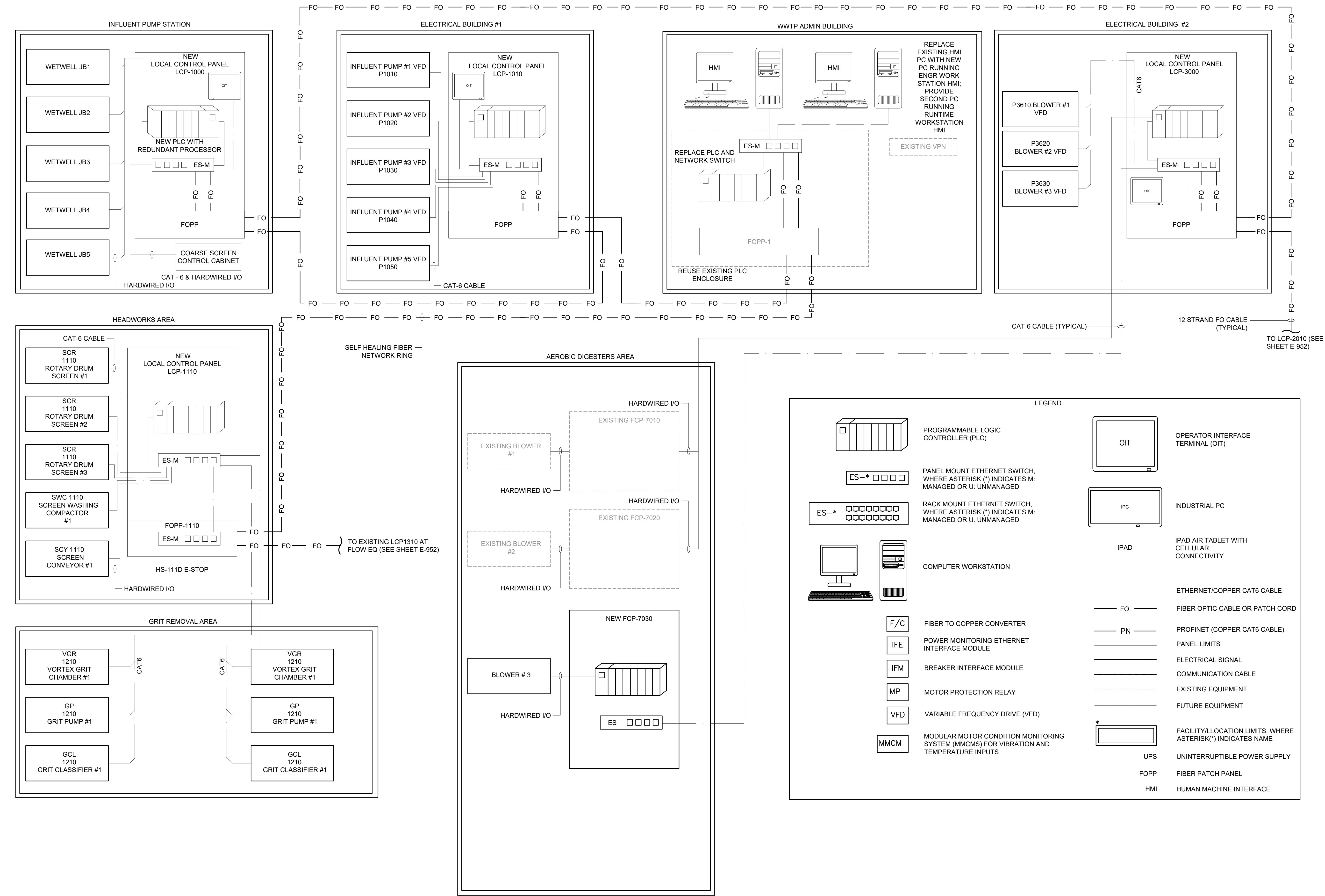
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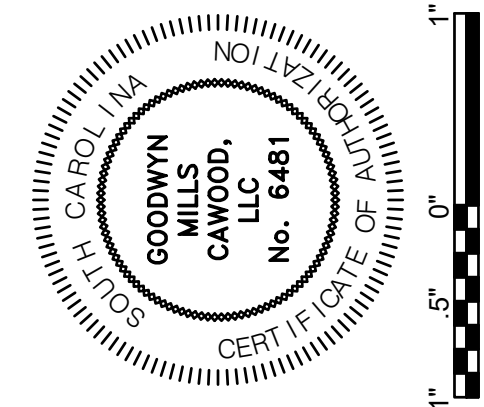
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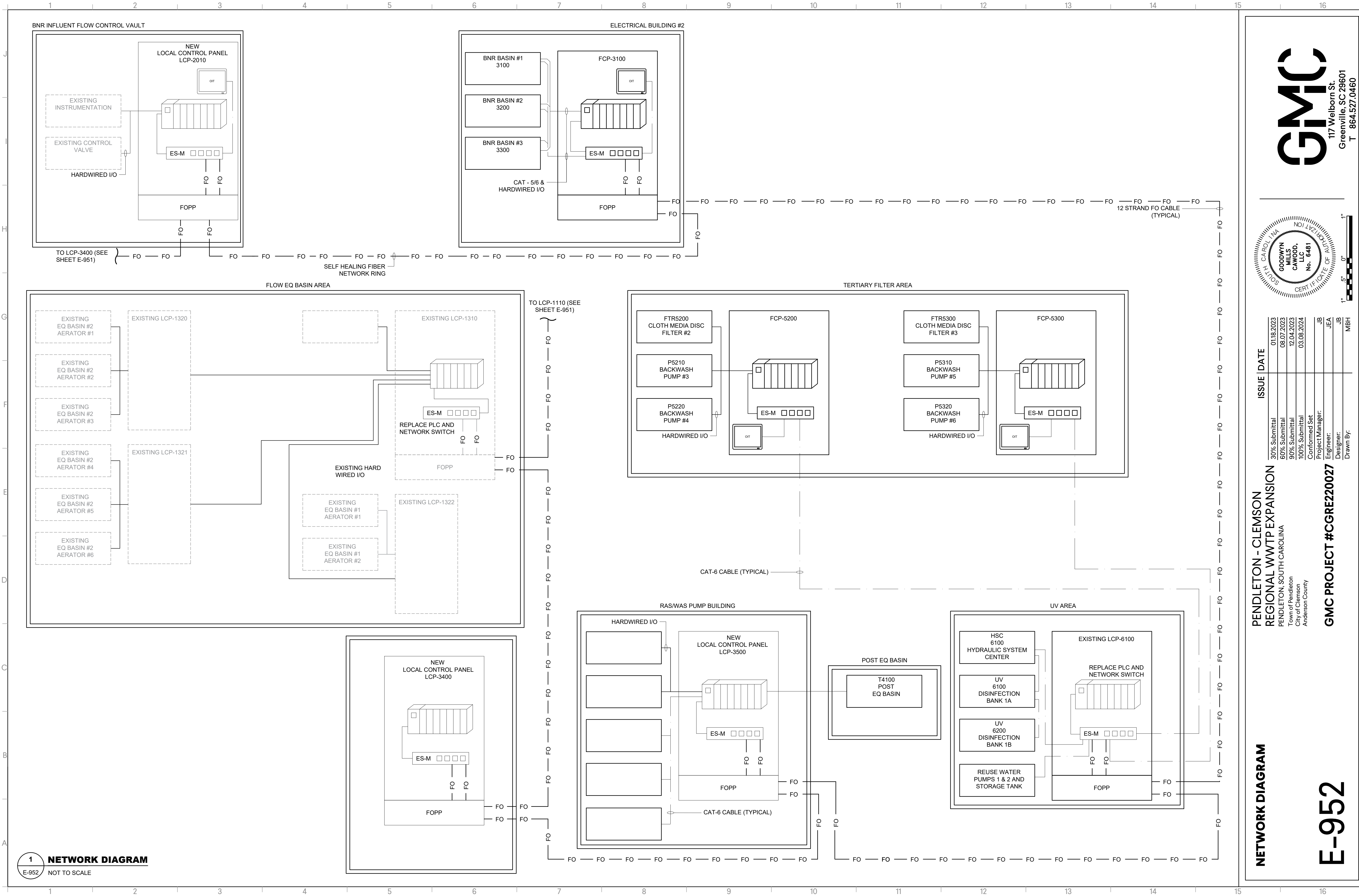
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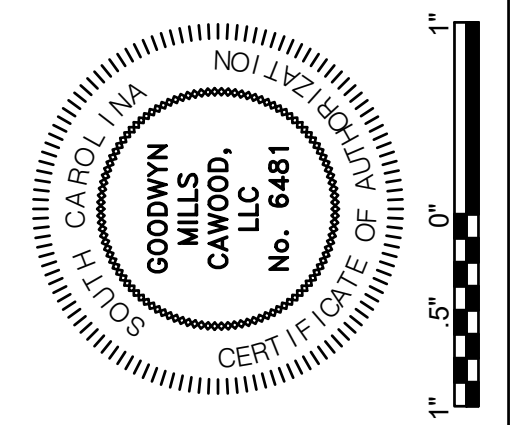


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1 NETWORK DIAGRAM
E-952 NOT TO SCALE



ISSUE	DATE
30% Submittal	01/18/2023
60% Submittal	08/07/2023
90% Submittal	12/04/2023
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REGIONAL WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
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Anderson County

GMC PROJECT #CGRE220027

NETWORK DIAGRAM

E-952

PENDLETON CLEMSON WWTP EXPANSION

PENDLETON, SOUTH CAROLINA

September 27, 2022

REPORT OF GEOTECHNICAL EXPLORATION

Prepared By



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GMC PROJECT NUMBER: GGRE220008



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September 27, 2022

Mr. Tony Reid, PE
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Greenville, SC 29601

**RE: REPORT OF GEOTECHNICAL EXPLORATION
PENDLETON CLEMSON WWTP EXPANSION
PENDLETON, SOUTH CAROLINA
GMC PROJECT NO. GGRE220008**

Dear Mr. Reid,

Goodwyn Mills Cawood, LLC (Geotechnical & Construction Services Division) is pleased to provide this report of geotechnical exploration performed for the above referenced project. This report includes the results of field and laboratory testing, general site preparation recommendations based on specific site conditions, and recommendations for foundation design.

We appreciate the opportunity to perform this study on this phase of the project for you and look forward to continued participation during the construction phase of this project. If you have any questions pertaining to this report, or if we may be of further service, please do not hesitate to contact us.

Sincerely,

GOODWYN MILLS CAWOOD, LLC

Kevin W. Wales
Executive Vice President

Michael J. Lloyd, EI
Staff Geotechnical Professional

Michael J. McNeill, PE
Senior Engineer
Licensed South Carolina 36909





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APPENDIX:

Figure 1 – Site Location Plan
 Figure 2 – Site Geology Map
 Figure 3 – USGS Site Map
 Figure 4 – Boring Location Plan
 Site Photographs
 Soil Classification Chart
 Subsurface Diagrams
 Boring Records
 Summary of Laboratory Results
 Field and Laboratory Procedure



1.0 PROJECT INFORMATION AND SCOPE OF WORK

1.1 Project Information

A geotechnical exploration has been conducted for the proposed Pendleton Clemson Waste Water Treatment Plant Expansion. The proposed project is located at the existing facility located on the south side of Woodburn Road just east of Eighteenmile Creek in Pendleton, South Carolina.

At the time this report was prepared, we had not been provided with planned grades or structural information for the proposed structures. We have assumed that the new structures will be at or near the current grades in their proposed locations. We understand the location of the Headworks will require building the existing slope of the equalization basin out, which will require up to 25 feet of fill to maintain the upper grade of the equalization basin. The table below provides a list of the proposed structures with their associated borings:

Structure	Boring(s)
Influent Pump Station	B-1-1, B-1-2
Aerobic Digester	B-5-1
Headworks	B-2-1, B-2-2, B-2-3, B-2-4
Biological Units	B-3-1, B-3-2, B-3-3
Secondary Clarifiers	B-4-1, B-4-2

1.2 Scope of Work

The purpose of this exploration was to characterize the subsurface soil conditions at the site, and to provide the following:

- A brief summary of our test procedures and the results of all field and laboratory testing.
- A review of the site conditions and geologic setting.
- A review of subsurface soil stratigraphy including the individual Boring Records, Subsurface Diagrams, and a Boring Location Plan.
- General recommendations for site preparation, excavation considerations, cut and fill slope recommendations, preparation of existing soils for proposed construction activities, and construction of compacted fills.
- Information regarding groundwater conditions

The scope of services for the geotechnical exploration did not include any environmental assessment for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Any statements, if any, in this report or on the boring records regarding odors, colors, or unusual or suspicious items or conditions are strictly for the information of the client.



2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 Existing Site Conditions

At the time of our exploration, the existing plant was operational and the site topography consisted of a hilly terrain. The site sloped down from east to west with the highest points of elevation around the existing Equalization Basin at EL 762 feet. The lowest point of the site is at EL 686 on the western fence line near the existing pump station. The proposed construction areas consisted of grass covered areas or slopes. Both cut and fill was required to construct the existing facility.

2.2 Site Geology

Published geologic information indicates that the site is in the Piedmont physiographic unit. The Piedmont is typically characterized by gently rolling topography and deeply weathered bedrock. The subsurface conditions can consist of up to 70 feet of weathered residual soils (saprolites) underlain by metamorphic and igneous rocks consisting of granite, schist, and gneiss. At this site, two geologic units are mapped: the Biotite-Plagioclase-Quartz Gneiss Formation and the Undifferentiated Granite Gneiss and Granodiorite Gneiss Formation. They are described below:

Biotite-Plagioclase-Quartz Gneiss Formation - This formation generally consists of gray to dark gray, medium-grained gneiss composed mostly of plagioclase, quartz and biotite, as well as some muscovite, microcline, garnet, sillimanite, and epidote-clinozoisite.

Undifferentiated Granite Gneiss and Granodiorite Gneiss Formation - This formation generally consists of light to medium gray, fine to medium-grained gneiss containing mostly plagioclase, quartz, biotite, and muscovite.

The subsurface bedrock in this region has undergone differing rates of weathering, which often produces a considerable variation in depth to competent rock over short horizontal distances. It is also not unusual for lenses and large boulders of hard rock and zones of partially weathered rock to be present within the soil mantle above the general bedrock level. The typical residual soil profile consists of clayey soils near the surface, where soil weathering is more advanced, underlain by sandy silts and silty sands, which often consist of saprolites (native soils which maintain the original fabric of the parent rock).

Generally, the soil becomes harder with depth to the top of parent crystalline rock or “massive bedrock.” This transitional zone is termed partially weathered rock (PWR). PWR is defined for engineering purposes as material with standard penetration N-values of more than 100 blows per foot. Weathering of the rock is influenced by joints, fractures, and less resistant rock types therefore, the profile of the PWR and hard rock is irregular. It is not unusual to find boulders, lenses of hard rock, and zones of PWR within the soil mantle, above the general bedrock level.

2.3 Field Exploration

The site subsurface conditions were explored by drilling a total of twelve (12) soil test borings across the plant site. Boring locations were selected by GMC and were staked in the field by GMC geotechnical personnel using handheld GPS equipment. The approximate boring locations can be found on the Boring Location Plan located in the Appendix. The ground surface elevations shown on the boring records were approximated from the provided topographic



survey provided and should be considered approximate. Field-testing employed by GMC was in general accordance with ASTM standards or generally accepted methods.

The borings were performed on July 25th and 26th, 2022, using an CME 550X ATV-mounted drill rig equipped with a rotary head and hollow stem augers (HSA). Soils were sampled using a two-inch outside diameter split barrel sampler driven with an automatic hammer. Soil sampling and drilling was performed in general accordance with the procedures for “Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils” (ASTM D1586). All samples were identified according to project number, boring number and depth, and were placed in polyethylene plastic wrapping to protect against moisture loss.

2.4 Subsurface Conditions

The descriptions given below are for materials that were encountered in the specific boring locations during the course of the fieldwork. The subsurface descriptions contained herein are of a generalized nature to highlight the major soil stratification features and soil characteristics. The boring records included in the Appendix should be reviewed for specific information as to specific boring locations. The stratification shown on the boring records and subsurface profiles represent conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. In addition, the stratifications represent the approximate boundary between subsurface materials, and the transition may be gradual. The results of laboratory tests, consisting of natural moisture contents performed on selected soil samples, are contained in the Appendix.

The following table summarizes the borings drilled:

Structure	Boring(s)	Approximate Ground Surface Elevation (feet)	Boring Termination (BT) or Auger Refusal Depth (AR) (feet below existing grade)	Groundwater Depth/Approximate Elevation (feet)
Influent Pump Station	B-1-1 B-1-2	690 692	24.5 (AR) 14.5 (AR)	13 / 677 Not encountered
Headworks	B-2-1, B-2-2, B-2-3, B-2-4	730 760 734 761	20 (BT) 20 (BT) 42 (AR) 50 (BT)	Not encountered Not encountered 21 / 713 Not encountered
Biological Units	B-3-1, B-3-2, B-3-3	733 734 733	15 (BT) 15 (BT) 15 (BT)	Not encountered Not encountered Not encountered
Clarifiers	B-4-1, B-4-2	711 724	25 (BT) 17 (AR)	Not encountered Not encountered
Aerobic Digester	B-5-1	707	25 (BT)	Not encountered



Influent Pump Station

Borings B-1-1 and B-1-2 encountered very loose to medium silty sand (SM) throughout the boring profile to the boring refusal depths. Auger refusal for borings B-1-1 and B-1-2 were encountered at approximate elevations of EL 665 and EL 676 feet, respectfully. Standard Penetration Test (SPT) N-values before auger refusal was met ranged from 2 to 18 blows per foot (bpf). The refusal material was not cored.

Headworks

Borings B-2-2 and B-2-4 were performed at the top of the hill where the equalization basins are located and borings B-2-1 and B-2-3 were drilled at the toe of the slope.

B-2-1 and B-2-3 (toe of slope)

The soils at B-2-1 and B-2-3 encountered residual silty sand (SM), sandy silt (ML), silty clayey sand (SC-SM), and sandy fat clay (CH) to approximate depths of 10 feet (approx. EL 720 feet) below the surface. SPT N-values for these soils ranged from 8 to 17 bpf or a soil stiffness of loose to medium (cohesionless soils) or medium to very stiff (cohesive soils).

Below EL 720, boring B-2-3 encountered layer of medium silt (ML) extending to about EL 700 feet with an SPT N-value range of 5 to 7 bpf, underlain by medium to dense silty sand (SM) to the auger refusal elevation of EL 692 feet (-42 feet). Boring B-2-1 encountered loose silty sand (SM) below EL 720 to the boring termination elevation of EL of 710 feet (-20 feet).

B-2-2 and B-2-4 (top of slope)

The material encountered in the upper 20 feet (to EL 740 feet) was classified as *FILL MATERIAL* consisting of soft to stiff sandy silt (ML). SPT N-values in the fill material ranged from 4 to 14 bpf. Boring B-2-4 encountered very stiff elastic silt (MH) to an approximate depth of 32 feet (EL 729 feet), underlain by loose to medium silty sand (SM) to the boring termination depth of 50 feet (EL 711 feet). Boring B-2-2 was terminated at 20 feet.

Biological Units

Borings B-3-1, B-3-2, and B-3-3 initially encountered approximately 1 inch of organic laden material (OLM). Boring B-3-3 also contained 1 inch of gravel material below the OLM. Below the OLM, the borings generally consisted of alternating layers of loose to dense silty sand (SM), very stiff elastic silt (MH), and medium to very stiff silt with sand (ML) to the termination depths of 15 feet. SPT N-values for these borings ranged from 9 to 47 bpf.

Clarifiers

Boring B-4-1 and B-4-2 initially encountered 1 inch of OLM underlain by silty sand (SM), elastic silt (MH), and silt (ML) to termination depths or auger refusal. The SPT N-values ranged from 5 to 26 bpf in the silts and from 3 to over 50 bpf in the sandy material. Boring B-4-1 was drilled to the termination depth of 25 feet, and boring B-4-2 encountered auger refusal at 17 feet below existing grade (EL 707 feet).



Aerobic Digester

Boring B-5-1 initially encountered 1 inch of OLM underlain by loose to medium silty sand (SM) throughout the boring profile to the termination depth of 25 feet. SPT N-values for this boring ranged from 6 to 25 bpf.

2.5 Groundwater Information

Groundwater was encountered in borings B-1-1 and B-2-3 at approximate elevations of EL 677 feet (13 feet) and EL 713 feet, (21 feet), respectively. The borings were backfilled at the end of the drilling operations and 24-hour water level reading were not performed. Groundwater levels may vary due to seasonal conditions and recent rainfall.

Depending on the final grades of the site, groundwater may impact the construction activities, especially at the proposed location for the pump station. Proper dewatering measures should be addressed if the excavations will be below these depths.

2.6 Laboratory Analyses

The laboratory-testing program included visual classification of all soil samples and laboratory testing of selected samples, which consisted of Atterberg limits, grain size analyses, and natural moisture content tests. The laboratory-testing program was conducted in general accordance with applicable ASTM standards and the results are summarized in the Appendix.

3.0 RECOMMENDATIONS

3.1 General

At the time of this report, we had not been provided with structural or grading information about the planned structures. The following is a summary of our findings:

- Although no grading plan has been provided, depths below grade of up to 30 feet may be required for the pump station. PWR and intact bedrock will likely be encountered within these depths in this area.
- The PWR and refusal depths were not encountered in the borings within the drilled depths of the biological units and the aerobic digester. Depending on the final grades, shallow foundations can likely be used for these structures. We recommend that once the planned grades and bearing depths are established, we be given the opportunity to modify our recommendations as needed.
- Refusal material was not encountered in the upper 17 feet of the borings drilled for the secondary clarifiers. Depending on the final grades, shallow foundations can likely be used for these structures.
- For the headworks, the existing slope will either need to be extended to allow for the construction of the structure or the structure will be cut into the existing slope. If the existing slope will be cut into during the construction, we recommend that the temporary cut slopes be no steeper than 2(H):1(V) or a driven sheet pile wall be used for bracing. Any new fill placed on the existing slope should be benched into the existing slope and be designed at a 3(H):1(V) slope like the existing. Depending on the final grades, shallow foundations can likely be used for the structure.
- High Plasticity Soils – In some cases, highly plastic soils such as fat clay (CH) or elastic silt (MH) may be encountered during excavations. These soils were noted in borings B-2-1, B-2-4, B-3-1, and B-4-1. These soils



have the potential of shrinking and swelling with a corresponding loss or gain in soil moisture. Such volume change can cause settlement and heave of foundations, floor slabs and pavements causing cracks and damage. If encountered in building areas and parking and drive areas, grading activities should be directed to provide a minimum of 36-inches of low plasticity material below the building subgrade elevation and 24-inches below subgrade in parking and drive areas. If the highly plastic soils are exposed during grading or construction of footings or slopes, they should be maintained in a moist condition (at or above their plastic limit). If they dry excessively, then they should be removed and replaced with select compacted fill.

3.2 Site Preparation

Stripping

Surface vegetation and deleterious materials in the planned construction area should be completely removed. Based on our observations, we recommend 2 inches of stripping be budgeted to remove organics and root zones in the areas adjacent to the existing structure on the site. It should be noted that deeper depths of organics may be present in lower lying areas of the site or in drainage features.

Proofrolling

Once the subgrade elevation has been achieved, we recommend that the subgrade be proofrolled with a loaded dump truck to verify the existing subgrade soils are suitable for slab support. Proofrolling consists of repeated passes with a loaded dump truck to locate areas of soft soil. Areas that rut or pump excessively will indicate those soils that will need remediation. If the layer of soft/pumping soils is relatively thin, less than about 1 foot, an attempt can be made to scarify, moisture condition, and compact the materials. Whether or not these soils will be problematic will be a function of prevailing weather conditions. If the soils are wet and adequate drying conditions are not present, this may not be practical. Deeper areas of soft/pumping soils should be removed until the thickness is such that the remaining material can be moisture conditioned and properly compacted. We recommend a GMC geotechnical engineer or qualified soils' technician observe the proofrolling operations.

Due to the moisture-sensitive nature of possible silty soils at the subgrade level, additional undercutting and/or stabilization will likely be required if proper site maintenance, protection from surface water, and equipment traffic control are not implemented. At the end of each day, the grading contractor should "weatherproof" exposed soil subgrades, and provide positive drainage for surface water flow if inclement weather is expected. The contractor should have water trucks available to wet subgrades exposed to prolonged dry periods. Twisting and turning of construction equipment over exposed soils, especially during and after rain events, should be avoided, or otherwise degradation of the prepared subgrade soils will occur.

Loose/Soft Soils

Generally, soils that have SPT N-values less than 6 to 8 bpf will typically experience pumping and rutting while performing proofrolls. Soils with loose and soft blow counts were observed at varied depths throughout all the borings except B-3-3. If grading plans extend to these elevations the subgrade will need to be remediated during site preparation and prior to new fill or foundation construction. Compaction of the exposed soils will be required to provide support for the structure's slabs and paved areas. In building/facility areas that experience deeper pumping with proofroll passes, we recommend that these surface soils be densified and/or undercut and replaced to a depth of about 3 feet prior to placing additional fill material.



3.3 Excavation Considerations

Site soils consists of silty sands and silts with very loose to very dense fine-grained materials. It is our opinion that conventional earthmoving equipment in proper working condition should be capable of making necessary excavations for the project. Some excavation of the materials onsite may require the use of a large dozer (D8 or larger) equipped with a single-shank ripper or a hydraulic ram. Utility installations that require deeper excavation may encounter more resistant material that will likely require blasting or other means to efficiently remove the rock.

