Specifications

CAREY STATION URBAN WATER REUSE FACILITY

0.5 MGD TO 1.0 MGD EXPANSION

GREENE COUNTY, GA

for

CAREY STATION WRF, LLC

January 2025

Revision August 2025

Volume 3 of 3

I certify that I have been in responsible charge of the design of this project in accordance with the rules of the Georgia State Board of Registration for Professional Engineers and Land Surveyors. I further certify, to the best of my knowledge and belief, that these plans and specifications were prepared in accordance with current standard engineering practices and accurately reflect the Design Development Report (DDR) previously reviewed and concurred in by EPD. I further certify that the system as designed can reasonably be expected to consistently meet all currently applicable permit limits, conditions, and regulatory requirements, provided the facility is constructed as designed and properly operated and maintained.

Prepared By

GMC

Goodwyn Mills Cawood, LLC.
801 Broad Street, Suite 900
Augusta, GA 30901
www.gmcnetwork.com

GMC PROJECT NUMBER: CAUG230002

SECTION 40 75 43 – FLUORESCENT DISSOLVED OXYGEN MEASURING

PART 1 - GENERAL

1.1 SUMMARY

A. Requirements for a high-performance, digital fluorescence sensor for measurement of dissolved oxygen in liquid. The sensor will offer fast, accurate and drift-free measurement. The sensor will support low maintenance, with high availability and easy handling. The sensor's long-term stable fluorescence layer will be exclusively oxygen-selective (interference-free), ensuring consistently reliable measurement. The sensor will use Memosens® digital technology to provide maximum process and data integrity, and facilitate simple lab calibration.

B. Related Sections:

1. Control and Information Systems Scope and General Requirements.
2. Power 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.
3. Measurement accuracy.
4. Range and range ability.
5. Enclosure Rating.
6. Classification Rating.
7. Power.
8. Output options.

1.3 QUALITY ASSURANCE

A. Manufacturing facilities shall be 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 sensor shall have standard one year warranty from date of shipment and if the measuring system is commissioned by a factory certified technician, the warranty is extended to three years from the date of shipment.

B. The manufacturer's warranty does not cover normal wear and tear, damage to the sensor due to improper storage or handling, or any other mode of failure or reduced sensor life that is not a direct consequence of a manufacturing defect.

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 Oxymax COS61D digital oxygen sensor with Liquiline CM44x or CM44xR transmitter.

B. Performance Criteria:

1. Measurement Range: 0-20 mg/l, 0-200 %SAT, 0-400 hPa

2. Repeatability: ±0.5% of measuring range end

3. Max Measured Error: 0.01 mg/l or ±1 % of measured value (< 12 mg/l) ±2 % of measured value (from 12 to 20 mg/l)

4. Response time (t_{90}): 60 sec.

5. Sensor cap lifetime: >2 years (under reference operating conditions, protected against direct sunlight)

6. Temperature Sensor: NTC temperature sensor, 0-50°C (32-122°F)

C. Certifications:

1. CE marked.
2. Interference emission and interference immunity with EN 61326; 2005, Namur NE 21:2007.

D. Environment:

1. Process temperature: -5 to 55 °C (23 to 131°F).
2. Process pressure: max 10 bar (145 psi).
3. Ambient Temperature: -20 to 60°C (0 to 140°C)
4. Ingress Protection: IP68

2.2 MANUFACTURED UNITS

A. Transmitter:

1. Shall be a multi-parameter controller as specified in Section 40 75 05 and on the plans.

B. Sensor:

1. Optical fluorescence technology with minimum maintenance and maximum availability.
2. Shall incorporate digital Memosens technology with calibration saved in sensor and a high degree of EMC protection.
3. Simple single-point calibration in air, air-saturated water or in medium shall be possible.
4. Extended maintenance intervals and a high degree of long-term stability; intelligent self-monitoring shall guarantee reliable measure values.
5. Fixed, waterproof cable connection at the sensor with up to 330 feet (100 meters) length between the sensor and transmitter.

2.3 ACCESSORIES

A. Assemblies

1. Sensor mounting hardware shall be available in a modular assembly system to secure sensors in open basins, channels and tanks. Versions in stainless steel shall be available for immersion in open basins. The mounting hardware shall be applicable for nearly any type of fixing - fixing on the floor, wall or directly on a rail.

2. A retractable assemby shall be available, constructed in stainless steel and ball valve, to allow for retraction of the sensor from the process without shutting down the process.

B. Interconnecting Cable

1. The sensor cable shall be available in length up to 330 feet (100 m) with a choice of direct wire to the transmitter or connection using M12 quick connections.

2.4 REQUIRED INSTRUMENTS

A. AIT-7101

B. AIT-7102

2.5 SOURCE QUALITY CONTROL AND CALIBRATION

A. Reagents, standards and cleaning solutions for the analyzer will be supplied with MSDS data sheets.

2.6 SAFETY

A. All devices shall be suitable for operation in a non-hazardous area.

B. Device failure modes, self-monitoring characteristics and diagnosis shall follow NAMUR standard NE 43.

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. Installation will occur in strict