3.4 Weathered Rock / Rock Excavation

Typically, material that can be augered through can be removed in large excavations by conventional grading equipment. Generally, materials exhibiting “N” values of 50 or less can excavated with conventional earth excavation equipment. Weathered rock exhibiting “N” values greater than 50 bpf can normally be removed by ripping in mass excavations. The hard soil and partially weathered rock (PWR) will likely require loosening with equipment such as a Caterpillar D8 or larger dozer equipped with a single tooth ripper or other means. Intact bedrock will likely require blasting to remove. In confined excavations such as for utilities or foundations, a hydraulic-ram or limited blasting may be required. It is our opinion that it would be reasonable to have the grading contractors bid the project based on **unclassified excavation**. Unclassified excavation is commonly used for bidding excavation work in rock units where there is gradual change from soil to partially weathered rock to intact bedrock.

If blasting is required during construction, it will be important to control blasting so that the rock below the established final grade is not fractured to a high degree. The over-break and disturbance of rock below the final grade can create voids and “fluffed up” rock that must be removed prior to foundation construction. Consequently, minimizing rock disturbance beneath structural areas will be an important item when resistant rock beds are excavated. Exercising strict elevation control when drilling the shot holes is the first step in controlling overblasting of rock below the final grade. We recommend that the grading specifications state that the contractor will be responsible for removing any over-blasted rock and replacing the disturbed rock with lean concrete or compacted engineered fill as appropriate. The grading contractor should recognize the stratified condition of the rock and the fact that resistant sandstone beds could be underlain by softer shale beds and thin clay seams, or vice versa. Also, because the rock is layered, it will tend to break in slab-like pieces.

Overblasting of rock on slope faces should also be controlled to minimize the need for corrective work. Any material that has been loosened or shattered by blasting should be removed to provide a reasonably uniform slope. We recommend that the grading specifications address contractor responsibility for removing any over-blasted rock and replacing the disturbed rock with lean concrete or compacted-engineered fill as appropriate. The rock beds in this geology are generally stratified (layered) and will be particularly prone to disturbance cause by overblasting.

3.5 Groundwater Management

Depending on the final site grades, the groundwater level could impact the excavation and construction of below grade structures. Temporary dewatering measures will be required. Typically, pumping from sumps can be used for temporary dewatering during construction. Well points may need to be installed temporarily if needed. We recommend that the contractor provide a dewatering plan prior to construction.



3.6 Time of Year Site Preparation Considerations

During periods of heavy rain, the near surface soils can become saturated and conditions of standing or ponding water at the ground surface can occur. The near-surface soils are deemed to be moisture sensitive and may lose their strength properties if exposed to excessive moisture. The time of the year that the sitework begins can affect the project considerably. In this area, the “wet season” is generally between the months of May and August, and the “dry season” from September to April. There are many considerations that need to be addressed prior to bidding a project that could affect the budget based on the time of year a project starts earthwork activities. The time of the year that the geotechnical borings were performed can provide a false sense of actual near surface conditions depending on the time of year and weather conditions. Below are considerations that should be addressed based on the time of the year earthwork is started.

“Wet” Season

During the wet season, the amount of undercutting may be greater, therefore resulting in greater excavation costs. The soils are typically proofrolled to determine their suitability for the placement of new fill or subgrade support. During the wet season, the surface soils have a higher moisture content and will tend to pump, therefore, hindering the placement of new fill. In addition, the drying time, time period between rain events, and temperature is not conducive to scarify soils, allow drying, and recompacting. At this time, the decision should be made to try either scarify/dry/compact the in-place soils, which could take time, or undercut and replace with suitable material, which could increase the sitework costs. Based on our experience, the amount of undercut could be 2 to 3 feet more (or greater in localized areas), whereas in drier weather, lesser amounts of undercutting may be necessary, if recompaction or stabilization of soils left in place can be achieved. Some undercut soils are not always “unsuitable” soil and can be moisture conditioned and reused as fill, if drying conditions are favorable.

The site contractor shall be responsible for maintaining a firm, unyielding and stable subgrade condition. Should the near surface soils become wet, the contractor should be prepared to mitigate these conditions by repeated aeration and exposure to sunlight or by admixture treatment.

“Dry” Season

During the dry season, the surface soils have a lower moisture content and will tend to “bridge” or “crust” softer underlying soils. They will generally allow the placement of new fill, but the crust can break down if repeated passes with heavily loaded equipment is persistent. In addition, new fill from cuts or other sources may need to be moisture conditioned prior to compaction. The soils can dry significantly, requiring the addition of water for proper compaction. Water trucks should be used, as required, by the contractor to condition the soils within the required specifications.

3.7 Fill Placement

Fill material beneath buildings/structures and pavements should meet the following characteristics:



Property	Requirement
Liquid Limit (LL) and Plasticity Index (PI)	LL < 50 and PI ≤ 25
Maximum Dry Density (ASTM D-698)	≥ 95 pcf
Maximum Particle Size	3 inches or less
Organic Matter	≤ 5%
Fill Loose Lift Thickness	8 inches or less (4 inches or less for walk-behind compaction equipment)

The following table summarizes the compacted fill requirements:

Location	Test Method	Compaction Required (minimum)	Moisture Content
Upper 18 inches below pavements	ASTM D698	98%	-3% to +3% of optimum moisture
Building Areas and 5 feet beyond perimeter	ASTM D698	98%	-3% to +3% of optimum moisture
All other areas	ASTM D698	95%	-3% to +3% of optimum moisture

On site soils classified as SM, SC-SM, and ML should be suitable for use as compacted fill. **Soils classified as fat clay (CH) or elastic silt (MH) should not be used as fill material under structures or roadways.** Any zones of debris or highly organic material should be segregated and not used beneath buildings or pavements. Samples of the proposed fill materials should be provided to the geotechnical engineer for testing and evaluation prior to placement. Density tests should be performed to document compaction and moisture content of any earthwork involving soils and other applicable materials. Density tests should be performed frequently, with a recommended minimum of one test per 5,000 square feet per lift of fill.

4.0 FOUNDATIONS

4.1 Shallow Foundations

Once structural information has been developed, we recommend that we be given the opportunity to review the recommendations for individual structures. If the site preparation recommendations in Section 3 are followed, the proposed structures can be supported on shallow foundations. The foundations should:

- Foundations may be sized using a net allowable soil bearing pressure of 2,000 pounds per square foot (psf).
- The foundations for the pump station, if founded below about EL 665 feet in the PWR, can be designed using a net allowable soil bearing pressure of 5,000 pounds per square foot (psf).
- Total settlements of foundations due to loads (up to 200 kips) are expected to be approximately 1 inch, with differential settlements of about ½-inch.



- Be founded a minimum of 24 inches below exterior adjacent grade in densified sands or newly placed fill (based on sitework recommendations).
- Even though computed footing dimensions may be less, column footings and continuous footings should have minimum dimensions of 24 inches and 18 inches, respectively. This allows for hand cleaning of materials disturbed during the excavation process and reduces the potential for punching shear failure.

The geotechnical engineer or his representative should observe all foundation excavations, prior to concrete placement. The engineer can provide geotechnical guidance to the owner's design team should any unforeseen foundation problems develop during construction. If any areas of foundation surfaces prove to be unsuitable, the foundation should be over-excavated.

The condition of the soils at the planned bearing elevations for each structure may vary, depending on the planned final subgrade elevation. If required by field conditions and directed by the geotechnical engineer, we recommend that an allowance be included in the budget to over-excavate footing excavations through existing loose soils where present. The over-excavated area can be backfilled with "lean" concrete, controlled low strength material (CLSM) with minimum 28-day strength of 1500 psi, or compacted well-graded crushed stone up to the planned foundation bearing depth.

Foundation concrete should be placed the same day they are excavated so that disturbance of the foundation bearing soils can be reduced. Foundation bearing surfaces should not be disturbed or left exposed during inclement weather. Saturation of the on-site soils can cause a loss of strength and increased compressibility. Excavations for footings should be hand cleaned to remove any loose soil or mud from the foundation bearing surface. If construction occurs during inclement weather and concreting is not possible immediately after excavation, we recommend that a thin layer (approximately 2 inches) of lean concrete or flowable fill be placed on the bearing surface for protection after we have observed and evaluated the exposed bearing surfaces.

4.2 Floor Slabs

Provided that the recommendations above are followed, we recommend a modulus of subgrade reaction, k_s , of 125 pounds per cubic inch (pci) be utilized in the design. We recommend that an effective vapor barrier should be used to reduce slab dampness due to soil moisture. We note that penetrations of the vapor barrier by construction staking and traffic should be kept to a minimum as they will greatly reduce the barrier effectiveness. We recommend that slabs be supported on a minimum of 4 inches of crushed aggregate or sand compacted to at least 95% of standard Proctor maximum dry density.

Slab subgrades are often disturbed between completion of grading and slab construction due to weather, footing, and utility line installation, and other construction activities. For this reason, we recommend that slab subgrades be evaluated by a Geotechnical Engineer prior to slab construction. This can be accomplished by proofrolling with heavy rubber-tired construction equipment. Areas determined by the Geotechnical Engineer to be unsatisfactory for slab support should be undercut to stable materials and replaced with properly compacted structural fill.

Care should be taken so that fines from the subgrade are not allowed to contaminate the granular layer. If fines do contaminate this layer, capillary rise and subsequent damage to moisture sensitive floor coverings could occur. On most projects, there is some time lag between initial grading and the time when the contractor is ready to place



concrete for the slab-on-grade. Inclement weather just prior to placement of concrete for the slab-on-grade can result in trapped water in the granular layer.

4.3 Seismic Site Classification

Subsurface information (SPT and soil classification) from the borings, published geologic information, and our experience was used to estimate the seismic site classification according to methods in the 2021 International Building Code. Based upon this information, we recommend a Seismic Class of D (Stiff Soil) for this site. Based on our understanding of the project, we have assumed a Risk Category of III. If the Risk Category is different, the values below may need to be revised. According to the ASCE 7/SEI 7-16 hazard standard information, the site has mapped 0.2 second spectral response acceleration (S_s) of approximately 0.357g and a mapped 1.0 second spectral response acceleration (S_1) of approximately 0.1g.

Using this information, Site Class D and Risk Category III, the site coefficients F_a and F_v have been determined to be 1.515 and 2.4, respectively. The design spectral response accelerations S_{D5} and S_{D1} were 0.36g and 0.16g, respectively.

4.4 Below Grade Walls

Below grade walls must be designed to resist the lateral earth pressures that will be induced by the weight of the backfill materials, hydrostatic pressures on the walls, and any adjacent slab or foundation surcharge loads exerted on the walls. It is recommended that the walls be supported as outlined above and backfilled with a free draining material such as crushed stone/gravel or clean sand (less than 10% passing a No. 200 sieve). **A drainage system should be provided near or at the base of the walls to collect and remove groundwater or seepage and to prevent buildup of hydrostatic pressures.**

Walls that support buildings or otherwise need to have little horizontal movement at the top should be designed for "at rest" earth pressure conditions. Walls that are free to deflect should be designed for "active" earth pressure conditions. The "passive" earth pressure state should be used for soils supporting the retaining structure, such as toe backfill.

Relatively free-draining crushed stone/gravel or sand should be used as backfill. Samples of all backfill material should be evaluated for use as backfill. The design values and recommendations presented above assume that the backfill behind the wall will be horizontal with no surcharge loads and that a permanent drainage system will be installed behind the retaining wall to prevent the development of hydrostatic pressures.

The fine-grained soils (CL, CH, ML, and MH) will not be acceptable to be used as backfill directly behind the walls.

Using a select material can significantly reduce the horizontal loads on the wall as well as improve the effectiveness of the wall drainage system. The noted backfill should extend from the wall and upward from the top of the footing on a line 30 degrees from the vertical.

The below requirements are for lift stations or structures that are not designed to withstand hydrostatic pressures up to the top of the structure. Structures that are designed to withstand hydrostatic pressures up to the ground surface should follow the requirements of Section 3.7 Fill Placement for material and compaction requirements. It is the responsibility of the Contractor to ensure safe excavations are maintained during construction.



The table below presents recommended values of earth pressure coefficients for the select backfill materials:

Soil Parameter	Backfill Type		
	SM, SC	SP, SW	GW, GP
Soil Unit Weight (pcf)	120	125	130
Buoyant unit Weight (pcf)	58	63	68
Angle of Internal Friction, Φ , deg	32	34	38
At rest Pressure Coefficient, K_o	0.47	0.44	0.38
Active Pressure Coefficient, K_a	0.31	0.28	0.24
Passive Pressure Coefficient, K_p	3.25	3.54	4.20
Coefficient of Friction, $\tan \Phi$	0.62	0.67	0.78
At-rest Equivalent Fluid Pressure, pcf (Above GWT, below GWT)	56	55	50
	89	90	88
Active Equivalent Fluid Pressure, pcf (Above GWT, below GWT)	37	35	31
	80	80	78
Passive Equivalent Fluid Pressure, pcf (Above GWT, below GWT)	391	442	546
	251	285	348

GWT - Ground Water Table

For analysis of sliding resistance of the base of the retaining walls, the ultimate coefficient of friction may be taken as 0.35 between concrete and firm soil.

Compaction of backfill behind walls should be performed by appropriate manual equipment. The wall should be properly braced and heavy equipment should not be allowed behind the wall. No equipment or construction loads should be allowed within 10 feet of retaining walls or half the distance of the freestanding wall-height. This will help prevent any surcharge loads from adding lateral earth pressures above that previously recommended to the retaining wall.

Below grade walls should be braced during any backfilling operations and monitored for movement. If the footing construction precedes the subgrade preparation, then the footings should either be embedded below the subgrade a sufficient distance to achieve the required horizontal component or the footing should include a shear key to prevent movement.

4.5 Backfilling of Utility Trenches

Backfilling of storm drain and utility trenches must be performed in a controlled manner to reduce settlement of the fill and cracking of overlying floor slabs and pavements. We recommend that utility trenches be backfilled with acceptable borrow or dense-graded crushed stone in 6-inch loose lifts compacted with mechanical piston tampers



to the project requirements. Should seepage occur in utility trenches, it may be necessary to “floor” the trench with dense-graded gravel. Open-graded crushed stone such as #57 can serve as a channel for seepage toward structures and therefore is not recommended for use as general utility trench backfill.

4.6 Slopes

We recommend that once the site grades have been established, any cut or fill slope should be evaluated for stability. Permanent cut and fill slopes should have a maximum slope orientation no steeper than 3(H):1(V). The recommended fill slope orientation is dependent on the fill being placed in accordance with the structural fill section of this report. If fill slopes will be placed above soft or loose soils, the slope stability should be evaluated to check whether geotextile reinforcement will be required to provide stable slopes. The slopes will experience erosion if runoff is not controlled. Runoff from above must be channeled to cross the slope in paved ditch sections or flumes and not allowed to flow down the face.

The foundation soils should be free of loose or compressive soils that can consolidate under the added load of the embankment. The Geotechnical Engineer or his designated representative should evaluate the suitability of exposed foundation soils.

Where a new embankment is placed against an existing steep slope (steeper than 5H:1V), the existing slope should be benched to provide good contact and prevent the formation of weak zones. The benching should commence at the toe of the proposed slopes and commence upwards as fill is placed. Inadequate benching could result in creep and perhaps slope failures. Benches should be at least 10 feet wide.

4.7 Subgrade Restoration

Typically, due to the movement of heavy equipment and weather conditions, the subgrade soil can become disturbed during construction. As a result, these soils have a tendency to lose shear strength and support capability. Therefore, additional effort on the Contractor's part will be required to reduce traffic and limit disturbance of soils. It is essential that the subgrade be restored to a properly compacted condition based on optimum moisture and density.

4.8 Drainage Considerations

Adequate drainage should be provided at the site to reduce possible increased moisture content of the foundation soils. We recommend that driveway areas, walkways, and the ground surface be sloped away from the structures on all sides. Roof drainage should be collected by gutters and downspouts and transmitted by pipe to the storm water drainage system or discharge a minimum of 5 feet away from the building.



5.0 REPORT LIMITATIONS

The recommendations submitted are based on the available soil information obtained by GMC and design details furnished by GMC for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, we should be notified immediately to determine if changes in the foundation, or other, recommendations are required. If GMC is not retained to perform these functions, GMC cannot be responsible for the impact of those conditions on the performance of the project.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans are more complete, the geotechnical engineer should be provided the opportunity to review the design plans to check that our engineering recommendations have been properly incorporated into the design documents. At that time, it may be necessary to submit supplementary recommendations.

We emphasize that this report was prepared for design and informational purposes only and may not be sufficient to prepare an accurate construction budget. Contractors reviewing this report should acknowledge that the information and recommendations contained herein are for design and informational purposes only. A more comprehensive exploration and testing program would be required to assist the contractor in preparing the final building pad preparation, grading, and foundation construction budgets. In no case should this report be utilized as a substitute for development of earthwork specifications.

The information contained in this report is not intended, nor is sufficient, to aid in the design of segmental or mechanically stabilized earth (MSE) retaining walls. Segmental or MSE wall designers and builders should not rely on this report and should perform independent analysis to determine all necessary soil characteristics for use in their wall design, including but not limited to, soil shear strengths, bearing capacities, global stability, etc.



APPENDIX

Figure 1 – Site Location Plan

Figure 2 – Site Geology Map

Figure 3 – USGS Site Map

Figure 4 – Boring Location Plan

Site Photographs

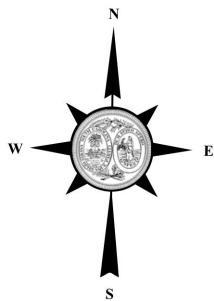
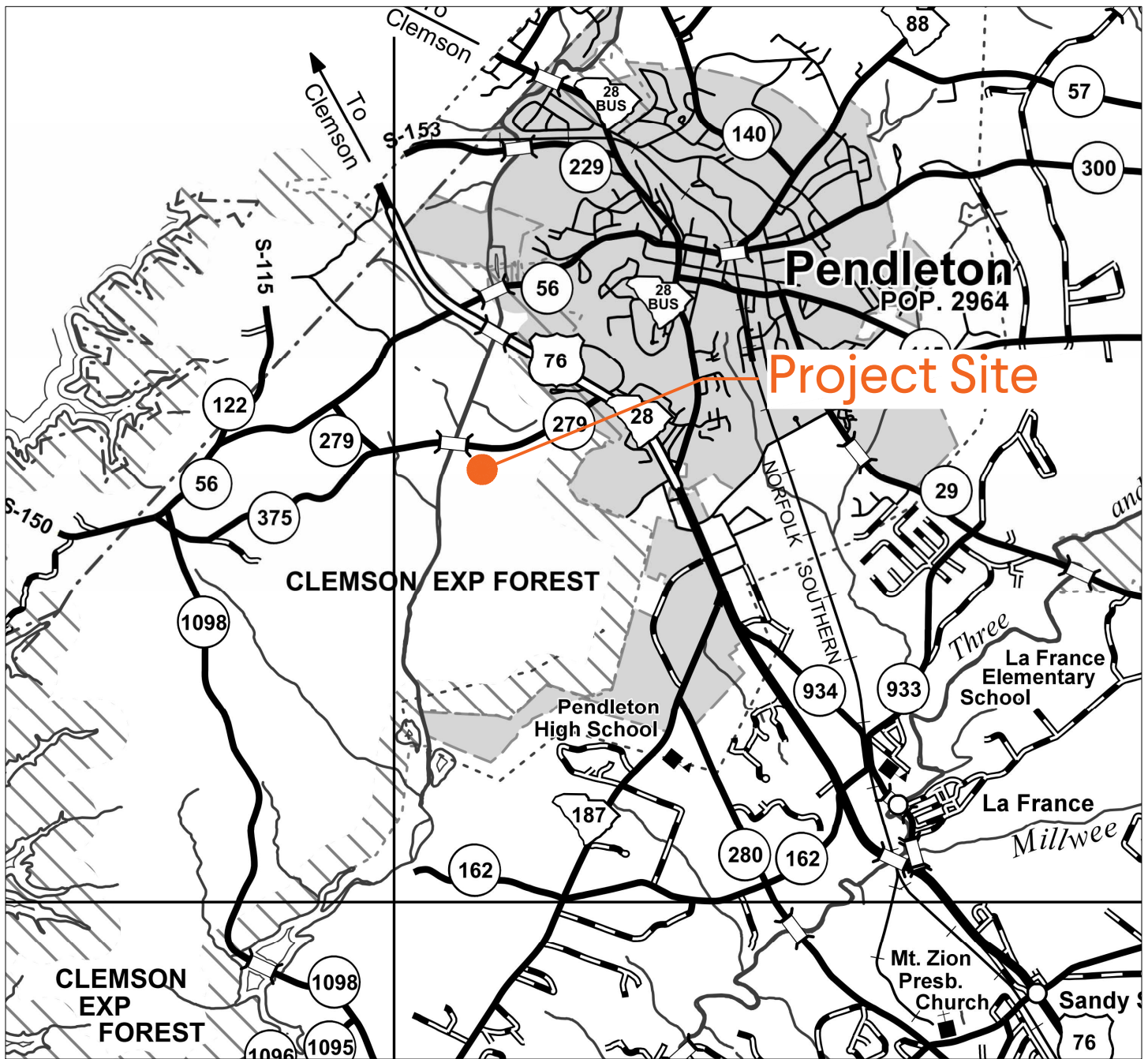
Soil Classification Chart

Subsurface Diagrams

Boring Records

Summary of Laboratory Results

Field and Laboratory Procedures



Reference: General Highway Map of Anderson County, SCDOT, 2015

Pendleton Clemson WWTP Expansion
Pendleton, South Carolina

Figure 1

SUPPLEMENTAL DRAWING

GMC # GGRE220008

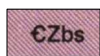
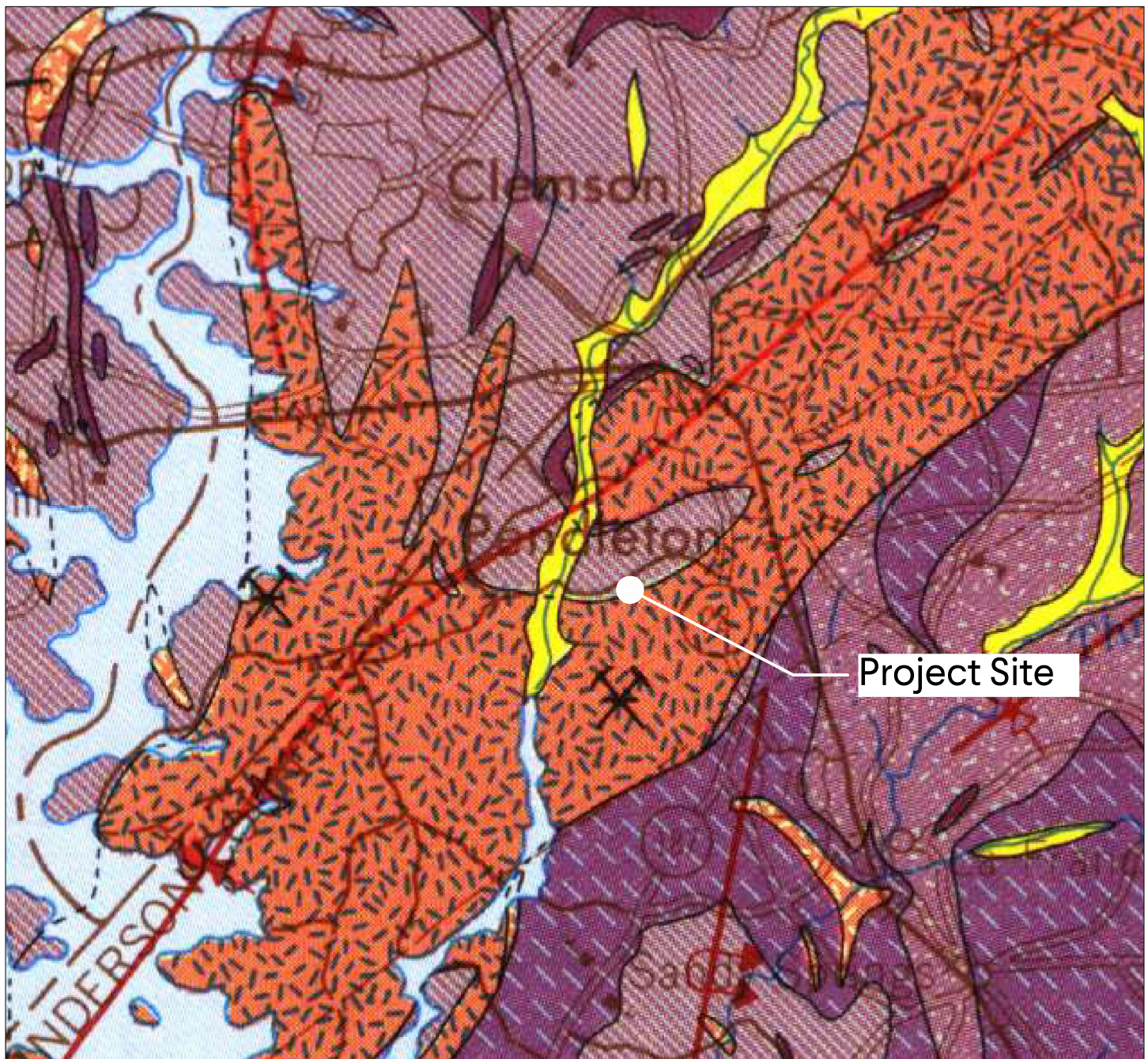
08/29/2022

DRAWN BY: MJL

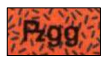
117 Wellborn Street
Greenville, SC 29601
T 864.527.0460
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GMC

Site Location Map



Biotite-Plagioclase-Quartz Gneiss Formation - Gray to dark gray, medium-grained, generally equigranular, thinly to thickly layered gneiss composed mostly of plagioclase, quartz, and biotite. Minor amounts of muscovite, microcline, garnet, sillimanite, and epidote-clinozoisite may be present.



Undifferentiated Granite Gneiss and Granodiorite Gneiss Formation - Light to medium-gray, fine to medium-grained, equigranular gneiss containing mostly plagioclase, quartz, biotite, and muscovite.

Reference: Arthur E. Nelson, J. Wright Horton, Jr., and James W. Clarke 1998, Geologic Map of Greenville Quadrangle, South Carolina, Georgia, and North Carolina

Pendleton Clemson WWTP Expansion
Pendleton, South Carolina

Figure 2

SUPPLEMENTAL DRAWING

GMC # GGRE220008

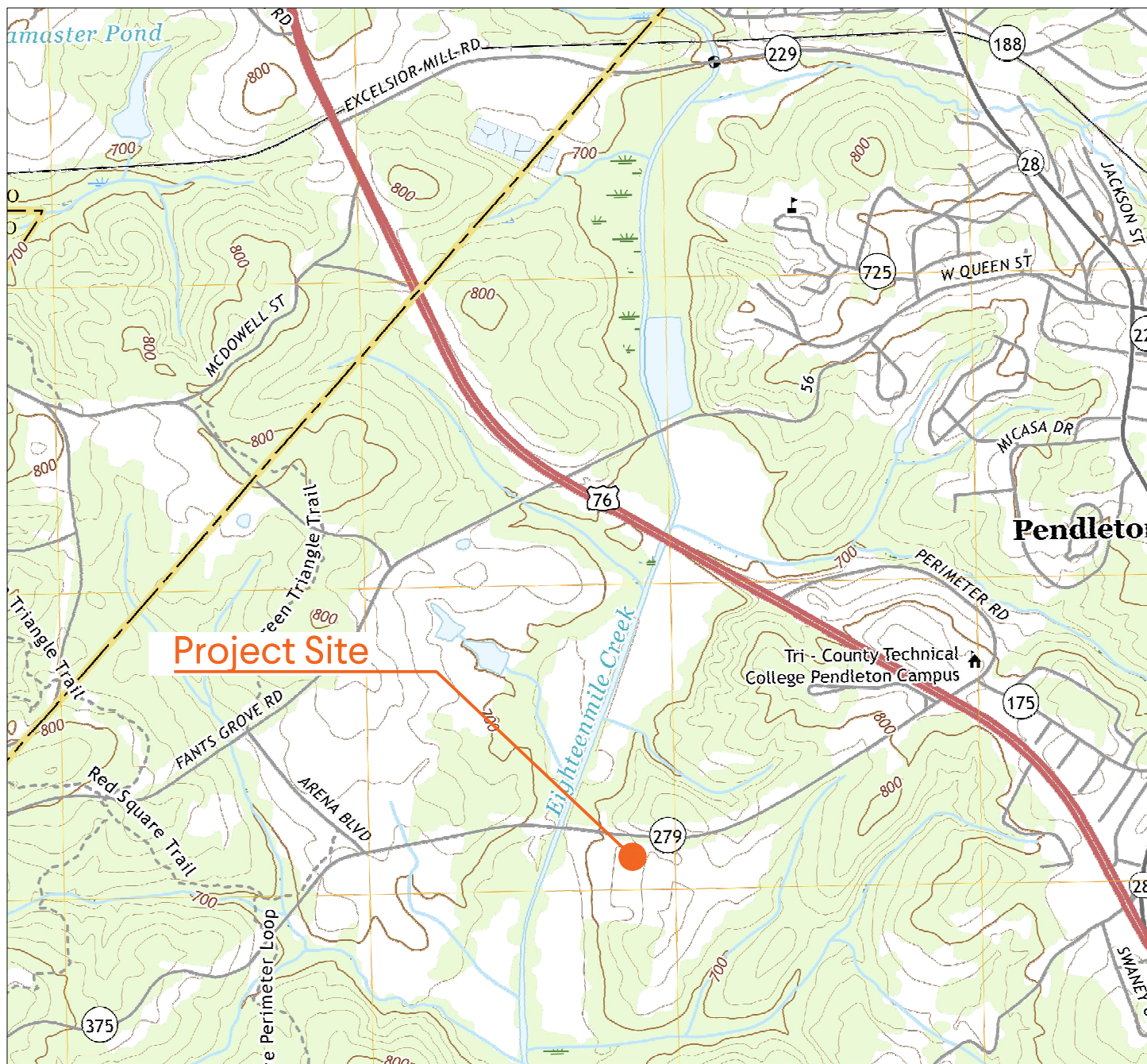
08/29/2022

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Site Geology Map



MN
 GN
 6°28'
 115 MILS
 1°2'
 18 MILS
 UTM GRID AND 2019 MAGNETIC NORTH
 DECLINATION AT CENTER OF SHEET



QUADRANGLE LOCATION

Reference: USGS Quadrangles 7.5 Minute Series (Topographic)

Pendleton Clemson WWTP Expansion
Pendleton, South Carolina

Clemson Quadrangle (2020)
USGS Site Map

Figure 3

SUPPLEMENTAL DRAWING

GMC # GMGM220008

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 Approximate Boring Location



Reference: GMC drawing adapted from Boring Site Plan and Google Earth Imagery dated June 14, 2022

Pendleton Clemson WWTP Expansion
Pendleton, South Carolina

Figure 4

SUPPLEMENTAL DRAWING

GMC # GGRE220008

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Boring Location Plan



Borings B-1-1 and B-2-2, View from N to S



Borings B-3-1, B-3-2, and B-3-3, View from E to W

REF. SHEET
DESCRIPTION:

SITE PHOTOGRAPHS

Pendleton-Clemson WWTP Expansion

GMC # GGRE220008
DATE: 9-26-2022
DRAWN BY:





Boring B-4-2, View from N to S



Boring B-5-1, View from E to W



Boring B-4-1
View from W to E

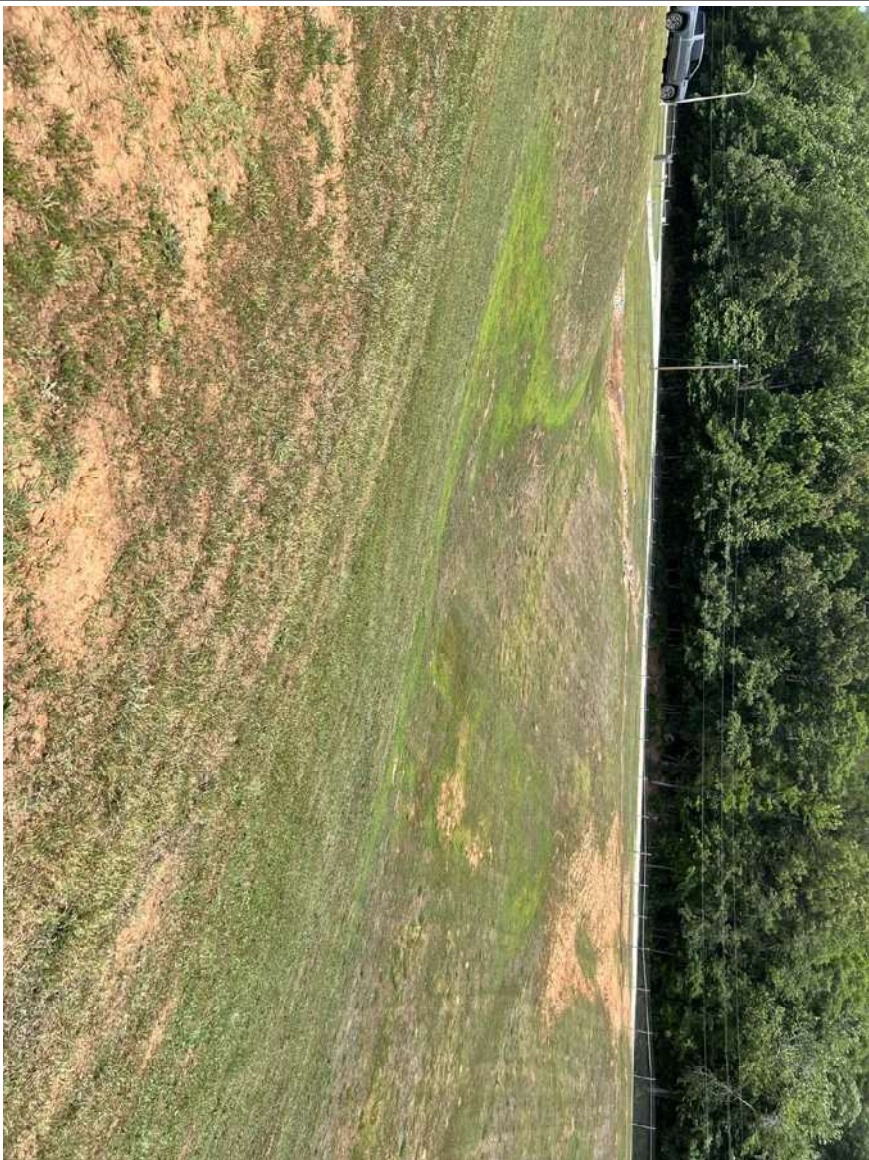
REF. SHEET
DESCRIPTION:

SITE PHOTOGRAPHS

Pendleton-Clemson WWTP Expansion

GMC # GGRE220008
DATE 9-26-2022
DRAWN BY,





Borings B-2-1 and B-2-3
View from S to N



Borings B-2-2 and B-2-4
View from E to W

REF. SHEET,
DESCRIPTION:

SITE PHOTOGRAPHS

Pendleton-Clemson WWTP Expansion

GMC # GGRE220008
DATE: 9-26-2022
DRAWN BY:





SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
				ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
				MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS



SUBSURFACE DIAGRAM
Influent Pump Station



TOPSOIL



SM

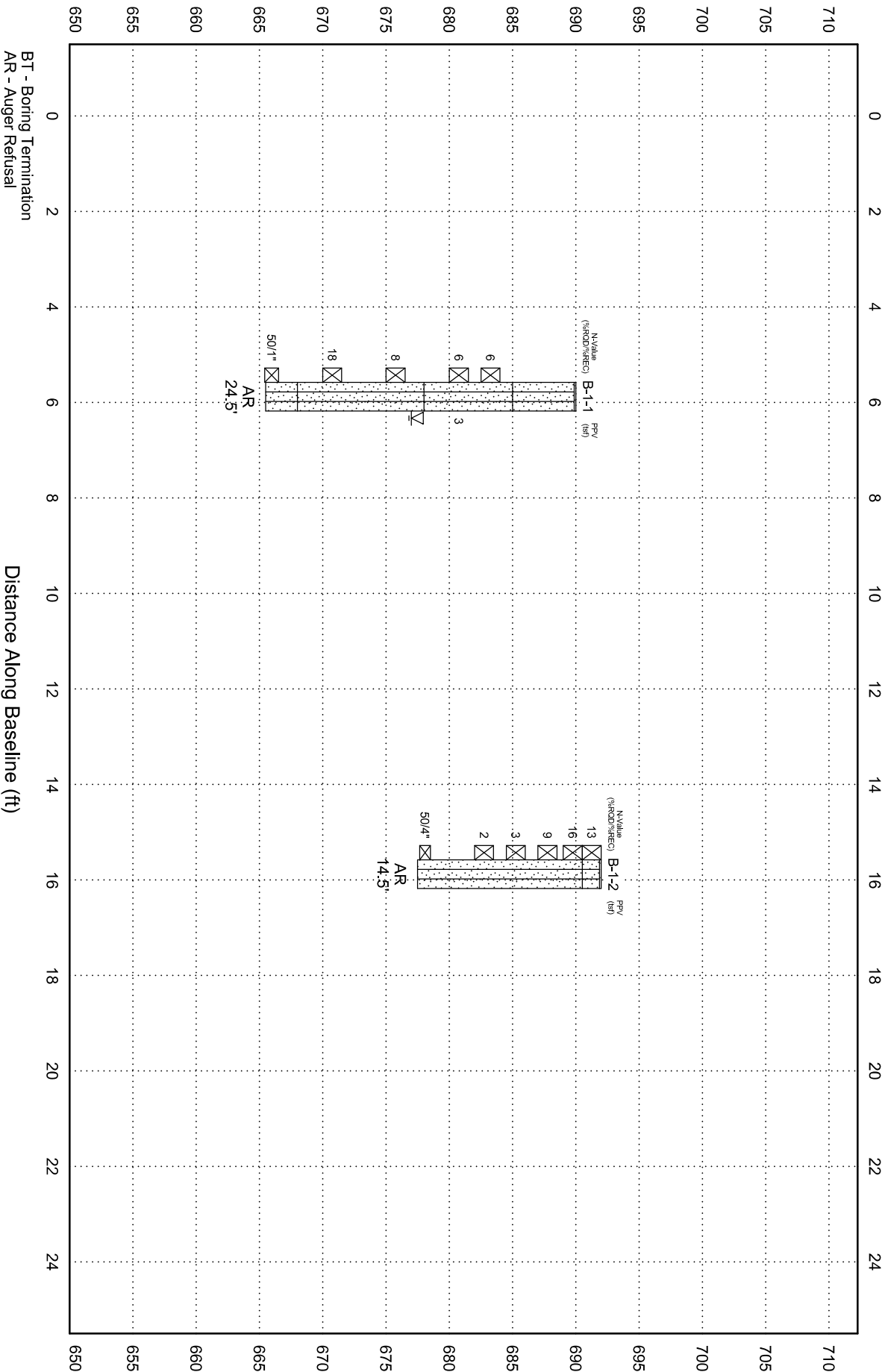
CLIENT Town of Pendleton

PROJECT NAME Pendleton Clemson WWTP Expansion

PROJECT NUMBER GGRE220008

PROJECT LOCATION Pendleton, South Carolina

Elevation (ft)





SUBSURFACE DIAGRAM
Aerobic Digester & Secondary Clarifiers

TOPSOIL

SM

ML

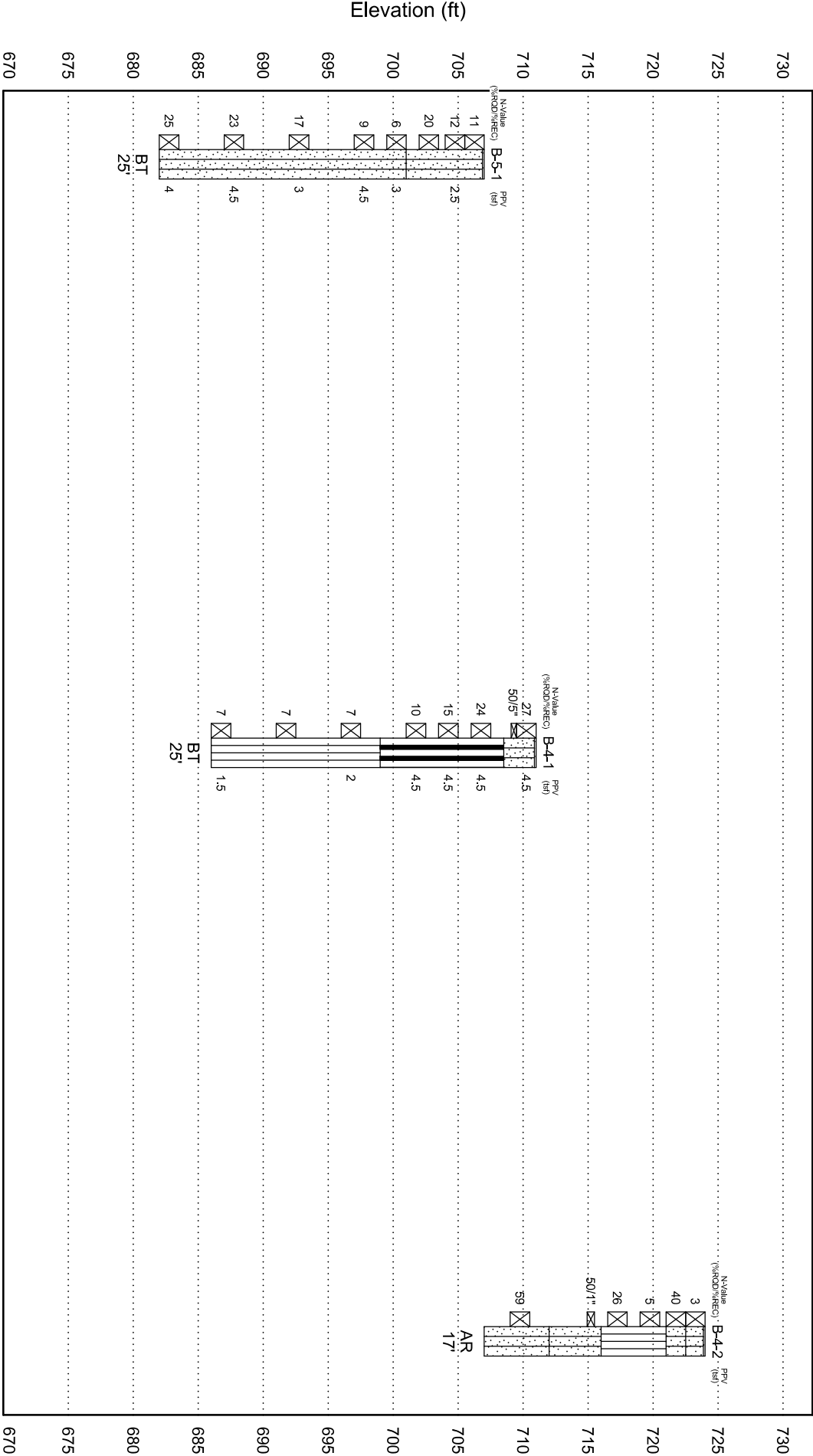
MH

CLIENT Town of Pendleton

PROJECT NAME Pendleton Clemson WWTP Expansion

PROJECT NUMBER GGRE220008

PROJECT LOCATION Pendleton, South Carolina



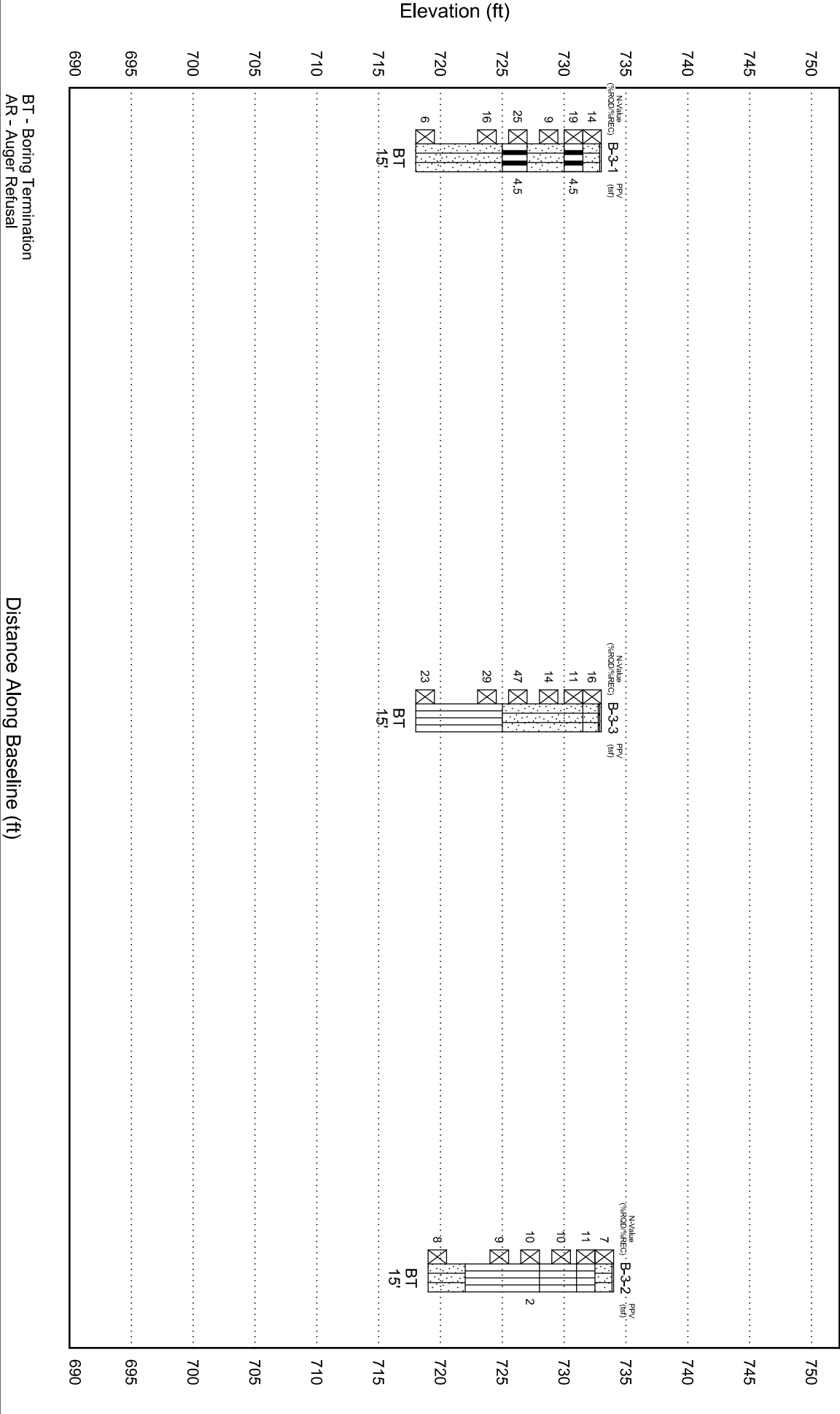
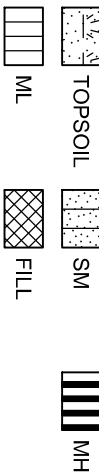
BT - Boring Termination
AR - Auger Refusal

Distance Along Baseline (ft)



SUBSURFACE DIAGRAM
Biological Units

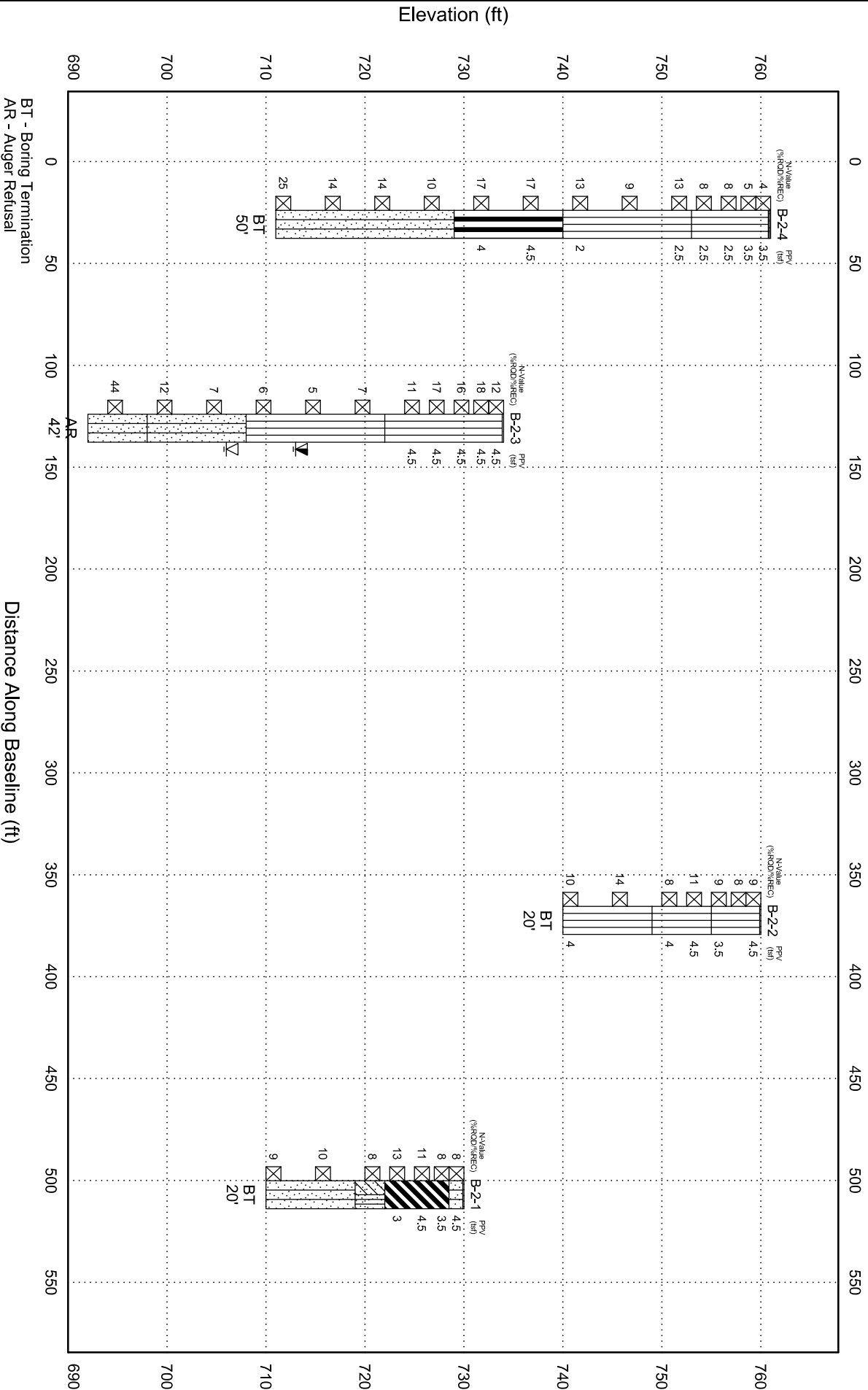
CLIENT Town of Pendleton
PROJECT NAME Pendleton Clemson WWTP Expansion
PROJECT NUMBER GGRE220008
PROJECT LOCATION Pendleton, South Carolina



			
MH	SC-SM	ML	FILL
			
TOPSOIL	SM	CH	

PROJECT NAME Pendleton Clemson WWTP Expansion

PROJECT LOCATION Pendleton, South Carolina



24hrs AFTER DRILLING Cave-In @ 18.5'

[illegible]

1.GMC BORINGS GGRE220008 PENDLETON CLEMSON WWTP EXPANSION.GPJ GMC DATA TEMPLATE.GDT 9/21/22



CLIENT Town of Pendleton

PROJECT NAME Pendleton Clemson WWTP Expansion

PROJECT NUMBER GGRE220008

PROJECT LOCATION Pendleton, South Carolina

DATE STARTED 7/26/22

COMPLETED 7/26/22

GROUND ELEVATION 692 ft

HOLE SIZE 2.25"

DRILLING CONTRACTOR Nicholson Exploration Services

GROUND WATER LEVELS:

DRILLING METHOD CME 550X, Auto-Hammer, HSA with SPT

AT TIME OF DRILLING None Encountered

LOGGED BY M. Lloyd

CHECKED BY K. Wales

AT END OF DRILLING ---

NOTES Elevations approximated from topographic survey

24hrs AFTER DRILLING Cave-In @ 8'

[illegible]

**BORING NUMBER B-2-1**

PAGE 1 OF 1

CLIENT Town of PendletonPROJECT NAME Pendleton Clemson WWTP ExpansionPROJECT NUMBER GGRE220008PROJECT LOCATION Pendleton, South CarolinaDATE STARTED 7/25/22COMPLETED 7/25/22GROUND ELEVATION 730 ftHOLE SIZE 2.25"DRILLING CONTRACTOR Nicholson Exploration Services

GROUND WATER LEVELS:

DRILLING METHOD CME 550X, Auto-Hammer, HSA with SPTAT TIME OF DRILLING None EncounteredLOGGED BY M. LloydCHECKED BY K. WalesAT END OF DRILLING ---NOTES Elevations approximated from topographic survey24hrs AFTER DRILLING Cave-In @ 13'

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
730	0		Organic Laden Material (OLM) - 1"	X SS		2-4-4 (8)	4.5		19				
			SILTY SAND (SM), red, loose	X SS		3-4-4 (8)	3.5		26				
			SANDY FAT CLAY (CH), red, medium to stiff										
725	5			X SS		7-4-7 (11)	4.5		24	52	27	25	68
				X SS		6-6-7 (13)	3		26				
720	10		SILTY CLAYEY SAND (SC-SM), red, loose	X SS		3-3-5 (8)							
			SILTY SAND (SM), gray, loose										
715	15			X SS		4-4-6 (10)							
710	20			X SS		3-3-6 (9)							
			Boring was terminated at 20.0 feet.										
705	25												
700	30												
695	35												

1.GMC BORINGS GGRE220008 PENDLETON CLEMSON WWTP EXPANSION.GPJ GMC DATA TEMPLATE.GDT 9/21/22

PROJECT NAME Pendleton Clemson WWTP Expansion

PROJECT LOCATION Pendleton, South Carolina

HOLE SIZE 2.25"

GROUND WATER LEVELS:

AT TIME OF DRILLING None Encountered

AT END OF DRILLING ---

24hrs AFTER DRILLING Cave-In @ 12'

[illegible]

**BORING NUMBER B-2-3**

PAGE 1 OF 2

CLIENT Town of PendletonPROJECT NAME Pendleton Clemson WWTP ExpansionPROJECT NUMBER GGRE220008PROJECT LOCATION Pendleton, South CarolinaDATE STARTED 7/25/22COMPLETED 7/25/22GROUND ELEVATION 734 ftHOLE SIZE 2.25"DRILLING CONTRACTOR Nicholson Exploration Services

GROUND WATER LEVELS:

DRILLING METHOD CME 550X, Auto-Hammer, HSA with SPT▽ AT TIME OF DRILLING 28.00 ft / Elev 706.00 ftLOGGED BY M. LloydCHECKED BY K. WalesAT END OF DRILLING ---NOTES Elevations approximated from topographic survey▽ 24hrs AFTER DRILLING 21.00 ft / Elev 713.00 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
	0												
			Organic Laden Material (OLM) - 1"	X SS		5-5-7 (12)	4.5						
			SANDY SILT (ML), red, very stiff to stiff	X SS		5-7-11 (18)	4.5						
730	5			X SS		9-7-9 (16)	4.5		22				
				X SS		7-7-10 (17)	4.5		28				
725	10			X SS		4-4-7 (11)	4.5						
			SILT WITH SAND (ML), red, white, gray, medium										
720	15			X SS		4-3-4 (7)			39	NP	NP	NP	79
715	20			X SS		2-3-2 (5)			44				
710	25			X SS		2-3-3 (6)			49				
			SILTY SAND (SM), gray, brown, loose to medium										
705	30			X SS		3-3-4 (7)			44	NP	NP	NP	34
700	35			X SS		3-3-9 (12)			44				

1.GMC BORINGS GGRE220008 PENDLETON CLEMSON WWTP EXPANSION.GPJ GMC DATA TEMPLATE.GDT 9/21/22

(Continued Next Page)

**BORING NUMBER B-2-4**

PAGE 1 OF 2

CLIENT Town of PendletonPROJECT NAME Pendleton Clemson WWTP ExpansionPROJECT NUMBER GGRE220008PROJECT LOCATION Pendleton, South CarolinaDATE STARTED 7/25/22COMPLETED 7/25/22GROUND ELEVATION 761 ftHOLE SIZE 2.25"DRILLING CONTRACTOR Nicholson Exploration Services

GROUND WATER LEVELS:

DRILLING METHOD CME 550X, Auto-Hammer, HSA with SPTAT TIME OF DRILLING None EncounteredLOGGED BY M. LloydCHECKED BY K. WalesAT END OF DRILLING ---NOTES Elevations approximated from topographic survey24hrs AFTER DRILLING Cave-In @ 32.5'

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
760	0		Organic Laden Material (OLM) - 1"	X SS		3-2-2 (4)	3.5						
			Aggregate Base - 1"	X SS		3-2-3 (5)	3.5						
			SANDY SILT (ML), red, brown, soft to medium - FILL	X SS		4-3-5 (8)	2.5						
755	5			X SS		4-3-5 (8)	2.5						
			SANDY SILT (ML), red, brown, stiff- FILL	X SS		5-6-7 (13)	2.5		29				
750	10			X SS		5-4-5 (9)			31				
745	15			X SS		4-5-8 (13)	2		29	NP	NP	NP	69
740	20		ELASTIC SILT with SAND (MH), red, very stiff	X SS		7-5-12 (17)	4.5		26	67	33	34	74
735	25			X SS		6-7-10 (17)	4						
730	30		SILTY SAND (SM), gray, loose to medium	X SS		3-3-7 (10)							
	35			X SS									

1.GMC BORINGS GGRE220008 PENDLETON CLEMSON WWTP EXPANSION.GPJ GMC DATA TEMPLATE.GDT 9/21/22

(Continued Next Page)

[illegible]

24hrs AFTER DRILLING Cave-In @ 9'

[illegible]

24hrs AFTER DRILLING Cave-In @ 8'

[illegible]

PROJECT NAME Pendleton Clemson WWTP Expansion

PROJECT LOCATION Pendleton, South Carolina

COMPLETED 7/26/22

HOLE SIZE 2.25"

DRILLING CONTRACTOR Nicholson Exploration Services

GROUND WATER LEVELS:

DRILLING METHOD CME 550X, Auto-Hammer, HSA with SPT

AT TIME OF DRILLING None Encountered

LOGGED BY M. Lloyd

CHECKED BY K. Wales

AT END OF DRILLING ---

NOTES Elevations approximated from topographic survey

24hrs AFTER DRILLING Cave-In @ 16.5'

[illegible]

24hrs AFTER DRILLING Cave-In @ 10'

[illegible]



BORING NUMBER B-5-1

PAGE 1 OF 1

CLIENT Town of Pendleton

PROJECT NAME Pendleton Clemson WWTP Expansion

PROJECT NUMBER GGRE220008

PROJECT LOCATION Pendleton, South Carolina

DATE STARTED 7/26/22

COMPLETED 7/26/22

GROUND ELEVATION 707 ft

HOLE SIZE 2.25"

DRILLING CONTRACTOR Nicholson Exploration Services

GROUND WATER LEVELS:

DRILLING METHOD CME 550X, Auto-Hammer, HSA with SPT

AT TIME OF DRILLING None Encountered

LOGGED BY M. Lloyd

CHECKED BY K. Wales

AT END OF DRILLING ---

NOTES Elevations approximated from topographic survey

24hrs AFTER DRILLING Cave-In @ 15.5'

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
	0												
705			Organic Laden Material (OLM) - 1"	X SS		5-5-6 (11)							
			SILTY SAND (SM), light brown, red, gray, medium	X SS		17-7-5 (12)	2.5						
5				X SS		16-14-6 (20)			12				
700			SILTY SAND (SM), red, loose to medium	X SS		4-3-3 (6)	3		21	48	29	19	49
10				X SS		3-3-6 (9)	4.5		22				
695													
15				X SS		5-7-10 (17)	3						
690													
20				X SS		6-9-14 (23)	4.5						
685													
25				X SS		10-10-15 (25)	4						
680			Boring was terminated at 25.0 feet.										
30													
675													
35													



SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 1

CLIENT Town of Pendleton

PROJECT NAME Pendleton Clemson WWTP Expansion

PROJECT NUMBER GGRE220008

PROJECT LOCATION Pendleton, South Carolina

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Max. Sieve Size Tested (mm)	%<#200 Sieve	Natural Moisture (%)	Classification	Opt. Moisture Content (%)	Max Dry Density (pcf)	Specific Gravity
B-1-2	1.5-3						11.2				
B-1-2	3.5-5						10.7				
B-1-2	6-7.5	NP	NP	NP	4.75	19	11.5	SM			
B-2-1	0-1.5						18.8				
B-2-1	1.5-3						25.5				
B-2-1	3.5-5	52	27	25	4.75	68	24.1	CH			
B-2-1	6-7.5						26.0				
B-2-2	1.5-3						29.5				
B-2-2	3.5-5						23.1				
B-2-2	6-7.5	NP	NP	NP	4.75	68	30.6	ML			
B-2-3	3.5-5						22.4				
B-2-3	6-7.5						27.8				
B-2-3	13.5-15	NP	NP	NP	4.75	79	38.8	ML			
B-2-3	18.5-20						43.7				
B-2-3	23.5-25						48.7				
B-2-3	28.5-30	NP	NP	NP	2.36	34	43.9	SM			
B-2-3	33.5-35						43.9				
B-2-4	8.5-10						29.3				
B-2-4	13.5-15						31.4				
B-2-4	18.5-20	NP	NP	NP	4.75	69	28.6	ML			
B-2-4	23.5-25	67	33	34	9.5	74	26.4	MH			
B-3-1	0-1.5						11.1				
B-3-1	1.5-3						18.5				
B-3-1	3.5-5						17.2				
B-3-1	6-7.5						24.2				
B-4-1	3.5-5	68	36	32	4.75	72	22.7	MH			
B-4-1	6-7.5						28.4				
B-4-1	13.5-15						21.4				
B-4-1	18.5-20	NP	NP	NP	4.75	56	33.2	ML			
B-5-1	3.5-5						11.7				
B-5-1	6-7.5	48	29	19	4.75	49	21.3	SM			
B-5-1	8.5-10						22.3				



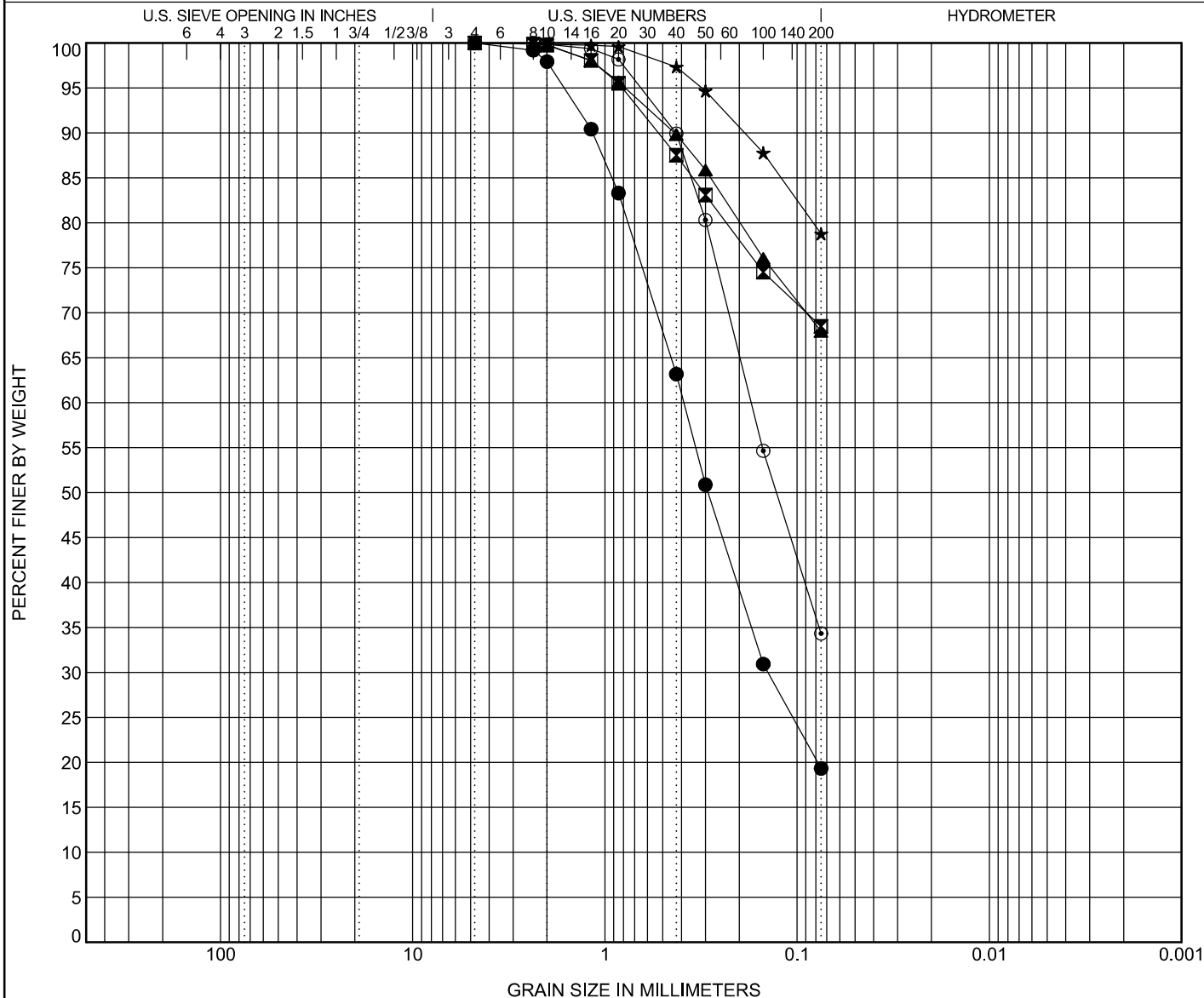
GRAIN SIZE DISTRIBUTION

CLIENT Town of Pendleton

PROJECT NAME Pendleton Clemson WWTP Expansion

PROJECT NUMBER GGRE220008

PROJECT LOCATION Pendleton, South Carolina



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification					LL	PL	PI	Cc	Cu
●	B-1-2	6.0-7.5	SILTY SAND(SM)					NP	NP	NP		
☒	B-2-1	3.5-5.0	SANDY FAT CLAY(CH)					52	27	25		
▲	B-2-2	6.0-7.5	SANDY SILT(ML)					NP	NP	NP		
★	B-2-3	13.5-15.0	SILT with SAND(ML)					NP	NP	NP		
⊙	B-2-3	28.5-30.0	SILTY SAND(SM)					NP	NP	NP		
Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
●	B-1-2	6.0-7.5	4.75	0.388	0.142		0.0	80.7	19.3			
☒	B-2-1	3.5-5.0	4.75				0.0	31.5	68.5			
▲	B-2-2	6.0-7.5	4.75				0.0	32.1	67.9			
★	B-2-3	13.5-15.0	4.75				0.0	21.2	78.8			
⊙	B-2-3	28.5-30.0	2.36	0.173			0.0	65.7	34.3			



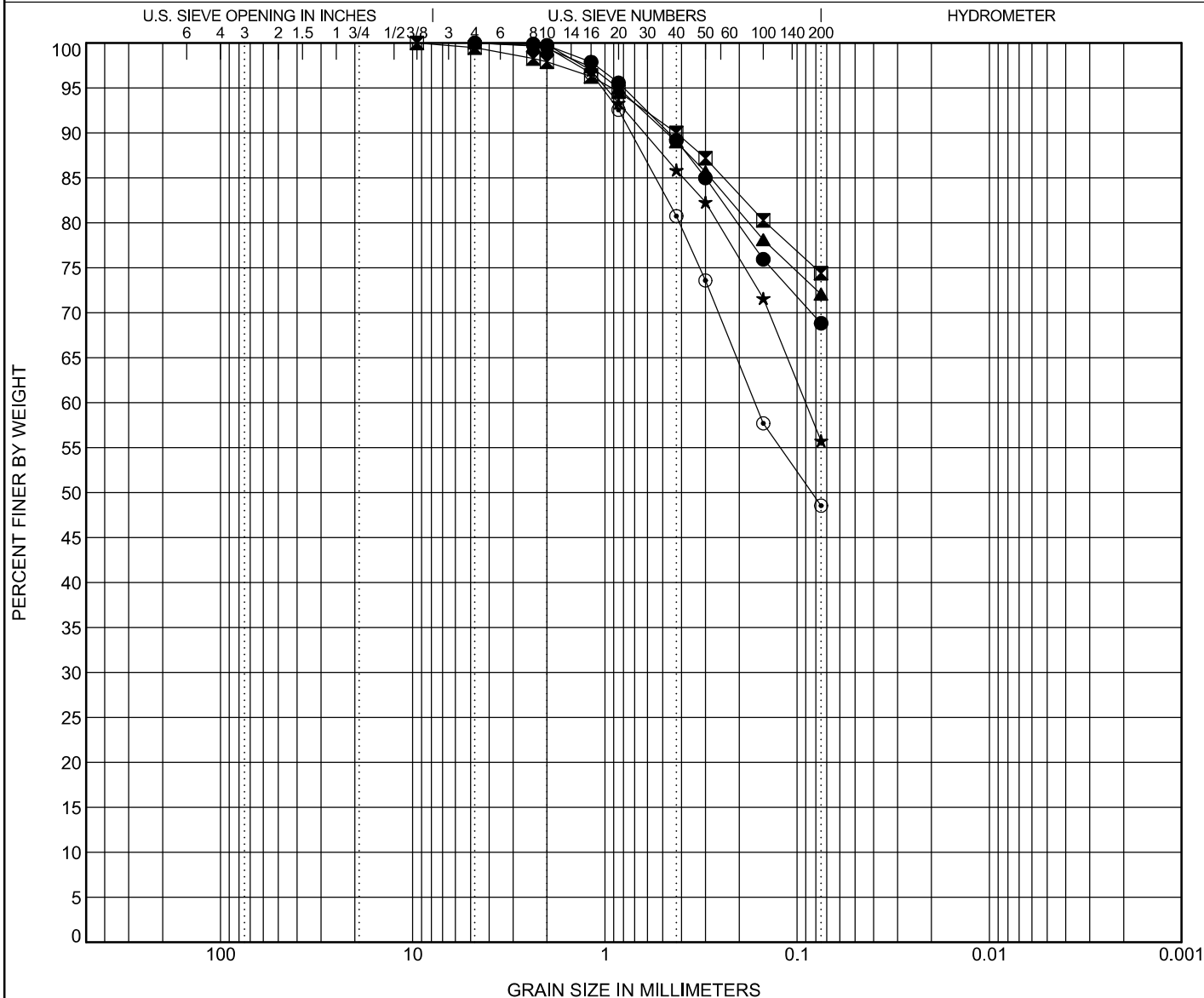
GRAIN SIZE DISTRIBUTION

CLIENT Town of Pendleton

PROJECT NAME Pendleton Clemson WWTP Expansion

PROJECT NUMBER GGRE220008

PROJECT LOCATION Pendleton, South Carolina



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification					LL	PL	PI	Cc	Cu
●	B-2-4	18.5-20.0	SANDY SILT(ML)					NP	NP	NP		
▣	B-2-4	23.5-25.0	ELASTIC SILT with SAND(MH)					67	33	34		
▲	B-4-1	3.5-5.0	ELASTIC SILT with SAND(MH)					68	36	32		
★	B-4-1	18.5-20.0	SANDY SILT(ML)					NP	NP	NP		
⊙	B-5-1	6.0-7.5	SILTY SAND(SM)					48	29	19		
Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
●	B-2-4	18.5-20.0	4.75				0.0	31.2	68.8			
▣	B-2-4	23.5-25.0	9.5				0.5	25.1	74.4			
▲	B-4-1	3.5-5.0	4.75				0.0	27.9	72.1			
★	B-4-1	18.5-20.0	4.75	0.09			0.0	44.2	55.8			
⊙	B-5-1	6.0-7.5	4.75	0.166			0.0	51.5	48.5			



FIELD TEST PROCEDURES

General

The general field procedures employed by Goodwyn Mills Cawood, LLC (GMC), are summarized in the American Society for Testing and Materials (ASTM) Standard D420 which is entitled "Investigating and Sampling Soil and Rock". This recommended practice lists recognized methods for determining soil and rock distribution and groundwater conditions. These methods include geophysical and in-situ methods as well as borings.

The detailed collection methods used during this exploration are presented in the following paragraphs.

Standard Drilling Techniques

General: To obtain subsurface samples, borings are drilled using one of several alternate techniques depending upon the subsurface conditions. These techniques are as follows:

In Soils:

- a) Continuous hollow stem augers.
- b) Rotary borings using roller cone bits or drag bits, and water or drilling mud to flush the hole.
- c) "Hand" augers.

In Rock:

- a) Core drilling with diamond-faced, double or triple tube core barrels.
- b) Core boring with roller cone bits.

Hollow Stem Auger: A hollow stem auger consists of a hollow steel tube with a continuous exterior spiral flange termed a flight. The auger is turned into the ground, returning the cuttings along the flights. The hollow center permits a variety of sampling and testing tools to be used without removing the auger.

Rotary Borings: Rotary drilling involves the use of roller cone or drag type drill bits attached to the end of drill rods. A flushing medium, normally water or bentonite slurry, is pumped through the rods to clear the cuttings from the bit face and flush them to the surface. Casing is sometimes set behind the advancing bit to prevent the hole from collapsing and to restrict the penetration of the drilling fluid into the surrounding soils. Cuttings returned to the surface by the drilling fluid are typically collected in a settling tank, to allow the fluid to be recirculated.

Hand Auger Boring: Hand auger borings are advanced by manually twisting a 4" diameter steel bucket auger into the ground and withdrawing it when filled to observe the sample collected. Posthole diggers are sometimes used in lieu of augers to obtain shallow soil samples. Occasionally these hand auger borings are used for driving 3-inch diameter steel tubes to obtain intact soil samples.

Core Drilling: Soil drilling methods are not normally capable of penetrating through hard cemented soil, weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound, continuous rock. Material that cannot be penetrated by auger or rotary soil-drilling methods at a reasonable rate is designated as "refusal material". Core drilling procedures are required to penetrate and sample refusal materials.

Prior to coring, casing may be set in the drilled hole through the overburden soils, to keep the hole from caving and to prevent excessive water loss. The refusal materials are then cored according to ASTM D2113 using a diamond studded bit fastened to the end of a hollow, double or triple tube core barrel. This device is rotated at high speeds, and the cuttings are brought to the surface by circulating water. Core samples of the material penetrated are protected and retained in the swivel-mounted inner tube. Upon completion of each drill run,



the core barrel is brought to the surface, the core recovery is measured, and the core is placed, in sequence, in boxes for storage and transported to our laboratory.

Sampling and Testing in Boreholes

General: Several techniques are used to obtain samples and data in soils; however, the most common methods in this area are:

- a) Standard Penetrating Testing
- b) Water Level Readings

These procedures are presented below. Any additional testing techniques employed during this exploration are contained in other sections of the Appendix.

Standard Penetration Testing: At regular intervals, the drilling tools are removed and soil samples obtained with a standard 2-inch diameter split tube sampler connected to an A or N-size rod. The sampler is first seated 6 inches to penetrate any loose cuttings, and then driven an additional 12 inches with blows of a 140-pound safety hammer falling 30 inches. Generally, the number of hammer blows required to drive the sampler the final 12 inches is designated the "penetration resistance" or "N" value, in blows per foot (bpf). The split barrel sampler is designed to retain the soil penetrated, so that it may be returned to the surface for observation. Representative portions of the soil samples obtained from each split barrel sample are placed in jars, sealed and transported to our laboratory.

The standard penetration test, when properly evaluated, provides an indication of the soil strength and compressibility. The tests are conducted according to ASTM Standard D1586. The depths and N-values of standard penetration tests are shown on the Boring Records. Split barrel samples are suitable for visual observation and classification tests but are not sufficiently intact for quantitative laboratory testing.

Water Level Readings: Water table readings are normally taken in the borings and are recorded on the Boring Records. In sandy soils, these readings indicate the approximate location of the hydrostatic water table at the time of our field exploration. In clayey soils, the rate of water seepage into the borings is low and it is generally not possible to establish the location of the hydrostatic water table through short-term water level readings. Also, fluctuation in the water table should be expected with variations in precipitation, surface run-off, evaporation, and other factors. For long-term monitoring of water levels, it is necessary to install piezometers.

The water levels reported on the Boring Records are determined by field crews immediately after the drilling tools are removed, and several hours after the borings are completed, if possible. The time lag is intended to permit stabilization of the groundwater table, which may have been disrupted by the drilling operation.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the cave-in zone. The cave-in depth is measured and recorded on the Boring Records.

Boring Records

The subsurface conditions encountered during drilling are reported on a field boring record prepared by the Driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of coarse gravel, cobbles, etc., and observations of ground water. It also contains the driller's interpretation of the soil conditions between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are kept on file in our office.

After the drilling is completed, a geotechnical professional classifies the soil samples and prepares the final Boring Records, which are the basis for all evaluations and recommendations. The following terms are taken



from ASTM D2487 or Deere's Technical Description of Rock Cores for Engineering Purposes, Rock Mechanical Engineering Geology 1, pp. 18-22.

Relative Density of Cohesionless Soils From Standard Penetration Test		Consistency of Cohesive Soils	
Very Loose	≤ 4 bpf	Very Soft	≤ 2 bpf
Loose	5 - 10 bpf	Soft	3 - 4 bpf
Medium	11 - 30 bpf	Medium	5 - 8 bpf
Dense	31 - 50 bpf	Stiff	9 - 15 bpf
Very Dense	> 50 bpf	Very Stiff	16 - 30 bpf
(bpf = blows per foot, ASTM D 1586)		Hard	> 30 bpf
Relative Hardness of Rock		Particle Size Identification	
Very Soft Rock disintegrates or easily compresses to touch; can be hard to very hard soil.		Boulders	Larger than 12"
Soft Rock may be broken with fingers.		Cobbles	3" - 12"
Moderately Soft Rock may be scratched with a nail, corners and edges may be broken with fingers.		Gravel	
Moderately Hard Rock a light blow of hammer is required to break samples.		Coarse	3/4" - 3"
Hard Rock a hard blow of hammer is required to break sample.		Fine	4.76mm - 3/4"
		Sand	
		Coarse	2.0 - 4.76 mm
		Medium	0.42 - 2.00 mm
		Fine	0.42 - 0.074 mm
		Fines (Silt or Clay)	Smaller than 0.074 mm
Rock Continuity		Relative Quality of Rocks	
RECOVERY = $\frac{\text{Total Length of Core}}{\text{Length of Core Run}} \times 100 \%$		RQD = $\frac{\text{Total core, counting only pieces } > 4" \text{ long}}{\text{Length of Core Run}} \times 100 \%$	
<u>Description</u>	<u>Core Recovery %</u>	<u>Description</u>	<u>RQD %</u>
Incompetent	Less than 40	Very Poor	0 - 25 %
Competent	40 - 70	Poor	25 - 50 %
Fairly Continuous	71 - 90	Fair	50 - 75 %
Continuous	91 - 100	Good	75 - 90 %
		Excellent	90 - 100 %



LABORATORY TESTING

GENERAL

The laboratory testing procedures employed by Goodwyn Mills Cawood, LLC (GMC) are in general accordance with ASTM standard methods and other applicable specifications.

Several test methods, described together with others in this Appendix, were used during the course of this exploration. The Laboratory Data Summary sheet indicates the specific tests performed.

SOIL CLASSIFICATION

Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply his past experience to current problems. In our investigations, samples obtained during drilling operations are examined in our laboratory and visually classified by an engineer. The soils are classified according to consistency (based on number of blows from standard penetration tests), color and texture. These classification descriptions are included on our "Boring Records".

The classification system discussed above is primarily qualitative and for detailed soil classification two laboratory tests are necessary; grain size tests and plasticity tests. Using these test results the soil can be classified according to the AASHTO or Unified Classification Systems (ASTM D-2487). Each of these classification systems and the in-place physical soil properties provides an index for estimating the soil's behavior. The soil classification and physical properties obtained are presented in this report.

POCKET PENETROMETER TEST

A pocket penetrometer test is performed by pressing the tip of a small, spring-loaded penetrometer with even pressure to a prescribed depth into a soil sample. This test yields a value for unconfined compressive strength, which may be correlated with unconfined compressive strengths obtained by other laboratory methods.

MOISTURE CONTENT

Moisture contents are determined from representative portions of the specimen. The soil is dried to a constant weight in an oven at 100° C and the loss of moisture during the drying process is measured. From this data, the moisture content is computed.

ATTERBERG LIMITS

Liquid Limit (LL), Plastic Limit (PL) and Shrinkage Limit (SL) tests are performed to aid in the classification of soils and to determine the plasticity and volume change characteristics of the materials. The Liquid Limit is the minimum moisture content at which a soil will flow as a heavy viscous fluid. The Plastic Limit is the minimum moisture content at which the soil behaves as a plastic material. The Shrinkage Limit is the moisture content below which no further volume change will take place with continued drying. The Plasticity Index (PI) is the numeric difference of Liquid Limit and Plastic Limit and indicates the range of moisture content over which a soil remains plastic. These tests are performed in accordance with ASTM D4318, D4943 and D427.

PARTICLE SIZE DISTRIBUTION

The distribution of soils coarser than the No. 200 (75-mm) sieve is determined by passing a representative specimen through a standard set of nested sieves. The weight of material retained on each sieve is determined and the percentage retained (or passing) is calculated.



BORING NUMBER A-1

PAGE 1 OF 1

CLIENT GMC	PROJECT NAME Pendleton Clemson WWTP Expansion
PROJECT NUMBER GGRE220008	PROJECT LOCATION Pendleton, South Carolina
DATE STARTED 10/18/23 COMPLETED 10/18/23	GROUND ELEVATION HOLE SIZE 4.25
DRILLING CONTRACTOR SAEDACCO	GROUND WATER LEVELS:
DRILLING METHOD CME 45, Auto-Hammer, HSA	AT TIME OF DRILLING Not Encountered
LOGGED BY S. Nickerson CHECKED BY K. Wales	AT END OF DRILLING ---
NOTES	AFTER DRILLING ---

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
	0		Organic Laden Material (OLM)- 6 inches										
			SILTY SAND (SM), reddish brown, very loose, with stone - FILL	SS		1-2-1 (3)							
	5			SS		2-2-1 (3)							
				SS		3-2-2 (4)							
	10		SILTY SAND (SM), reddish brown, loose to medium	SS		2-2-5 (7)							
	15			SS		5-5-6 (11)							
	20		POORLY GRADED SAND with SILT (SP-SM), brown, loose	SS		4-3-5 (8)							
	25		Boring was terminated at 20.0 feet.										



BORING NUMBER A-2

PAGE 1 OF 2

CLIENT GMCPROJECT NAME Pendleton Clemson WWTP ExpansionPROJECT NUMBER GGRE220008PROJECT LOCATION Pendleton, South CarolinaDATE STARTED 10/18/23 COMPLETED 10/18/23GROUND ELEVATION _____ HOLE SIZE 4.25DRILLING CONTRACTOR SAEDACCO

GROUND WATER LEVELS:

DRILLING METHOD CME 45, Auto-Hammer, HSAAT TIME OF DRILLING Not EncounteredLOGGED BY S. Nickerson CHECKED BY K. WalesAT END OF DRILLING ---

NOTES _____

AFTER DRILLING ---

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
	0		Organic Laden Material (OLM)- 6 inches SILT (ML), reddish brown, medium, with clay	X SS		2-4-4 (8)							
	5		SILTY SAND (SM), reddish brown, loose	X SS		3-3-4 (7)							
			POORLY GRADED SAND with SILT (SP-SM), reddish brown, loose to medium	X SS		3-2-3 (5)							
	10			X SS		2-3-2 (5)							
	15		, light brown and gray	X SS		2-3-5 (8)							
	20			X SS		4-9-13 (22)							
	25			X SS		8-8-10 (18)							

1.GMC BORINGS CLEMSON PENDLETON WWTP.GPJ GMC DATA TEMPLATE.GDT 10/25/23

(Continued Next Page)



BORING NUMBER A-2

PAGE 2 OF 2

CLIENT GMC

PROJECT NAME Pendleton Clemson WWTP Expansion

PROJECT NUMBER GGRE220008

PROJECT LOCATION Pendleton, South Carolina

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
	25		, light brown and gray (<i>continued</i>)										
	30		, wet	SS		5-10-16 (26)							
	35			SS		21-31-31 (62)							
	40		PARTIALLY WEATHERED ROCK (PWR) - Sampled as POORLY GRADED SAND with SILT (SP-SM), light brown and gray, very dense	SS		45-50/2"							
	45			SS		50/2"							
	50		Auger refusal was encountered at 47.0 feet.	SS		50/0"							



BORING NUMBER A-3

PAGE 1 OF 2

CLIENT GMC		PROJECT NAME Pendleton Clemson WWTP Expansion	
PROJECT NUMBER GGRE220008		PROJECT LOCATION Pendleton, South Carolina	
DATE STARTED 10/18/23		COMPLETED 10/18/23	
DRILLING CONTRACTOR SAEDACCO		GROUND ELEVATION _____ HOLE SIZE 4.25	
DRILLING METHOD CME 45, Auto-Hammer, HSA		GROUND WATER LEVELS:	
LOGGED BY S. Nickerson		AT TIME OF DRILLING Not Encountered	
CHECKED BY K. Wales		AT END OF DRILLING ---	
NOTES _____		AFTER DRILLING ---	

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
	0		Organic Laden Material (OLM)- 6 inches SILT (ML), reddish brown, medium to stiff, with clay										
				X SS		6-5-9 (14)							
				X SS		3-5-5 (10)							
	5												
			SILTY SAND (SM), reddish brown, loose	X SS		4-3-6 (9)							
				X SS		4-4-4 (8)							
	10												
			POORLY GRADED SAND with SILT (SP-SM), brown, very loose to dense	X SS		2-1-2 (3)							
	15												
			, gray	X SS		18-16-15 (31)							
	20												
			PARTIALLY WEATHERED ROCK (PWR) - Sampled as POORLY GRADED SAND with SILT (SP-SM), gray, very dense	X SS		34-50/2"							
	25												

1.GMC BORINGS CLEMSON PENDLETON WWTP.GPJ GMC DATA TEMPLATE.GDT 10/25/23

(Continued Next Page)



BORING NUMBER A-3

PAGE 2 OF 2

CLIENT GMC

PROJECT NAME Pendleton Clemson WWTP Expansion

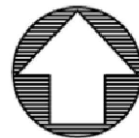
PROJECT NUMBER GGRE220008

PROJECT LOCATION Pendleton, South Carolina

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
	25		GNEISS										
				RC	53 (0)								
	30			RC	53 (0)								
				RC	40 (13)								
	35			RC	7 (0)								
	40			RC	78 (0)								
	45												
	50		Auger refusal was encountered at 50.0 feet.										



 Approximate Boring Location



Reference: GMC drawing adapted from Boring Site Plan and Google Earth Imagery dated June 14, 2022

Pendleton Clemson WWTP Expansion
Pendleton, South Carolina

Figure 4

SUPPLEMENTAL DRAWING

GMC # GGRE220008

08/29/2022

DRAWN BY: MJL

117 Wellborn Street
Greenville, SC 29601
T 864.527.0460
GMCNETWORK.COM

GMC

Boring Location Plan



CITY OF CLEMSON
AGENDA ITEM REQUEST FORM

Requested By:

Date Submitted:

Council Meeting Date:

Type of Request: (check only one)

☐ Report/Discussion

☒ Policy/Action

☐ Executive Session

Agenda Item Summary: (brief for public information and posted agenda)

Consider 2nd reading of an ordinance to amend City Ordinance Section 4-6 Cruelty to Animals. and Section 4-31 Outside shelter requirements for Dogs.

Agenda Item Detail: (expand as necessary for clarification)

Consider changes to the Animal Cruelty Ordinance to clarify sheltering standards and adding an ordinance to establish standards to shelter dogs outside during extreme weather conditions.

CODE OF ORDINANCES

CHAPTER 4 ANIMALS AND FOWL (1)

FOOTNOTE(S):

--- (1) ---

Cross reference—Health and sanitation, ch. 10; racing animals by rider or driver, § 18-26.

State Law reference—Municipal authority to enact ordinances for care and control of dogs, cats, and other animals, S.C. Code 1976, § 47-3-20.

ARTICLE I. IN GENERAL

Sec. 4-6. Cruelty to animals.

It shall be unlawful for any person to inflict cruelty upon any animal; or ride, drive or work such animal when the animal is sick or unfit for work; override, overwork, overload, or ride when overworked; torture, torment, or beat or whip cruelly any animal; and it shall be unlawful for any such person owning or having charge of any animal to fail to provide such animal with proper food, drink, shelter, or protection from the weather.

Proper shelter is a structure large enough for the animal to stand, turn around in, and lie in a normal manner. The structure must adequately protect the animal from rain, snow, standing water, and from harsh weather; at a minimum, it shall have a roof, four sides, a floor (not earth), and an opening for ingress and egress.

An owner or keeper of animals shall, at all times, maintain a clean shelter and living area, free of accumulated waste and debris so that the animal shall be free to walk or lie down without coming in contact with any waste or debris. In cold weather, the shelter shall have bedding. **Additional shelter requirements for dogs are contained in Section 4-31.**

Any person who is an owner, manager, resident, or user of property, or structure where an animal is maltreated based on these provisions and knows, should have known, or has reason to know, these acts or omissions are occurring and fails to notify law enforcement is in violation of this Section.

CODE OF ORDINANCES

CHAPTER 4 ANIMALS AND FOWL (1)

FOOTNOTE(S):

--- (1) ---

Cross reference—Health and sanitation, ch. 10; racing animals by rider or driver, § 18-26.

State Law reference—Municipal authority to enact ordinances for care and control of dogs, cats, and other animals, S.C. Code 1976, § 47-3-20.

ARTICLE II. DOGS; RABIES CONTROL

Sec. 4-31. Outside shelter requirements for Dogs.

In addition to the shelter requirements contained in Section 4-6, the following requirements must be met when a dog is kept outside for longer than 4 hours:

1. During weather with a temperature equal to or greater than 90 degrees Fahrenheit, there must be adequate shade for the dog to have relief from direct sunlight. If no shade is available, then the shelter must have adequate ventilation to prevent temperatures inside the shelter from rising above the ambient outside temperature.
2. During weather with a temperature equal to or lower than 32 degrees Fahrenheit, there must be a shelter that is constructed in such a manner as to prevent wind from passing through the shelter and bedding must be provided such that the bedding is capable of maintaining the dog's body heat.



CITY OF CLEMSON
AGENDA ITEM REQUEST FORM

Requested By:

Date Submitted:

Council Meeting Date:

Type of Request: (check only one)

☐ Report/Discussion

☒ Policy/Action

☐ Executive Session

Agenda Item Summary: (brief for public information and posted agenda)

Consider second reading of a supplemental bond ordinance for the issuance of water and sewer revenue bonds.

Agenda Item Detail: (expand as necessary for clarification)

These bonds will be issued to fund the expansion of the Pendleton/Clemson Wastewater Treatment Plant, an equipment purchase for an AMI system, and the replacement of pump stations 5 and 7 along with their connecting interceptor.

This treatment plant expansion will increase capacity at the Pendleton plant from 2MGD to 5MGD. The City of Clemson currently has 1MGD of the plants existing capacity and will obtain an additional 1MGD through the expansion.

The Guaranteed Maximum Price for the expansion came in at \$60,994,197.92. The City of Clemson will be responsible for 33.34% of the expansion cost. The project has received a \$9,400,000 SCIIP grant and an additional \$1,500,000 from the state in this years budget. The City's net share of the expansion project is \$16,701,406. Anderson County and the City of Clemson will need to reimburse the Town of Pendleton for design costs. The City's share of that expense is \$1,111,556, bringing the total City of Clemson cost to \$17,812,961.

The Advanced Metering Infrastructure (AMI) equipment will allow the City to read approximately 10,000 meters remotely. AMI is a two-way communication system to collect detailed metering information throughout the service area. The system will also provide advanced notice of excessive water use, allowing us to warn customers of a possible leak. The project cost is \$3,000,000.

The interceptor line between pump stations 5 and 7 is old, deteriorated, and undersized. This line and pump stations 5 and 7 are 44 years old and need to be replaced. This project will decrease the likelihood of sanitary sewer overflows that could cause significant environmental damage to Abernathy Park and Lake Hartwell. The project cost is \$8,500,000. The combined cost for these projects is \$29,312,961. The bond ordinance includes a not to exceed amount of \$30,000,000.

CITY OF CLEMSON, SOUTH CAROLINA

SEVENTH SUPPLEMENTAL ORDINANCE NO. CC-2024-__

AUTHORIZING AND PROVIDING FOR THE ISSUANCE OF WATER AND SEWER SYSTEM REVENUE BONDS OF THE CITY OF CLEMSON, SOUTH CAROLINA, SOUTH CAROLINA, IN ONE OR MORE SERIES, IN THE AGGREGATE PRINCIPAL AMOUNT OF NOT EXCEEDING \$30,500,000; AUTHORIZING THE MAYOR OR CITY ADMINISTRATOR TO DETERMINE CERTAIN MATTERS WITH RESPECT TO THE BONDS; PRESCRIBING THE FORM AND DETAILS OF THE BONDS; ESTABLISHING CERTAIN FUNDS AND ACCOUNTS IN CONNECTION WITH THE BONDS; PROVIDING FOR CERTAIN AMENDMENTS TO THE CITY'S GENERAL BOND ORDINANCE NO. CC-2005-16; AND OTHER MATTERS RELATING THERETO.

Enacted: July 15, 2024

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF CLEMSON, SOUTH CAROLINA, IN COUNCIL ASSEMBLED, AS FOLLOWS:

Section 1. Definitions. The terms in this Section 1 and all words and terms defined in General Bond Ordinance No. CC-2005-16 enacted by the City Council (the “Council”) of the City of Clemson, South Carolina (the “City”) on June 6, 2005 (except as herein otherwise expressly provided or unless the context otherwise requires), shall for all purposes of this Seventh Supplemental Ordinance have the respective meanings given to them in the General Bond Ordinance and in Section 1 hereof.

“2005A SRF Note” shall mean the \$3,457,000 original principal amount Promissory Note of the City, Series 2005A, dated June 17, 2005, outstanding as of the date hereof in the principal amount of \$1,626,747.

“2005B SRF Note” shall mean the \$561,226 original principal amount Promissory Note of the City, Series 2005B, dated May 1, 2006, outstanding as of the date hereof in the principal amount of \$247,296.

“2009 SRF Note” shall mean the not exceeding \$575,800 Promissory Note of the City, Series 2009, dated December 18, 2009, outstanding as of the date hereof in the principal amount of \$41,119.

“2014 SRF Note” shall mean the not exceeding \$1,570,000 Promissory Note of the City, Series 2014, dated September 29, 2014, outstanding as of the date hereof in the principal amount of \$648,513.

“2015 SRF Note” shall mean the not exceeding \$1,890,000 Promissory Note of the City, Series 2015, dated June 30, 2015, outstanding as of the date hereof in the principal amount of \$891,982.

“2024 Projects” shall mean any one or more of the following: (i) the acquisition of 1,000,000 gallons per day (“GPD”) of wastewater treatment capacity in the Pendleton/Clemson Wastewater Treatment Plant (the “Plant”) over and above the City’s current allocated wastewater treatment capacity in the Plant of 1,000,000 GPD), following the expansion of the wastewater treatment capacity of the Plant from 2,000,000 gallons per day to 5,000,000 gallons per day through a joint undertaking by the City, the Town of Pendleton and Anderson County (the “Expansion Project”); (ii) the acquisition of Advanced Metering Infrastructure (“AMI”) equipment, including the acquisition and installation of approximately 8,000 new AMI meters and MXU transmitters; (iii) replacement of deteriorated and undersized sewer trunks, installation of a new pump station #5 and a new pump station #7 in order to provide adequate capacity and redundancy; and (iv) any other improvements relating to the foregoing and such other improvements as the City may deem necessary or incidental to the System.

“Beneficial Owner” shall mean any purchaser who acquires beneficial ownership interest in any Initial Bond held by the Depository. In determining any Beneficial Owner, the City, Registrar and the Paying Agent may rely exclusively upon written representations made and information given to the City, the Registrar and the Paying Agent, as the case may be, by the Depository or its Participants with respect to any New Bonds held by the Depository or its Participants in which a beneficial ownership interest is claimed.

“Bond of 2020A” shall mean the \$7,000,000 original principal amount Water and Sewer System Revenue Bond, Series 2020A of the City, dated May 28, 2020, outstanding as of the date hereof in the principal amount of \$6,498,511.

"Bond of 2020B" shall mean the \$5,018,000 original principal amount Water and Sewer System Revenue Bond, Series 2020B of the City, dated May 28, 2020, outstanding as of the date hereof in the principal amount of \$4,658,476.

"Bond Purchase Agreement" shall mean one or more Bond Purchase Agreements or Purchase Contracts, if any, to be dated the date of execution and delivery thereof between the City and the Underwriter, related to the applicable Series of New Bonds.

"Book-Entry Form" or "Book-Entry System" shall mean with respect to the Initial Bonds, a form or system, as applicable, under which (a) the ownership of beneficial interests in the Initial Bonds may be transferred only through a book-entry and (b) physical bond certificates in fully registered form are registered only in the name of a Depository or its nominee as Holder, with the physical bond certificates "immobilized" in the custody of the Depository. The book-entry maintained by the Depository is the record that identifies the owners of participatory interests in the Initial Bonds, when subject to the Book-Entry System.

"Construction Fund" shall mean the fund or funds established pursuant to Section 11 hereof.

"Continuing Disclosure Certificate" shall have the meaning given that term in Section 14 hereof.

"Costs of Issuance Account" shall mean one or more accounts established pursuant to Section 11 hereof to defray the cost of all or a portion of the Costs of Issuance of the New Bonds.

"Credit Facility" shall mean one or more instruments provided by a Credit Facility Issuer, which may include a bond insurance policy, letter of credit, contract, agreement or similar credit facility meeting any applicable requirements of the Supplemental Ordinance pursuant to which such Series of Bonds is issued.

"Credit Facility Agreement" shall mean the agreement or agreements, if any, among the City, the Credit Facility Issuer, and any other necessary party relating to a Credit Facility.

"Credit Facility Issuer" shall mean, if a Credit Facility is in effect, the institution issuing the Credit Facility.

"Debt Service Payment Agreement" shall mean the Debt Service Payment Agreement by and among the City, the Town of Pendleton, South Carolina and Anderson County, South Carolina, dated November 12, 2009, in connection with a loan incurred by the Town of Pendleton for certain improvements to the Plant.

"Depository" shall mean any securities depository that is a "clearing corporation" within the meaning of the New York Uniform Commercial Code and a "clearing agency" registered pursuant to the provisions of Section 17A of the Securities Exchange Act of 1934, as amended, operating and maintaining, with its Participants or otherwise, a Book-Entry System to record ownership of beneficial interests in the Initial Bonds, and to effect transfers of the Initial Bonds, in Book-Entry Form, and includes and means initially The Depository Trust Company (a limited-purpose trust company), New York, New York.

"Fifth Supplemental Ordinance" shall mean Fifth Supplemental Ordinance No. CC-2015-18 of the City enacted on May 18, 2015, authorizing the issuance of the 2015 SRF Note.

"First Supplemental Ordinance" shall mean First Supplemental Ordinance No. CC-2005-17 of the City enacted on June 6, 2005, authorizing the issuance of the 2005A SRF Note.

“Fourth Supplemental Ordinance” shall mean Fourth Supplemental Ordinance No. CC-2014-08 of the City enacted on September 22, 2014, authorizing the issuance of the 2014 SRF Note.

“General Bond Ordinance” shall mean General Bond Ordinance No. CC-2005-16 duly enacted on June 6, 2005, providing for the issuance of Water and Sewer System Revenue Bonds.

“Initial Bonds” shall mean, if applicable, the New Bonds initially issued in Book-Entry Form as provided in Section 4 hereof.

“Interest Payment Date” shall mean June 1 and December 1 of each year commencing December 1, 2024, or such other dates (including such other commencement date) as determined by the City Administrator pursuant to Section 4 hereof.

“New Bonds” shall mean the City of Clemson, South Carolina, Water and Sewer System Revenue Bonds, issued in one or more series, with appropriate descriptive terminology, if necessary, and with an appropriate series designation, in the aggregate principal amount of not exceeding \$30,500,000 authorized to be issued hereunder.

“Parity Bonds” shall mean, collectively, the then Outstanding 2005A SRF Note, 2005B SRF Note, 2009 SRF Note, 2014 SRF Note, 2015 SRF Note, Bond of 2020A and Bond of 2020B.

“Participant” shall mean any bank, brokerage house or other financial institution for which, from time to time, the Depository effects book-entry transfers and pledges of securities deposited with the Depository.

“Paying Agent” shall mean U.S. Bank Trust Company, National Association, as Paying Agent for the New Bonds.

“Permitted Investments” shall mean, with respect to a Series Debt Service Reserve Fund established in connection with any Series of New Bonds for which a Credit Facility is in effect, and only for the time during which such Credit Facility is in effect, only such Permitted Investments, as defined in the General Bond Ordinance, as also qualify pursuant to the terms and conditions set forth in the applicable Credit Facility Agreement relating thereto.

“Principal Payment Date” shall have the meaning given to such term in Section 3(a).

“Purchaser” shall mean the respective original purchasers of such New Bonds that are issued on a private placement basis, and their successors or assignees.

“Registrar” shall mean U.S. Bank Trust Company, National Association, as Registrar for the New Bonds.

“Reserve Fund Instrument” shall mean any surety bond, insurance policy, letter of credit or other instrument provided to meet, in whole or in part, a Reserve Fund Requirement for a Debt Service Reserve Fund under the provisions of Section 6.8.A. of the General Bond Ordinance.

“Reserve Fund Instrument Agreement” shall mean the agreement or agreements, if any, among the City, the Reserve Fund Instrument Provider, and any other necessary party, relating to a Reserve Fund Instrument, if any.

“Reserve Fund Instrument Provider” shall mean, if a Reserve Fund Instrument is in effect, the institution providing the Reserve Fund Instrument.

“Rural Development” shall mean the United States Department of Agriculture, acting by and through Rural Development within the United States Department of Agriculture or any entity which lawfully succeeds to the rights and responsibilities of Rural Development with respect to the Series 2020 Bonds.

“Second Supplemental Ordinance” shall mean Second Supplemental Ordinance No. CC-2005-30 of the City enacted on September 12, 2005, authorizing the issuance of the 2005 SRF Note.

“Series Bond and Interest Redemption Fund” shall mean one or more Funds established pursuant to Section 7 hereof to (a) provide for the payment of the principal of and interest on the New Bonds related thereto; and (b) provide for the redemption (as applicable) of the New Bonds. Pursuant to Section 7, each Series Bond and Interest Redemption Fund shall be further identified or designated to relate to the specific Series of New Bonds issued hereunder.

“Series Capitalized Interest Account” shall mean one or more accounts, if any, within a respective Series Bond and Interest Redemption Fund, established pursuant to Section 7 hereof, to provide for the payment of all or a portion of the interest due and payable on the applicable Series of New Bonds.

“Series Costs of Issuance Account” shall mean one or more accounts, further identified or designated to relate to a specific Series of the New Bonds issued hereunder, established pursuant to Section 10 hereof to defray the cost of all or a portion of the Costs of Issuance of a Series of New Bonds.

“Series Debt Service Reserve Fund” shall mean one or more Funds, if any, established pursuant to Section 8 hereof to (a) to insure the timely payment of the principal and interest on applicable Series of New Bonds related thereto; and (b) to provide for the redemption of the applicable Series of New Bonds related thereto. Pursuant to Section 8, each Series Debt Service Reserve Fund shall be further identified or designated to relate to the specific Series of New Bonds issued hereunder.

“Series Reserve Fund Requirement” shall mean the amount, if any, established pursuant to Section 8 hereof, with respect to a specific Series of New Bonds issued hereunder.

“Seventh Supplemental Ordinance” shall mean this Seventh Supplemental Ordinance No. CC-2024-____ authorizing the issuance of the New Bonds.

“Sixth Supplemental Ordinance” shall mean Sixth Supplemental Ordinance No. CC-2020-06 enacted by the City Council on April 20, 2020, authorizing the Bond of 2020A and the Bond of 2020B.

“Third Supplemental Ordinance” shall mean Third Supplemental Ordinance No. CC-2009-13 of the City enacted on September 21, 2009, authorizing the issuance of the 2009 SRF Note.

“Underwriter” shall mean Wells Fargo Bank, National Association (operating under the trade name Wells Fargo Securities).

Section 2. Certain Findings and Determinations.

The City hereby finds and determines:

(a) The City is an incorporated municipality located in portions of Anderson County and Pickens County, South Carolina, and as such has all powers granted to municipalities by the Constitution and general laws of this State, including the power to possess and operate a water system and sewer system.

(b) The act permits the City to refinance any bonds and improve the System. This Seventh Supplemental Ordinance supplements the General Bond Ordinance, constitutes and is a "Supplemental Ordinance" within the meaning of such quoted term as defined and used in the General Bond Ordinance, and is enacted under and pursuant to the General Bond Ordinance.

(c) The New Bonds constitute and are "Bonds" within the meaning of the quoted word as defined and used in the General Bond Ordinance. Each of the 2024 Projects constitute and is a "Project" within the meaning of the quoted word as defined and used in the General Bond Ordinance

(d) The New Bonds, upon their issuance, will be payable on a parity with the Parity Bonds and any other Bonds hereafter issued by the City under the General Bond Ordinance, and will be secured equally and ratably by the lien, pledge, provisions and covenants of the General Bond Ordinance and entitled to the benefits thereof. The pledge of the Net Revenues for the payment of the Debt Service Payment Agreement is subordinate and inferior to the lien upon and pledge of the Net Revenues for the payment and security of the Parity Bonds and the Series 2020 Bonds.

(e) The City has determined that it is in the best interest of the City to undertake the 2024 Projects which will become part of the System.

(f) There does not exist an Event of Default, nor does there exist any condition which, after the passage of time or the giving of notice, or both, would constitute such Event of Default.

(g) The estimated Costs of Acquisition and Construction of the 2024 Projects (exclusive of Costs of Issuance) is approximately \$29,769,061, all or a portion of which will be financed with the proceeds of one or more Series of the New Bonds.

(h) The period of usefulness of the System is in excess of forty (40) years from the date hereof.

(i) Section 3.3 of the General Bond Ordinance provides that one or more Series of Bonds (exclusive of refunding Bonds) may be issued for such purposes as may be permitted by the Act upon compliance with certain provisions of the General Bond Ordinance for the purpose of paying all or a part of the Costs of Acquisition and Construction of one or more Projects.

(j) Bonds issued upon compliance with Section 3.2 and Section 3.3 or Section 3.4 of the General Bond Ordinance shall be issued on a parity with the pledge of and lien upon the Net Revenues of the System *inter sese*, but not with regard to the particular Debt Service Fund or Debt Service Reserve Fund created for the benefit of the Holders of the Bonds of such Series.

(k) In compliance with the provisions of Sections 3.2 and 3.3 of the General Bond Ordinance, the Council further finds and determines the following:

(1) The issuance of the New Bonds is authorized under and pursuant to an ordinance supplemental to the General Bond Ordinance as provided in Article III and Article IX of the General Bond Ordinance.

(2) Prior to the issuance of the New Bonds there shall be executed a certificate required by paragraph A, and a report required by paragraph C of Section 3.3 of the General Bond Ordinance.

(3) A portion of the proceeds of the New Bonds will be used for the purpose of defraying the Costs of Acquisition and Construction of a Project, i.e., the 2024 Projects.

(4) Pursuant to the authority granted in Section 4 hereof, the Mayor or City Administrator may determine whether to establish one or more Series Debt Service Reserve Funds (with appropriate Series designations) for the respective Series of New Bonds. Subject to Section 8 hereof, if a Series Debt Service Reserve Fund is established hereunder, it shall secure only the Series of New Bonds relating thereto, and the Series Reserve Fund Requirement (if any) will either be satisfied through the deposit of cash, the purchase of a Reserve Fund Instrument, or any combination thereof, for the benefit of the Holders of the applicable Series of New Bonds.

(l) The consent of Rural Development, as Holder of the Bond of 2020A and the Bond of 2020B, to the issuance of the New Bonds will be obtained prior to the issuance thereof.

(m) The New Bonds are being issued for the purposes of: (i) defraying the Costs of Acquisition and Construction of the 2024 Projects; (ii) funding the Series Debt Service Reserve Fund (if any) in an amount equal to the Series Reserve Fund Requirement through the deposit of cash, the purchase of a Reserve Fund Instrument, or any combination thereof; (iii) paying a portion of the interest coming due on one or more Series of New Bonds; and (iv) paying the Costs of Issuance of the Series of the New Bonds, including, if applicable, premiums due on any Credit Facility or Reserve Fund Instrument for any Series of New Bonds.

(n) It is necessary and in the best interest of the City to undertake the 2024 Projects, and to issue the New Bonds, in one or more series, in the aggregate principal amount of not exceeding \$30,500,000 in accordance with the Act, the General Bond Ordinance, and this Seventh Supplemental Ordinance for the purposes set forth above, which New Bonds shall be issued on a parity with the Parity Bonds and other Bonds issued by the City from time to time.

Section 3. Authorization of Bonds.

(a) There is hereby authorized to be issued one or more Series of Bonds designated "City of Clemson, South Carolina, Water and Sewer System Revenue Bonds, Series [2024] [or appropriate year and series designation]" (the "New Bonds"), in the aggregate principal amount of not exceeding \$30,500,000. The New Bonds may be issued in a year subsequent to calendar year 2024, and may be issued in one or more series. Accordingly, the New Bonds may have such other descriptive terms in its series designation as may be necessary to properly identify the applicable Series of New Bonds. The proceeds of the New Bonds shall be used for the purposes set forth in Section 2(m) hereof.

Unless otherwise determined by the Mayor or City Administrator pursuant to Section 4 hereof, the New Bonds shall mature on June 1 in each of the years (the "Principal Payment Dates") and in the principal amounts, and bear interest at the rates per annum (calculated on the basis of a 360-day year comprised of twelve 30-day months), as determined by the Mayor or City Administrator pursuant to Section 4 hereof.

(b) Such of the New Bonds as the Mayor or City Administrator shall determine pursuant to Section 4 hereof may be subject to mandatory redemption at a redemption price equal to the principal amount of the New Bonds to be redeemed, together with interest accrued from the date of redemption, in the years and in the amounts determined by the Mayor or City Administrator pursuant to Section 4 hereof.

At its option, to be exercised on or before the sixtieth (60th) day prior to any mandatory redemption date, the City may (i) deliver to the Trustee for cancellation New Bonds which are subject to mandatory redemption in any aggregate principal amount desired or (ii) receive a credit in respect of its mandatory redemption obligation for any such New Bonds which, prior to such date, have been purchased or redeemed (otherwise than through the operation of the mandatory redemption requirement) by the City and cancelled by the Trustee and not theretofore applied as a credit against any mandatory redemption obligation. Each Series 2024 Bond so delivered or previously purchased or redeemed shall be credited by the Trustee, at one hundred percent (100%) of the principal amount thereof, to the obligation of the City on those respective mandatory redemption obligations in chronological order or such other order as may be directed in writing by the City to the Trustee, and the principal amount of the New Bonds to be redeemed by operation of the mandatory redemption requirement shall be accordingly reduced.

(c) The Registrar, without further authorization or direction from the City, shall give notice of all mandatory redemptions within the time periods and in the manner specified in Article V of the General Bond Ordinance.

(d) The New Bonds shall be issued as fully registered Bonds, in the denominations of \$5,000 and integral multiples of \$5,000, or in such other denominations as the Mayor or City Administrator may determine pursuant to Section 4 hereof (including a single denomination for each separate Series of New Bonds in the event of a private placement of such New Bonds); and shall be payable on each Interest Payment Date.

(e) Principal of and redemption premium, if any, on the New Bonds shall be payable at the designated corporate trust office of the Paying Agent. Interest on the New Bonds shall be payable on each Interest Payment Date, in each case to the Holders as of the immediately preceding Record Date, such interest to be paid by the Paying Agent by check or draft mailed to each Holder at the address as it appears on the Books of Registry maintained at the designated corporate trust office of the Registrar or, in the case of a Holder of \$1,000,000 or more in principal amount of New Bonds, by wire transfer to an account within the continental United States upon the timely receipt of a written request of such Holder. Except as otherwise provided in the New Bonds, payment of the principal of and interest on such New Bonds may be payable to the Holder thereof without presentation and surrender of such New Bonds; provided, the Paying Agent assumes no liability to any person in the event that the Holder should fail to return such New Bonds to the Paying Agent after final payment, and no obligation will be imposed upon the Paying Agent to seek the return of such New Bonds from the Holder thereof.

(f) In the event one or more Series of New Bonds are sold to a Purchaser pursuant to a private placement transaction, to the extent agreed to by the applicable Purchaser, the New Bonds may be sold or transferred by the initial Purchaser only to purchasers ("Qualified Investors") who execute an investment letter delivered to the City, in form satisfactory to the City (the "Investment Letter"), containing certain

representations, warranties and covenants as to the suitability of such purchasers to purchase and hold the New Bonds to be transferred. Such restriction shall be set forth on the face of the New Bonds and shall be complied with by each transferee of the New Bonds.

(g) The New Bonds shall be in substantially the form set forth in Exhibit A hereto, with such necessary or appropriate variations, omissions and insertions as are incidental to the issuance of a Series of Bonds or as are otherwise permitted or required by law or by the General Bond Ordinance, including this Seventh Supplemental Ordinance, including, but not limited to, any variations, omissions and insertions made as a result of a determination that such Series of New Bonds shall not be issued pursuant to a Book-Entry System, or any other determination of the Mayor or City Administrator in accordance with the authority granted herein. The New Bonds shall be executed in the name and on behalf of the City by the manual or facsimile signatures of the Mayor (or in his or her absence, the Mayor Pro Tempore) and the Municipal Clerk.

(h) A copy of the approving opinion to be rendered on a Series of New Bonds may be attached to each such Bond. If so attached, preceding the same, a certificate shall appear which shall be signed on behalf of the City by a manual or facsimile signature of the Municipal Clerk of the City. Such certificate shall be in the form substantially as follows:

IT IS HEREBY CERTIFIED that the following is a true and correct copy of the approving opinion of Burr & Forman LLP, Greenville, South Carolina, the original of which was manually executed, dated and issued as of the date of the delivery of and payment for the bonds, and a copy of which is on file with the City of Clemson, South Carolina.

CITY OF CLEMSON, SOUTH CAROLINA

By: _____
Municipal Clerk

(i) In the event a Credit Facility is purchased with respect to a Series of New Bonds, a “statement of insurance” or similar provision may be attached to each applicable Series of New Bonds in the form provided in the applicable Credit Facility Agreement.

Section 4. Sale and Issuance of New Bonds; Authority of the Mayor or City Administrator.

(a) Without further authorization, the Council hereby authorizes and directs the Mayor or City Administrator to:

(i) determine the respective sale date, original issue date and date of delivery for each Series of the New Bonds;

(ii) determine whether to issue the New Bonds in one or more series, and determine the particular 2024 Projects to be financed with the proceeds of each such series of New Bonds;

(iii) determine the aggregate principal amounts and authorized denominations of each Series of New Bonds;

(iv) determine the principal repayment schedule for the applicable New Bonds and the Principal Payment Dates of the applicable New Bonds if different from that set forth herein;

(v) determine the interest rates, Interest Payment Dates and initial Interest Payment Date for the applicable New Bonds if different from that set forth herein;

(vi) determine the optional and mandatory redemption terms for the applicable New Bonds, and determine whether all or a portion of a Series of New Bonds shall be issued as Term Bonds and, if so, the principal amounts and maturity dates of the New Bonds subject to mandatory sinking fund redemption;

(vii) determine whether a Series Debt Service Reserve Fund will be established and funded with respect to each respective Series of New Bonds and, if so, the amount of the Series Reserve Fund Requirement and the manner and timing of which the Series Reserve Fund Requirement will be satisfied (including, but not limited to, whether to purchase a Reserve Fund Instrument);

(viii) determine whether a Credit Facility or a Reserve Fund Instrument, or both, will be purchased with respect to the respective Series of New Bonds;

(ix) determine whether a portion of the proceeds of a Series of New Bonds shall be used to pay a portion of the interest due and payable on such Series of New Bonds;

(x) determine the manner of sale of the applicable Series of New Bonds (i.e., whether such New Bonds shall be sold through a private placement transaction with a bank or other financial institution, or sold to the Underwriter pursuant to one or more Bond Purchase Agreements), and determine whether the Book-Entry System of transfer will apply to such New Bonds;

(xi) in the event a Series of New Bonds is not sold to the Underwriter:

1. negotiate the sale of the applicable Series of New Bonds with one or more prospective Purchasers on such terms as the Mayor or City Administrator may determine to be most advantageous to the City, or, in the alternative, approve the forms of one or more Requests for Proposals with respect to the applicable New Bonds and the distribution of such Requests for Proposals to various banks and other financial institutions in the City and other areas as the Chief Financial Officer of the City determines;

2. determine the dates and times for receipt of bids under the applicable Request for Proposals;

3. award the sale of the applicable New Bonds to the bidder or bidders providing the most advantageous proposals therefor in accordance with the terms of the applicable Request for Proposals, or reject all bids and negotiate the sale of the applicable Series of New Bonds directly with one or more prospective Purchasers (without regard to whether such prospective Purchasers submitted proposals in response to a Request for Proposals) and award the sale of the applicable Series of New Bonds to one or more Purchasers on such terms as the Mayor or City Administrator may determine to be most advantageous to the City;

(xii) in the event a Series of New Bonds is sold to the Underwriter:

1. determine the date and time of sales of the respective New Bonds and the interest rates for each Series of 2024 Bonds;

2. approve any original issue discount or original issue premium at which each Series of New Bonds will be sold, or whether any Underwriter's discount or other fee will be paid to the purchasers of such Series of New Bonds;

3. enter into, on behalf of the City, one or more Bond Purchase Agreements to be dated the date of their execution. Upon the submission of any such Bond Purchase Agreement by the Underwriter, the Mayor or City Administrator shall further determine that the Bond Purchase Agreement is fair and reasonable and in the best interest of the City; that the applicable Series of New Bonds shall be sold to the Underwriter upon the terms and conditions set forth in such Bond Purchase Agreement and upon the basis of the representations therein set forth, and that all conditions precedent to or concurrent with the acceptance of the Bond Purchase Agreement have been met. The Mayor or City Administrator is authorized and directed to execute such Bond Purchase Agreement, and deliver such executed Bond Purchase Agreement to the Underwriter, the execution and delivery of the Bond Purchase Agreement constituting conclusive evidence of the Mayor's or City Administrator's approval of the matters therein contained;

4. negotiate and approve one or more Preliminary Official Statements relating to one or more Series of New Bonds. The Mayor or City Administrator is hereby authorized to "deem final" the Preliminary Official Statement for purposes of complying with the requirements set forth in Rule 15c2-12 of the Securities and Exchange Commission promulgated under the Securities Exchange Act of 1934, as amended;

5. approve a final Official Statement of the City to be dated of even date with the execution and delivery of the applicable Bond Purchase Agreement relating to the Series of New Bonds substantially in the form of the Preliminary Official Statement, with such modifications as the Mayor or City Administrator may approve. The Mayor or City Administrator is hereby authorized and directed to execute copies of the final Official Statement and deliver the same to the Underwriter, which execution and delivery shall be conclusive evidence of the approval of any such modifications; and the City hereby authorizes the use of the Preliminary Official Statement, the final Official Statement, the General Bond Ordinance, this Seventh Supplemental Ordinance, and the information contained herein and therein in connection with the public offering and sale of a Series of New Bonds by the Underwriter;

(xiii) negotiate the terms of, execute in the name and on behalf of the City, and deliver any escrow agreements, investment agreements, forward delivery agreements, repurchase agreements, guaranteed investment contracts, Credit Facility Agreements, Reserve Fund Instrument Agreements, letters of credit, surety bonds, and any other agreements (including agreements relating to any credit enhancement) in connection with each Series of New Bonds, to prepare and solicit bids for providers of such agreements and to execute, in the name and on behalf of the City, written confirmations of any such agreements and other documents as may be necessary in connection therewith;

(xiv) determine whether any Series of New Bonds shall be issued on a federal tax-exempt basis and, if issued on a federal tax-exempt basis, whether any Series of New Bonds shall be designated as a "qualified tax-exempt obligation" under Section 265(b)(3) of the Code; and

(xv) agree to any other covenants, terms, provisions and matters necessary or advisable to effect the issuance of the New Bonds, including such terms as may be requested by the respective Purchasers.

In the event any of the foregoing items (i) through (xv) have already been determined or undertaken by the Mayor or City Administrator, such actions are hereby ratified by the Council.

(b) A copy of this Seventh Supplemental Ordinance shall be filed with the minutes of the Council meeting at which this Seventh Supplemental Ordinance was enacted.

(c) The Council hereby authorizes and directs all of the officers and employees of the City to carry out or cause to be carried out all obligations of the City hereunder and to perform such other actions as they shall consider necessary or advisable in connection with the issuance, sale and delivery of the New Bonds, and the effectuation of any of the undertakings authorized by this Seventh Supplemental Ordinance.

Section 5. Book-Entry System; Recording and Transfer of Ownership of the New Bonds.

(a) In the event a Series of New Bonds is not issued under the Book-Entry System of transfer, such New Bonds will be issued as a single Bond representing the entire principal amount of the applicable New Bonds in the name of the respective Purchaser thereof. The City, the Paying Agent and the Registrar may treat the respective Purchaser or subsequent Holder of such New Bonds as the sole and exclusive owner of such New Bonds registered in its name for the purpose of payment of the principal of, and interest or premium, if any, on the New Bonds, giving any notice permitted or required to be given to the Purchaser or subsequent Holder under the General Bond Ordinance or this Seventh Supplemental Ordinance, registering the transfer of the applicable New Bonds, obtaining any consent or other action to be taken by Bondholders and for all other purposes whatsoever, and shall not be affected or by any notice to the contrary.

(b) In the event a Series of New Bonds is issued under the Book-Entry System of transfer, the following provisions under this Section 5 shall apply to such Bonds.

The Initial Bonds will be eligible securities for the purposes of the Book-Entry System of transfer maintained by the Depository, and transfers of beneficial ownership of the Initial Bonds shall be made only through the Depository and its Participants in accordance with rules specified by the Depository. Such beneficial ownership must be of \$5,000 principal amount of Bonds of the same Series and maturity or any integral multiple of \$5,000.

The Initial Bonds will be issued in fully registered form, as a single bond representing the entire principal amount of each Series of New Bonds or one bond for each of the maturities of a Series of New Bonds, in the name of Cede & Co., as the nominee of the Depository. When any principal of, premium, if any, or interest on the Initial Bonds becomes due, the City shall transmit or cause the Paying Agent to transmit to the Depository an amount equal to such installment of principal of, premium, if any, and interest. Such payments will be made to Cede & Co. or other nominee of the Depository as long as it is the owner of record on the applicable Record Date. Cede & Co. or other nominee of the Depository shall be considered to be the owner of the Initial Bonds so registered for all purposes of this Seventh Supplemental Ordinance, including, without limitation, payments as aforesaid and receipt of notices. The Depository shall remit such payments to the Beneficial Owners of the New Bonds or their nominees in accordance with its rules and regulations.

Notices of redemption of the Initial Bonds or any portion thereof shall be sent to the Depository in accordance with the provisions of the General Bond Ordinance.

The Depository is expected to maintain records of the positions of Participants in the Initial Bonds, and the Participants and persons acting through Participants are expected to maintain records of the Beneficial Owners in the Initial Bonds. The City, the Trustee, the Registrar and the Paying Agent make no assurances that the Depository and its Participants will act in accordance with such rules or expectations on a timely basis,

and the City, the Trustee, the Registrar and the Paying Agent shall have no responsibility for any such maintenance of records or transfer of payments by the Depository to its Participants, or by the Participants or persons acting through Participants to the Beneficial Owners.

The City, the Paying Agent, the Registrar and the Trustee may treat the Depository (or its nominee) as the sole and exclusive owner of the New Bonds registered in its name for the purpose of payment of the principal of, premium, if any, and interest on the New Bonds, giving any notice permitted or required to be given to Bondholders under the General Bond Ordinance or this Seventh Supplemental Ordinance, registering the transfer of the New Bonds, obtaining any consent or other action to be taken by Bondholders and for all other purposes whatsoever, and shall not be affected by any notice to the contrary. The City, the Trustee, the Paying Agent and the Registrar shall not have any responsibility or obligation to any Participant, any person claiming a beneficial ownership interest in the New Bonds under or through the Depository or any Participant, or any other person which is not shown on the Books of Registry of the City maintained by the Registrar as being a Bondholder, with respect to the accuracy of any records maintained by the Depository or any Participant; the payment by the Depository or any Participant of any amount in respect of the principal of, premium, if any, and interest on the New Bonds, the sending of any transaction statements; the delivery or timeliness of delivery by the Depository or any Participant of any notice which is permitted or required to be given to Bondholders thereunder, the selection of Bondholders to receive payments upon any partial redemption of the New Bonds or under the conditions to transfers or exchanges adopted by the City or the Registrar; or any consent given or other actions taken by the Depository as a Bondholder.

If (a) the Depository determines not to continue to act as securities depository for the New Bonds and gives reasonable notice to the Registrar or the City, or (b) the City has advised the Depository of the City's determination that the Depository is incapable of discharging its duties, then the City shall attempt to retain another qualified securities depository to replace the Depository. Upon receipt by the City or the Registrar of the Initial Bonds together with an assignment duly executed by the Depository, the City shall execute and deliver to the successor depository the New Bonds of the same principal amount, interest rate and maturity. If the City is unable to retain a qualified successor to the Depository, or the City has determined that it is in its best interest not to continue the Book-Entry System of transfer or that interests of the Beneficial Owners of the New Bonds might be adversely affected if the Book-Entry System of transfer is continued (the City undertakes no obligation to make any investigation to determine the occurrence of any events that would permit it to make any such determination), and has made provision to so notify Beneficial Owners of the New Bonds by mailing an appropriate notice to the Depository, upon receipt by the City of the Initial Bonds together with an assignment duly executed by the Depository, the City shall execute, authenticate and deliver to the Participants the New Bonds in fully registered form, in authorized denominations; provided, however, that the discontinuation of the Book Entry System of registration and transfer with respect to the New Bonds or the replacement of the Depository or any successor depository shall be subject to the applicable rules and procedures of the Depository or such successor depository on file or otherwise approved by the Securities and Exchange Commission. Prior to any transfer of the New Bonds outside of the Book-Entry Only system (including, but not limited to, the initial transfer outside of the Book-Entry Only system) the transferor shall provide or cause to be provided to the Trustee all information necessary to allow the Trustee to comply with any applicable tax reporting obligations, including without limitation any cost basis reporting obligations under Internal Revenue Code Section 6045, as amended. The Trustee shall conclusively rely on the information provided to it and shall have no responsibility to verify or ensure the accuracy of such information.

Section 6. Payment of the New Bonds. The New Bonds, together with the interest thereon, shall be payable, in such coin or currency of the United States of America which at the time of such payment is legal tender for public and private debts, solely from the Net Revenues of the System in accordance with the provisions of the General Bond Ordinance and this Seventh Supplemental Ordinance. The applicable New Bonds shall be secured by a pledge of Net Revenues on a parity with the pledge of Net Revenues securing the Parity Bonds, any other New Bonds issued hereunder, and any other Bonds (as defined in the General Bond Ordinance) issued pursuant to the General Bond Ordinance.

The New Bonds do not constitute an indebtedness of the City within any State constitutional provisions (other than Article X, Section 14, Paragraph 10 of the South Carolina Constitution authorizing obligations payable solely from special sources not involving revenues from any tax or license) or statutory limitation. The New Bonds shall not be a debt of the City, nor a charge, lien or encumbrance, legal or equitable, upon any property of the City or upon any income, receipts or revenues thereof, other than the aforesaid Net Revenues of the System pledged thereto. No recourse shall be had for the payment of the New Bonds or the interest thereon against the general fund of the City, nor shall the credit or taxing power of the City be deemed to be pledged thereto. The full faith, credit and taxing powers of the City are not pledged to the payment of the principal of or interest on the New Bonds.

Section 7. Establishment of Series Bond and Interest Redemption Fund. In accordance with Section 6.7 of the General Bond Ordinance, Series Bond and Interest Redemption Funds are hereby directed to be established by the Trustee on the date of the original delivery of the respective New Bonds for the benefit of the Holders of the applicable New Bonds. In accordance with Section 6.7(a), (b) and (c) of the General Bond Ordinance, there is hereby directed to be established within each respective Series Bond and Interest Redemption Fund an Interest Account, a Principal Account and, if applicable, a Bond Redemption Account for the payment of interest, principal and sinking fund installment requirements of Term Bonds, respectively, on the New Bonds as the same become due and payable. In addition, to the extent it is determined by the Mayor or City Administrator pursuant to Section 4 that a portion of the proceeds of a Series of New Bonds shall be used to pay a portion of the interest due and payable on such Series of New Bonds, there shall be established within the applicable Series Bond and Interest Redemption Fund a Series Capitalized Interest Account into which such proceeds shall be deposited.

Section 8. Establishment of Series Reserve Fund Requirement and Series Debt Service Reserve Fund. In accordance with Section 6.8 of the General Bond Ordinance, the Mayor or the City Administrator may determine whether it is necessary or desirable to establish a Series Debt Service Reserve Fund for the benefit of the Holders of one or more Series of New Bonds and the amount and timing of funding of the Series Reserve Fund Requirement, and, if so, such Series Debt Service Reserve Fund shall be established on the date of the original delivery of such Series of New Bonds or funded from Net Revenues over a period of time thereafter and held by the Trustee, all as provided in the General Bond Ordinance; provided, however, that (1) upon the issuance of one or more Series of New Bonds, separate funds or accounts may be established (if at all) for each Series of New Bonds, with such additional numbers or letters to identify its relevance, but each such separate fund or account will be considered the "Series Debt Service Reserve Fund" with respect to the related Series of New Bonds; and (2) in the event of any full or partial defeasance of a Series of New Bonds under Article XII of the General Bond Ordinance, then the Series Reserve Fund Requirement established for such Series of New Bonds shall be recalculated based on the then Outstanding principal amount of such Series. If the Series Debt Service Reserve Fund is established, the Series Reserve Fund Requirement initially will be satisfied by the City by the deposit of cash into the Series Debt Service Reserve Fund (which may, as determined by the Mayor or the City Administrator pursuant to Section 11 hereof, be funded from the proceeds of the New Bonds on the date of delivery thereof or from System Revenues thereafter), with the provision of a Reserve Fund

Instrument, or any combination of the foregoing, in each case for the benefit of the Holders of the New Bonds. A Series Reserve Fund Requirement shall be deemed permanently satisfied to the extent a Reserve Fund Instrument is deposited with the Trustee for the benefit of the Holders of the applicable Series of New Bonds notwithstanding any downgrade to bond insurer ratings to the provider of such Reserve Fund Instrument.

Section 9. Designation of Trustee, Registrar, Paying Agent and Custodian. Pursuant to the General Bond Ordinance, the Trustee is U.S. Bank Trust Company, National Association. The Council hereby designates U.S. Bank Trust Company, National Association as Registrar and Paying Agent for the New Bonds. The Registrar, the Paying Agent shall signify their acceptances of their respective duties upon delivery of the New Bonds. The initial Custodian of the Construction Fund and the Series Costs of Issuance Account, if any, shall be selected by the City Administrator. The City Administrator or the Finance Director of the City may, at any time, remove the initial Custodian of any Construction Fund or Series Costs of Issuance Account, and replace such initial Custodian with one or more alternate Custodians.

Section 10. Disposition of Proceeds of New Bonds. The proceeds derived from the sale of the New Bonds shall be used for the following purposes:

(a) A portion of the proceeds thereof shall be deposited in one or more Construction Funds established in Section 10 hereof to be used for and applied to the payment of Costs of Acquisition and Construction of the 2024 Projects. A portion of the proceeds deposited in such Construction Fund may be used to pay all or a portion of the Costs of Issuance of the New Bonds relating thereto.

(b) If the Mayor or City Administrator determine that a Series Debt Service Reserve Fund shall be established for a Series of New Bonds and the Series Reserve Fund Requirement shall be funded with a portion of the proceeds of a Series of the New Bonds, there shall be deposited with the Trustee for deposit into such Series Debt Service Reserve Fund an amount which, together with other available funds, equals the Series Reserve Fund Requirement.

(c) If the Mayor or City Administrator determine that a Credit Facility or Reserve Fund Instrument shall be acquired in connection with a Series of New Bonds, a portion of the proceeds may be paid directly to the provider of such Credit Facility or Reserve Fund Instrument, respectively.

(d) If the Mayor or City Administrator determines that a portion of the proceeds of a Series of New Bonds shall be used to pay a portion of the interest due and payable on such Series of New Bonds, such amount shall be deposited with the Trustee for deposit into the applicable Series Capitalized Interest Account within the applicable Series Bond and Interest Redemption Fund.

(e) A portion of the proceeds of a Series of New Bonds may be deposited into a Series Costs of Issuance Account to be held by a bank, a financial institution, or the South Carolina Pooled Investment Fund, at the direction of the City Administrator or the Chief Financial Officer of the City, such funds to be used and applied to the payment of Costs of Issuance of the applicable New Bonds. If any moneys remain in the applicable Series Costs of Issuance Account after the payment in full (or after adequate provision has been made therefor) of all Costs of Issuance of the applicable New Bonds, such excess shall be paid into the Construction Fund for such New Bonds and used and applied therefrom to pay Costs of Acquisition and Construction of the 2024 Projects, or if such Construction Fund no longer exists, shall be deposited into the applicable Bond and Interest Redemption Fund.

The respective amounts specified in this Section 10 shall be determined by the City Administrator or the Finance Director of the City upon delivery of the applicable New Bonds.

Section 11. Construction Fund. There is hereby authorized to be created and established one or more Construction Funds with such further words, numbers or letters as may be necessary or desirable to distinguish such fund or funds, which fund or funds shall be held by one or more Custodians selected by the City. The moneys on deposit in the Construction Fund shall be used and applied to the payment of the Costs of Acquisition and Construction of the 2024 Projects, and may be used to pay Costs of Issuance not paid from a separate Costs of Issuance Account. Withdrawals from a Construction Fund may be made in the manner that withdrawals from other funds of the City are made. Further, withdrawals from the Construction Fund may be made in order to make any payments due from the City pursuant to one or more project agreements among the City, the Town of Pendleton and Anderson County relating to the Expansion Project. Any amounts remaining in a Construction Fund following completion of the applicable 2024 Projects shall be deposited in the respective Bond and Interest Redemption Fund relating thereto.

Section 12. Federal Tax Covenant; Written Procedures; Exemption from State Taxes. The City hereby covenants and agrees with the Holders of the New Bonds that it will not take any action which will, or fail to take any action which failure will, cause interest on the New Bonds to become includable in the gross income of the Bondholders for federal income tax purposes pursuant to the applicable provisions of Section 103 and Sections 141 through 150 of the Code and the regulations promulgated thereunder in effect on the date of original issuance so long as any of the New Bonds are Outstanding. The City further covenants and agrees with the Holders of the New Bonds that no use of the proceeds of the New Bonds shall be made which, if such use had been reasonably expected on the date of issue of the New Bonds would have caused the New Bonds to be "arbitrage bonds," as defined in the Code; and to that end the City hereby shall:

- (a) comply with the applicable provisions of Section 103 and Sections 141 through 150 of the Code and any regulations promulgated thereunder so long as any of the New Bonds are Outstanding;
- (b) establish such funds, make such calculations and pay such amounts, if necessary, in the manner and at the times required in order to comply with the requirements of the Code relating to required rebate of certain amounts to the United States; and
- (c) make such reports of such information at the times and places required by the Code.

The City Administrator and the Finance Director of the City, or either of them acting alone, are hereby authorized to adopt written procedures to ensure the City's compliance with federal tax matters relating to any Bonds, including the New Bonds, which are issued on a federal tax-exempt basis.

[This Seventh Supplemental Ordinance shall constitute the City's declaration of official intent pursuant to Regulation §1.150-2 of the Code to reimburse the City from a portion of the proceeds of the New Bonds for expenditures the City anticipates incurring (the "Expenditures") with respect to the 2024 Projects prior to the issuance of the Series of New Bonds relating thereto. Expenditures which may be reimbursed are limited to Expenditures which are: (a) properly chargeable to capital account (or would be so chargeable with a proper election or with the application of the definition of placed in service under Regulation §1.150-2 of the Code) under general federal income tax principals; or (b) certain *de minimis* or preliminary Expenditures satisfying the requirements of Regulation §1.150-2(f) of the Code. The source of funds for the Expenditures with respect to the Utility Projects will be the Revenues, cash on hand, and available reserves of the System. To be eligible for reimbursement of the Expenditures, the reimbursement allocation must be made not later than 18 months

after the later of (a) the date on which the Expenditures were paid; or (b) the date the applicable 2024 Project was placed in service, but in no event more than three (3) years after the original Expenditures.]

Both the principal of and interest on the New Bonds shall be exempt, in accordance with the provisions of Section 12-2-50 of the South Carolina Code from all State, county, municipal, school district and all other taxes or assessments, except estate or other transfer taxes, direct or indirect, general or special, whether imposed for the purpose of general revenue or otherwise.

Section 13. New Bonds May Be Designated Qualified Tax-Exempt Obligations. The City Administrator is authorized to determine whether one or more of the respective series of New Bonds shall be designated as “qualified tax-exempt obligations” as defined in the Code. In such event, the City and all subordinate entities thereof will not anticipate issuing more than \$10,000,000 (or the applicable limitation in effect at the time of issuance of such series of New Bonds) in tax-exempt bonds or other tax-exempt obligations in the year in which such New Bonds are issued other than private activity bonds (except for qualified 501(c)(3) bonds) within the meaning of the Code.

Section 14. Continuing Disclosure.

To the extent that Rule 15c2-12(b)(5) adopted by the Securities and Exchange Commission under the Securities Exchange Act of 1934 applies to a particular Series of New Bonds, the Finance Director of the City is hereby authorized and directed to execute and deliver a Continuing Disclosure Certificate related to such Series of New Bonds as required by applicable law (each, a “Continuing Disclosure Certificate”), the execution and delivery of such Continuing Disclosure Certificate constituting conclusive evidence of the approval of the matters therein contained. Notwithstanding any other provision of the General Bond Ordinance or this Seventh Supplemental Ordinance, failure of the City to comply with the provisions of the Continuing Disclosure Certificate shall not be considered an Event of Default under the General Bond Ordinance or this Seventh Supplemental Ordinance, and no liability for damages shall attach therefor. The Continuing Disclosure Certificate shall be executed by the City Administrator prior to the delivery of the New Bonds. The City Administrator or the Finance Director is authorized to adopt written procedures relating to compliance with continuing disclosure obligations in connection with the New Bonds.

The City covenants, so long as and to the extent required pursuant to Section 11-1-85, Code of Laws of South Carolina 1976, as amended, to file with a central repository for availability in the secondary bond market when requested:

- (i) an annual independent audit, within thirty (30) days of the City’s receipt of the audit;
- and
- (ii) event specific information within thirty (30) days of an event adversely affecting more than five percent (5%) of the Revenues or the City’s tax base.

The only remedy for failure by the City to comply with the covenant in this Section 14 shall be an action for specific performance of this covenant; and failure to comply shall not constitute a default or an “Event of Default” under the General Bond Ordinance or this Seventh Supplemental Ordinance. Notwithstanding anything to the contrary contained in the General Bond Ordinance, the Trustee, the Registrar and the Paying Agent shall have no responsibility to monitor the City’s compliance with this covenant. The City specifically reserves the right to amend or delete this covenant in order to reflect any change in Section 11-1-85 of the Code

of Laws of South Carolina 1976, as amended, without the consent of the Trustee, the Registrar and the Paying Agent or the Holder of any Series 2024 Bond.

Section 15. Further Actions. The Mayor, Mayor Pro-Tempore, City Administrator, Finance Director, Municipal Clerk and City Attorney are hereby authorized and directed to take any and all such further actions as shall be deemed necessary or desirable in order to effectuate issuance of the New Bonds, and to carry out the intentions of this Seventh Supplemental Ordinance.

Section 16. Credit Facility. In the event that the Mayor or City Administrator determines pursuant to the authorization set forth in Section 4 hereof that the City shall purchase one or more Credit Facilities with respect to a Series of New Bonds, the Mayor and City Administrator are hereby authorized to approve the form of any Credit Facility Agreement and are hereby authorized to execute the Credit Facility Agreement and deliver the Credit Facility Agreement to the Credit Facility Issuer, the Mayor's or City Administrator's execution and delivery of the Credit Facility Agreement constituting conclusive evidence of such signatory's approval of the matters therein contained.

Section 17. Reserve Fund Instrument. In the event that the Mayor or City Administrator determines pursuant to the authorization set forth in Section 4 hereof that the City shall purchase one or more Reserve Fund Instruments with respect to a Series of New Bonds, the Mayor and City Administrator are each hereby authorized to approve the form of any Reserve Fund Instrument Agreement and are hereby authorized to execute the Reserve Fund Instrument Agreement and deliver the Reserve Fund Instrument Agreement to the Reserve Fund Instrument Provider, the City Administrator's execution and delivery of the Reserve Fund Instrument Agreement constituting evidence of such signatory's approval of the matters therein contained.

Section 18. Amendments to the General Bond Ordinance.

A. The following provisions of the General Bond Ordinance are hereby amended pursuant to Article IX of the General Bond Ordinance. Any Bonds (as defined in the General Bond Ordinance), including the New Bonds, issued after the date of enactment of this Seventh Supplemental Ordinance shall contain a reference to the amendments herein made:

1. The definition of "Act" in Section 1.1 is hereby amended by replacing the current text with the following:

"Act" shall mean Title 6, Chapter 17, Code of Laws of South Carolina 1976, as amended, Title 6, Chapter 21, Code of Laws of South Carolina 1976, as amended, and all other statutory authorizations, now or hereinafter enacted, authorizing and enabling the City to provide for the issuance of Bonds, including, if applicable, with respect to any Series of refunding Bonds, Title 11, Chapters 15 and 21, Code of Laws of South Carolina 1976, as amended.

2. The following definition shall be added in Section 1.1:

"Costs of Issuance Fund" shall mean any fund established with an maintained by the Trustee or a Custodian and derived, in whole or in part, from certain of the proceeds of the sale of a Series of Bonds, and intended to defray the Costs of Issuance of such Bonds, as may be established in a Supplemental Ordinance authorizing the issuance of any Series of Bonds.

3. The definition of “Custodian” in Section 1.1 is hereby amended by replacing the current text with the following:

“Custodian” shall mean any bank, depository or trust company duly qualified and doing business within the State, or the South Carolina Pooled Investment Fund (or similar entity or program of the State) selected by the City as a depository of moneys or securities held in a Construction Fund or a Costs of Issuance Fund.

4. The definition of “Expenses of Operating and Maintaining the System” in Section 1.1 is hereby amended by replacing the current text with the following:

“Expenses of Operating and Maintaining the System” shall mean the current expenses, paid or accrued, of operation and administration, maintenance and current repair of the System, as calculated in accordance with generally accepted accounting practices, and shall include, without limiting the generality of the foregoing, administrative charges, salaries, wages, employee benefits, costs of materials and supplies, costs of routine repairs, renewals, replacements and alterations occurring in the usual course of business, properly allocable share of City administrative and overhead expenses, contractual payments to any entity or person providing treatment of water or treatment and disposal of wastewater from the System (including but not limited to payments which the City is presently required to make pursuant to a Water Sale and Purchase Agreement with the Anderson County Joint Municipal Water System, and any payments which the City may in the future be required to make pursuant to an agreement with a joint system pursuant to Title 6, Chapter 25, Code of Laws of South Carolina 1976, as amended), costs of billings and collections, costs of insurance, costs of any audit of the System, the premiums for all insurance required with respect to the System, taxes, if any, and amounts payable by way of arbitrage rebate. Expenses of Operating and Maintaining the System shall not include: (1) the payment of interest on Bonds or other System-related indebtedness; (2) capital outlay; (3) any allowance for depreciation or renewals or replacements of capital assets of the System; (4) amounts deemed to be payments in lieu of taxes or other transfers to the City’s general fund; (5) the amortization of financing expenses, underwriting discounts, call premiums, gains or losses on the extinguishment of debt due to the refinancing of the same, and other related or incidental non-recurring expenses resulting from the issuance of Bonds; (6) expenses relating directly from the operation of Special Facilities to the extent that the revenues derived therefrom have been pledged to secure, and used for, the payment of Special Facilities Bonds; (7) any non-cash expenses resulting from the application of GASB Statement 45 regarding the provision of postemployment benefits other than pensions; and (8) as to any non-cash expenses, any cumulative effect of a change resulting from adoption of any new accounting pronouncement as required by any accounting standards body.

5. A definition of “Financial Advisor” shall be added to Section 1.1 as follows:

“Financial Advisor” shall mean shall mean a registered municipal advisor or municipal advisor firm within the meaning of Section 15B of the Securities Exchange Act of 1934, having a favorable reputation for skill and experience in advising governmental entities with respect to the issuance of bonds and other financial obligations, and who or which is not a full-time employee of the City.

6. The definition of “Junior Bonds” in Section 1.1 is hereby amended by replacing the current text with the following:

“Junior Bonds” shall mean, to the extent expressly designated as a “Junior Bond” in the ordinance or other authorization of the City providing for the issuance or undertaking thereof (which ordinance or other authorization shall not be supplemental to this Ordinance) either (a) bonds or bond anticipation notes secured by a pledge of Net Revenues junior and subordinate in all respects to the pledge securing the Bonds or (b) any other payment obligation or form of indebtedness, including a Capital Lease, secured by Net Revenues after provision has been made for all payments required to be made with respect to the Bonds.

7. The definition of “Project” in Section 1.1 is hereby amended by replacing the current text with the following:

“Project” shall mean any work, undertaking, project or capital asset, including the acquisition of capacity or capacity rights, which the City is or may hereafter be authorized to construct or acquire with the proceeds of any Bonds and which will become part of the System, including the acquisition of any system which shall be combined with or consolidated into the System pursuant to law.

8. Section 3.3.C. is hereby amended by replacing the current text with the following:

For the issuance of Bonds to finance the Costs of Acquisition and Construction, or a portion thereof, of any Project, there shall be delivered either:

(i) a certificate or report, based upon the latest audit of the City as required by Section 7.5 hereof, from the City Administrator or Finance Director of the City, or an Accountant or Consulting Engineer stating that the amount of the Net Revenues of the System for the period covered by such audit is not less than 120% of the sum of the Maximum Debt Service on Bonds then Outstanding and the Bonds then proposed to be issued, or

(ii) a certificate from an Accountant, a Financial Advisor or a Consulting Engineer stating that the amount of the Net Revenues of the

System, as shall have been forecasted by such Accountant, Financial Advisor or Consulting Engineer, is not less than 120% of the actual Debt Service on all Bonds then Outstanding and the Bonds then proposed to be issued for each of the three (3) Fiscal Years following the later of the date of the delivery of the Bonds of such Series, or the period (if any) for which interest is funded from the proceeds of such Bonds;

provided the amount of Net Revenues for the periods referred to in item (i) or item (ii) above may be adjusted by adding the following:

- (1) in case the rates and charges for the services furnished by the System shall have been revised and such revised rates and charges shall have gone into effect prior to the delivery of the Bonds proposed to be issued, the additional amount of Net Revenues which would have been realized during the periods referred to above if such rates and charges had been in effect during such periods as determined by: (A) if with respect to item (i) above, the City Administrator, the Finance Director of the City, an Accountant, a Financial Advisor or a Consulting Engineer, or (B) if with respect to item (ii) above, an Accountant, a Financial Advisor or a Consulting Engineer; and
- (2) in case an existing sewer system, existing water system, or any other public utility system is to be acquired and combined or made a part of the System from the proceeds of the Bonds proposed to be issued, the additional amount of Net Revenues which would have been realized during the periods referred to above if such existing system or systems to be acquired had been a part of the System during such periods (which computation of the additional amount of Net Revenues shall be based upon the method of computing Net Revenues under this Ordinance and approved by an Accountant, a Financial Advisor or a Consulting Engineer).

9. Section 6.1 is amended by adding item (vii) thereto:

- (vii) Costs of Issuance Fund, if established by the applicable Supplemental Ordinance, to be held by a Custodian designated by the City.

Further, the last paragraph in Section 6.1 is amended by replacing the current text with the following:

One or more accounts may, by written direction of the City, or by the terms of a Supplemental Ordinance, be established within any of the above funds. It is intended by this intended by this Ordinance that the funds and accounts referred to in this Article (other than the Construction Fund and the Costs of Issuance Fund) shall remain in existence for so long a time as any sum remains due and payable by way of principal of and interest on the Bonds, and that deposits and withdrawals therefrom be made in the manner herein

prescribed and in the order of priority hereinafter set forth in Section 6.2 hereof.

10. The title of Section 6.12 is amended to state: "Establishment of Construction Fund; Establishment of Costs of Issuance Fund", and the following paragraph is added to the end of such Section 6.12:

There may be established with a Custodian a Costs of Issuance Fund with respect to any Series of Bonds in the Supplemental Ordinance providing for their issuance, the moneys in which shall be used to defray the Costs of Issuance of such Series of Bonds. On the occasion of the delivery of any Series of Bonds, a portion of the proceeds therefrom may be paid into the Costs of Issuance Fund established for such Series as set forth in a Supplemental Ordinance providing for their issue. Withdrawals from the Costs of Issuance Fund shall be made in accordance with the provisions set forth in the Supplemental Ordinance establishing such Costs of Issuance Fund.

11. The following sentence is added to the end of the first paragraph of Section 9.1.B.:

Upon the issuance of any Series of Bonds, the underwriter or purchaser of such Series of Bonds may assent to and consent to any amendments to this General Bond Ordinance as contemplated by this paragraph in the same manner as the Holders of such Series of Bonds.

B. The amendments to the General Bond Ordinance set forth above (the "Amendments") shall not become effective until the first to occur of either of the following:

1. All of the Parity Bonds shall cease to be Outstanding; or
2. The Holders of 66-2/3% in principal amount of the Bonds then Outstanding assent to and authorize the effectiveness of the Amendments;

To the extent that the receipt of the consent of the Holders of any Bonds is required for purposes of the effectiveness of the Amendments, such consent shall be deemed to have occurred with respect to any Holders of the Bonds issued after the date hereof by virtue of the initial purchases by such Holders of such future Bonds and the disclosure of the Amendments to such Holders prior to such purchases. Additionally, the Underwriter, as initial Holder of any of the New Bonds, will be requested to consent to the Amendments upon the issuance of such New Bonds.

Upon satisfaction of the conditions necessary for the Amendments to become effective, the City Administrator shall deliver a certificate to the Trustee to the effect that such conditions have been satisfied.

Section 19. Headings. The headings and titles of the several sections hereof shall be solely for convenience of reference and shall not affect the meaning, construction, interpretation or effect of this Seventh Supplemental Ordinance.

Section 20. Notices. All notices, certificates or other communications hereunder shall be given or made in writing and shall be delivered personally, or sent by registered mail, postage prepaid, return receipt requested, or overnight delivery service, to the party to whom they are directed at the following addresses, or at such other addresses as may be designated by notice from such party to all other parties:

If to the City:

City Administrator
City of Clemson
1250 Tiger Boulevard, Suite 1
Clemson, SC 29631

If to the Paying Agent, Registrar, or Trustee

U.S. Bank Trust Company, National Association
Attn: Global Corporate Trust
1441 Main Street, Suite 775
Columbia, South Carolina 29201

The above parties may, by notice given to the other parties, designate any further or different addresses to which subsequent notices, certificates or other communications shall be sent.

The City may send notices by electronic mail. The City agrees that the Trustee, Registrar and Paying Agent cannot determine the identity of the actual sender of such instructions and that the Trustee, Registrar and Paying Agent shall conclusively presume that instructions that purport to have been sent by a City Representative have been sent by such City Representative. The City shall be responsible for ensuring that only City Representatives transmit such instructions to the Trustee, Registrar and Paying Agent, and the City and the City Representatives are responsible to safeguard the use and confidentiality of applicable user and authorization codes, passwords and authentication keys provided by the Trustee, Registrar and Paying Agent. The Trustee, Registrar and Paying Agent shall not be liable for any losses, costs, or expenses arising directly or indirectly from their reliance upon and compliance with such instructions notwithstanding such instructions conflict or are inconsistent with a subsequent written instruction. The City agrees (i) to assume all risks arising out of the use of electronic mail to submit instructions and direction to the Trustee, Registrar and Paying Agent, including without limitation the risk of the Trustee, Registrar and Paying Agent acting on unauthorized instructions and the risk of interception and misuse by third parties; (ii) that it is fully informed of the protections and risks associated with the various methods of transmitting instructions to the Trustee, Registrar and Paying Agent and that there may be more secure methods of transmitting instructions than the method(s) selected by the City; (iii) that the security procedures (if any) to be followed in connection with its transmission of instructions provide to it a commercially reasonable degree of protection in light of its particular needs and circumstances; and (iv) that it will notify the Trustee, Registrar and Paying Agent immediately upon learning of any compromise or unauthorized use of the security procedures.

Section 21. Repeal of Inconsistent Ordinances and Resolutions. All rules, regulations, ordinances, resolutions and parts thereof, procedural or otherwise, in conflict herewith or the proceedings authorizing the issuance of the New Bonds are, to the extent of such conflict, hereby repealed and this Seventh Supplemental Ordinance shall take effect and be in full force from and after its enactment.

Section 22. Severability. If any section, phrase, sentence or portion of this Seventh Supplemental Ordinance is for any reason held invalid or unconstitutional by any court of competent jurisdiction, such portion shall be deemed a separate, distinct and independent provision, and such holding shall not attest the validity of the remaining portions thereof.

Section 23. Effective Date. This Seventh Supplemental Ordinance shall become effective upon its enactment.

[Signature page follows]

Enacted by the City Council of the City of Clemson, South Carolina, this 15th day of July, 2024.

CITY COUNCIL OF THE CITY OF CLEMSON,
SOUTH CAROLINA

(SEAL)

Robert Halfacre, Mayor

ATTEST:

Jeremiah Jackson, City Clerk

Date of First Reading: May 20, 2024
Date of Second Reading: July 15, 2024

Ordinance No.: CC-2024-____

[Execution page]

Exhibit A

FORM OF BOND

[FORM TO BE REVISED AS APPROPRIATE FOR ANY SERIES OF NEW BONDS
SOLD IN A PRIVATE PLACEMENT TRANSACTION]

UNITED STATES OF AMERICA
STATE OF SOUTH CAROLINA
CITY OF CLEMSON
WATER AND SEWER SYSTEM REVENUE BOND
SERIES 20__

REGISTERED

No. R-_____

ORIGINAL ISSUE
DATE

MATURITY
DATE

INTEREST
RATE

CUSIP

REGISTERED HOLDER: CEDE & CO.

PRINCIPAL AMOUNT: \$ _____

The City of Clemson, South Carolina (the "City"), is justly indebted and, for value received, hereby promises to pay to the Registered Holder (named above), or registered assigns, but solely from the Net Revenues hereinafter mentioned and not otherwise, the Principal Amount shown above on the Maturity Date shown above (unless the within Bond shall be subject to prior redemption and shall have been duly called for previous redemption and payment of redemption price made or provided for), upon presentation and surrender of this Bond at the designated office of U.S. Bank Trust Company, National Association, as paying agent (the "Paying Agent"), and to pay interest, but solely from the Net Revenues hereinafter mentioned and not otherwise, on such principal amount from the date hereof at the Interest Rate per annum shown above (calculated on the basis of a 360-day year of twelve 30-day months) until this Bond matures. Interest on this Bond is payable semiannually on _____ 1 and _____ 1 of each year commencing _____ 1, _____ until this Bond matures or is earlier redeemed, and shall be payable by wire transfer to the registered holder owning at least \$1,000,000 aggregate principal amount of the Bonds to an account within the continental United States or by check or draft mailed to the person in whose name this Bond is registered on the registration books of the City maintained by U.S. Bank Trust Company, National Association, as registrar (the "Registrar"), at the close of business on the fifteenth (15th) day of the calendar month preceding each semiannual interest payment date. The principal, redemption premium, if any, and interest on this Bond are payable in any coin or currency of the United States of America which is, at the time of payment, legal tender for public and private debts; provided, however, that interest on this fully registered Bond shall be paid by wire transfer, check or draft as set forth above.

THIS BOND HAS BEEN ISSUED UNDER THE PROVISIONS OF TITLE 6, CHAPTER 21, CODE OF LAWS OF SOUTH CAROLINA, 1976, AS AMENDED (THE "ACT"), AND DOES NOT CONSTITUTE AN INDEBTEDNESS OF THE CITY WITHIN THE MEANING OF ANY STATE CONSTITUTIONAL PROVISION (OTHER THAN ARTICLE X, SECTION 14, PARAGRAPH 10 OF THE SOUTH CAROLINA CONSTITUTION AUTHORIZING OBLIGATIONS PAYABLE SOLELY FROM SPECIAL SOURCES NOT INVOLVING REVENUES FROM ANY TAX OR LICENSE) OR

STATUTORY LIMITATION. THIS BOND AND THE BONDS OF THE SERIES OF WHICH IT IS ONE SHALL NOT CONSTITUTE A DEBT OF THE CITY, NOR A CHARGE, LIEN OR ENCUMBRANCE, LEGAL OR EQUITABLE, UPON ANY PROPERTY OF THE CITY OR ON ANY INCOME, RECEIPTS OR REVENUES THEREOF, OTHER THAN THE AFORESAID NET REVENUES OF THE SYSTEM (AS DEFINED HEREIN) PLEDGED THERETO. NO RECOURSE SHALL BE HAD FOR THE PAYMENT OF THIS BOND OR THE INTEREST THEREON AGAINST THE GENERAL FUND OF THE CITY AND NEITHER THE CREDIT NOR THE TAXING POWER OF THE CITY SHALL BE DEEMED TO BE PLEDGED THERETO. THE FULL FAITH, CREDIT AND TAXING POWERS OF THE CITY ARE NOT PLEDGED TO THE PAYMENT OF THE PRINCIPAL OF OR INTEREST ON THIS BOND.

This Bond shall not be entitled to any benefit under the Bond Ordinance (hereinafter defined), nor become valid or obligatory for any purpose, until the certificate of authentication hereon shall have been duly executed by the Registrar.

This Bond is one of an authorized series of Bonds (as defined in the Bond Ordinance) of the aggregate principal amount of _____ Dollars (\$_____) of like date of original issue, tenor and effect, except as to number, date of maturity, principal amount, date of authentication, registered holder, redemption provisions and rate of interest, issued by the City for the purpose of making certain improvements, enlargements and extensions to the City's water and sewer system (the "System") and paying costs of issuance relating to the Bonds. This Bond and the series of Bonds of which it is one are authorized to be issued and are issued under, pursuant to and in full compliance with the Constitution and statutes of the State of South Carolina, including particularly Article X, Section 14(10) of the South Carolina Constitution and the Act. This Bond and the series of Bonds of which it is one are also authorized to be issued and are issued under and pursuant to General Bond Ordinance No. CC-2005-16 of the City duly enacted on June 6, 2005, as amended (the "General Bond Ordinance"), and Seventh Supplemental Ordinance No. CC-2024-___ of the City duly enacted on July 15, 2024 (the "Seventh Supplemental Ordinance" and, together with the General Bond Ordinance, the "Bond Ordinance"), under the Act which Bond Ordinance has been duly codified and indexed as prescribed by law.

The Bond Ordinance contains provisions defining terms, including the properties comprising the System; sets forth the revenues pledged for the payment of the principal of and interest on this Bond and the Bonds (as defined in the Bond Ordinance) of other series which may hereafter be issued on a parity herewith under the Bond Ordinance; sets forth the nature, extent and manner of enforcement of the security of this Bond and of such pledge, and the rights and remedies of the holder hereof with respect thereto; sets forth the terms and conditions upon which and the extent to which the Bond Ordinance may be altered, modified and amended; sets forth the terms and conditions upon which this Bond is issued upon which other bonds may be hereinafter issued payable as to principal, premium, if any, and interest on a parity with this Bond and equally and ratably secured herewith; sets forth the rights, duties and obligations of the City thereunder; and sets forth the terms and conditions upon which the pledge made in the Bond Ordinance for the security of this Bond and upon which the covenants, agreements and other obligations of the City made therein may be discharged at or prior to the maturity or redemption of this Bond with provisions for the payment thereof in the manner set forth in the Bond Ordinance. Reference is hereby made to the Bond Ordinance to all of the provisions of which any holder of this Bond by the acceptance hereof thereby assents.

The provisions of the Act and the Bond Ordinance shall be a contract with the holder of this Bond.

This Bond and the series of Bonds of which it is one and the interest thereon are special obligations of the City and are secured by and payable solely from, and secured equally and ratably by a pledge of and lien upon, the Net Revenues (as defined in the General Bond Ordinance) derived by the City from the System (as defined in the General Bond Ordinance) and on a parity with the Parity Bonds and any other Bonds (as such terms are defined in the Bond Ordinance) hereafter issued under the General Bond Ordinance payable from such Net Revenues on a parity and equally and ratably secured therewith.

This Bond and the series of Bonds of which it is one maturing on or prior to _____ 1, _____, shall not be subject to redemption prior to their stated maturities. This Bond and the series of Bonds of which it is one maturing on or after _____ 1, _____, shall be subject to redemption prior to maturity, at the option of the City, on and after _____ 1, _____, in whole or in part at any time in such order of their maturities as the City shall determine and by lot within a maturity, at the redemption price equal to 100% of the principal amount of this Bond and the series of Bonds of which it is one to be redeemed together with the interest accrued on such principal amount to the date fixed for redemption.

If less than all the Bonds of the series of which this Bond is one of any maturity are called for redemption, the Bonds of such maturity to be redeemed shall be selected by lot by the Registrar. In the event this Bond is redeemable, as aforesaid, and shall be called for redemption, notice of the redemption hereof, describing this Bond and specifying the redemption date, the premium payable upon such redemption and any conditions applicable to such redemption, including but not limited to the availability of money therefor, shall be given by the Registrar by first class mail, postage prepaid, to the registered owner thereof not less than thirty (30) days and not more than sixty (60) days prior to the redemption date at the last address appearing upon the registration books of the City. If this Bond be redeemable and shall have been duly called for redemption and notice of the redemption hereof mailed as aforesaid, and if on or before the date fixed for such redemption, payment hereof shall be duly made or provided for, interest hereon shall cease to accrue from and after the redemption date hereof.

[The Bonds of the series of which this Bond is one maturing in the year 20__ shall be retired by sinking fund installments which shall be accumulated in the Bond Redemption Account in the Series Bond and Interest Redemption Fund (as defined in the Seventh Supplemental Bond Ordinance) established for the Bonds in amounts sufficient to redeem on January 1 of each year, at a redemption price equal to the principal amount of the Bond or Bonds to be redeemed, together with interest accrued thereon to the date fixed for redemption, the principal amount of such Bonds specified for each of the years shown below:

<u>Year</u>	<u>Principal Amount</u>
-------------	-------------------------

At its option, to be exercised on or before the sixtieth (60th) day prior to any mandatory redemption date, the City may (i) deliver to the Registrar for cancellation Bonds which are subject to mandatory redemption in any aggregate principal amount desired or (ii) receive a credit in respect of its mandatory redemption obligation for any such Bonds which, prior to such date, have been purchased or redeemed (otherwise than through the operation of the mandatory redemption requirement) by the City and cancelled by the Registrar and not therefore applied as a credit against any mandatory redemption obligation. Each Bond so delivered or previously purchased or redeemed shall be credited by the Registrar, at 100% of the principal amount thereof, to the obligation of the City on those respective mandatory redemption obligations in chronological order or such other order as the City may direct in writing, and the principal amount of the Bonds of the series of which this Bond is one to be redeemed by operation of the mandatory redemption requirement shall be accordingly reduced.]

This Bond is transferable, as provided in the Bond Ordinance, only upon the books of the City kept for that purpose at the designated office of the Registrar by the registered owner in person or by his duly authorized attorney upon surrender of this Bond together with a written instrument of transfer satisfactory to the Registrar duly executed by the registered owner or his duly authorized attorney. Thereupon a new fully registered Bond or Bonds of the same aggregate principal amount, rate of interest and maturity shall be issued to the transferee in exchange therefor as provided in the Bond Ordinance. The City, the Registrar and the Paying Agent may deem and treat the person in whose name this Bond is registered as the absolute owner hereof for the purpose of receiving payment of or on account of the principal or redemption premium, if any, hereof and interest due hereon and for all other purposes.

To the extent and in the manner permitted by the terms of the Bond Ordinance, the provisions of this Bond or of the Bond Ordinance, or any ordinance amendatory thereof or supplemental thereto, may be amended or modified by the City in certain circumstances described in the General Bond Ordinance without the consent of the Holders of any Bonds, and in other circumstances only with the written consent of the holders of at least sixty-six and two-thirds percent (66-2/3%) in principal amount of the Bonds (as defined in the Bond Ordinance) then outstanding under the Bond Ordinance (including the Bonds of the series of which this Bond is one); provided always that without the consent of the Holder of each Bond affected thereby, no such amendment or modification shall (a) extend the time of payment of principal of or the interest on any Bond, or (b) give to any Bond or Bonds any preference over any other Bond or Bonds, or (c) authorize the creation of any pledge prior to or, except as provided in the General Bond Ordinance with respect to the issuance of Series of Bonds, on a parity with the pledge of Net Revenues to the payment of Bonds afforded by the General Bond Ordinance, or (d) reduce the percentage in principal amount of the Bonds required to assent to or authorize any such modification to the General Bond Ordinance.

Upon satisfaction of certain conditions as more particularly set forth in the Seventh Supplemental Ordinance, certain amendments to the General Bond Ordinance set forth in Section 18 of the Seventh Supplemental Ordinance will become effective. The holders of this Bond and the series of Bonds of which it is one are deemed to have consented to the amendments to the General Bond Ordinance set forth in Section 18 of the Seventh Supplemental Ordinance.

Under the laws of the State of South Carolina, this Bond and the interest hereon are exempt from all State, county, municipal, school district and all other taxes or assessments, except estate or other transfer taxes, direct or indirect, general or special, whether imposed for the purpose of general revenue or otherwise.

It is hereby certified, recited and declared that all acts, conditions and things required by the Constitution and statutes of the State of South Carolina to exist, to happen and to be performed precedent to and in the issuance of this Bond, do exist, have happened and have been performed in due time, form and manner as required by law; that the series of which this Bond is a part does not exceed any constitutional or statutory limitation of indebtedness; and that provision has been made for the payment of the principal of and interest on this Bond and the series of which it is a part, as provided in the Bond Ordinance.

IN WITNESS WHEREOF, the City of Clemson, South Carolina, has caused this Bond to be executed in its name by the facsimile/manual signature of the Mayor of the City and attested by the facsimile/manual signature of the Municipal Clerk of the City under the seal of the City impressed, imprinted or reproduced hereon.

CITY OF CLEMSON, SOUTH CAROLINA

By: _____
Mayor

(SEAL)

ATTEST:

Municipal Clerk

(FORM OF REGISTRAR'S CERTIFICATE OF AUTHENTICATION)

This Bond is one of the Bonds described in the within-mentioned Seventh Supplemental Ordinance of City of Clemson, South Carolina.

U.S. BANK TRUST COMPANY, NATIONAL
ASSOCIATION., as Registrar

Dated: _____

By: _____
Authorized Officer

(FORM OF ASSIGNMENT)

FOR VALUE RECEIVED, the undersigned sells, assigns and transfers unto

(Name and Address of Transferee)

the within Bond and does hereby irrevocably constitute and appoint attorney to transfer the within Bond on the books kept for registration thereof, with full power of substitution in the premises.

Dated: _____

By: _____
(Authorized Officer)

Signature Guaranteed

Notice: Signature must be guaranteed by an institution which is a participant in the Securities Transfer Agents Medallion Program ("STAMP") or similar program.

Notice: The signature to the assignment must correspond with the name of the registered holder as it appears upon the face of the within Bond in every particular, without alteration or enlargement or any change whatever.

The following abbreviations, when used in the inscription on the face of this Bond, shall be construed as though they were written out in full according to applicable laws or regulations.

TEN COM - as tenants in common

UNIF GIFT MIN ACT -

TEN ENT - as tenants by the
entireties

_____ Custodian _____
(Cust) (Minor)
under Uniform Gifts to
Minors Act _____
(State)

JT TEN - as joint tenants with
right of survivorship
and not as tenants in
common

Additional abbreviations may also be used though not in above list.

CERTIFICATE

IT IS HEREBY CERTIFIED that the following is a true and correct copy of the complete legal opinion (except for date, letterhead and signature) of Burr & Forman LLP, Greenville, South Carolina, the original of which was manually executed, dated and issued as of the date of the delivery of and payment for the bonds, and a copy of which is on file with the City of Clemson, South Carolina.

CITY OF CLEMSON, SOUTH CAROLINA

By: _____
Municipal Clerk



CITY OF CLEMSON
AGENDA ITEM REQUEST FORM

Requested By:

Date Submitted:

Council Meeting Date:

Type of Request: (check only one)

☒ Report/Discussion

☐ Policy/Action

☐ Executive Session

Agenda Item Summary: (brief for public information and posted agenda)

Discuss the city's current FOIA policy and provide staff and legal counsel guidance on any desired amendments.

Agenda Item Detail: (expand as necessary for clarification)

Staff has been asked to prepare a revised policy for Council consideration. The current FOIA policy and request forms are attached below. There are opportunities to enhance this policy and having your input on issues such as, but not limited to, how to handle redacted documents, fees, and codification will be very helpful as we prepare a policy action item for your August 5th meeting.



CITY OF Clemson SOUTH CAROLINA

South Carolina law provides that it is a crime to knowingly obtain or use personal information from a public body for commercial solicitation.

FOIA Records Request

Please Print

Name _____ Date Requested _____
Address _____ Daytime Phone _____
City/State/Zip _____ Cellular Phone _____
Agency, Firm, or Organization _____
Address (if different) _____ Daytime Phone _____
City/State/Zip _____ Cellular Phone _____
Information Requested (attach additional description, if required) _____
Requested Delivery: Mail _____ Pick Up _____ Email _____ Email Address _____

Office Use Only

Date Request Received: _____

Written FOIA Response determining availability of records and notice of any exemptions due: _____

10 business days from date of receipt of FOIA request for records less than 24 months old
20 business days from date of receipt of FOIA request for records more than 24 months old

Written FOIA Response provided to Requestor: _____

If the City of Clemson determines that the requested records are available and not exempt from disclosure, the records will be furnished to the requestor within 30 calendar days of its written response, or within 35 calendar days if the records are more than two years old.

A DEPOSIT (25% of reasonably anticipated cost for reproduction of the records) IS REQUIRED, if search and retrieval time is greater than 30 minutes and/or the number of pages to be produced is greater than 10 pages. The balance must be paid at the time of production.

Estimated Search/Retrieval Time	Number of Minutes/Hours	Rate	Cost
		\$15.00/hour	
Estimated # of black-white copies	Number of Pages		
Estimated # of color copies	Number of Pages		
Estimated # of discs for audio or video recording	Number of Discs		

Estimated Cost: _____ Deposit Amount: _____

Deposit Received on: _____

Production of Documents Due: _____

30 days after date of receipt of deposit for records less than 24 months old
35 days after date of receipt of deposit for records more than 24 months old

Name	Department	Time	Rate:	Cost
			X \$15.00/hr	
			X \$15.00/hr	
			X \$15.00/hr	
			X \$15.00/hr	
			X \$15.00/hr	
			X \$15.00/hr	

Fee Schedule

	Minutes/Hours	X Rate	= Cost
Search/Retrieval Time There is no retrieval charge for records retrieved and copied within ½ hour or less.		\$15.00	
Copies There is no charge for copies of records if the total number of pages responsive to the FOIA Request is 10 pages or less or if an electronic version of a record is available, and the requestor elects to receive the record electronically, then there will be no charge for copies.**	Number or Pages	Unit Price	
Black-White Paper Records/Standard Reports 8.5x11		\$0.25/page	
Color Paper Records/Standard Reports 8.5x11		\$0.50/page	
Standard Maps/Plots up to 11x 17 black-white		\$0.50/each	
Standard Maps/Plots up to 11x 17 color		\$1.00/each	
Standard Maps/Plots larger than 11x 17		\$5.00/each	
Microfiche/Microfilm Copies		\$0.25/each	
CD/DVD		\$1.00/each	
Flash Drive		\$12.00/each	
TOTAL COST			

**Please note that if the requested records are not in electronic format and our office agrees to transfer documents to an electronic format, there will be a charge for the staff time required to transfer the documents to an electronic format.

Certain **search/retrievals** may also require an additional rate.

Information reviewed by: _____ Date information provided to requestor: _____



CITY OF Clemson SOUTH CAROLINA

FREEDOM OF INFORMATION ACT POLICY AND FEE SCHEDULE

South Carolina law provides that it is a crime to knowingly obtain or use personal information from a public body for commercial solicitation.

Pursuant to the South Carolina Freedom of Information Act, the City of Clemson ("City") will provide access to or copies of public records in its custody unless the records are exempt from disclosure under S.C. Code of Laws §30-4-40. All Freedom of Information Act ("FOIA") requests should directed to:

Zoning, Building & Fire Codes:	Jacob Peabody	jpeabody@cityofclemson.org
Police reports:	Police Records	CPDFOIA@cityofclemson.org
All other:	Jeremiah Jackson	jjackson@cityofclemson.org

Mailing Address: **City of Clemson**
 1250 Tiger Blvd, Suite 1
 Clemson, SC 29631

Upon receipt of a written request for records under FOIA, the City will determine if the records are available. The City will notify the requestor of this determination in writing within ten (10) business days for records less than two (2) years old, or within twenty (20) business days for records more than two (2) years old. Business days does not include Saturdays, Sundays, and legal public holidays.

If the search/retrieval time is less than half an hour and/or the total number of documents responsive to the FOIA request is ten (10) pages or less, no reproduction fee will be charged.

If the City determines that the requested records are available and are not exempt from disclosure, the records will be furnished to the requestor within thirty (30) calendar days of the written determination, or within thirty-five (35) calendar days if the records are more than two years old.

A DEPOSIT IS REQUIRED prior to searching for and/or copying records pursuant to a FOIA request (25% of reasonably anticipated cost for reproduction of the records), if search and retrieval time is greater than thirty (30) minutes and/or the number of pages to be produced is greater than ten (10) pages. The balance must be paid at time of production.

If the City requires a deposit prior to searching for or making copies of the records, then the records will be furnished within thirty (30) calendar days of when the deposit is received. If the records are more than two years old, the records will be furnished within thirty-five (35) calendar days of when the deposit is received.

Pursuant to S.C. Code of Laws §30-4-30(B), fulfillment of FOIA requests is subject to fees for search and retrieval, as well as fees for providing copies of documents.

Fee Schedule

	Minutes/Hours	X Rate	= Cost
Search/Retrieval Time There is no retrieval charge for records retrieved and copied within ½ hour or less.		\$15.00	
Copies There is no charge for copies of records if the total number of pages responsive to the FOIA Request is 10 pages or less or if an electronic version of a record is available, and the requestor elects to receive the record electronically, then there will be no charge for copies.**	Number or Pages	Unit Price	
Black-White Paper Records/Standard Reports 8.5x11		\$0.25/page	
Color Paper Records/Standard Reports 8.5x11		\$0.50/page	
Standard Maps/Plots up to 11x 17 black-white		\$0.50/each	
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Microfiche/Microfilm Copies		\$0.25/each	
CD/DVD		\$1.00/each	
Flash Drive		\$12.00/each	
TOTAL COST			

**Please note that if the requested records are not in electronic format and our office agrees to transfer documents to an electronic format, there will be a charge for the staff time required to transfer the documents to an electronic format.

Certain **search/retrievals** may also require an additional rate.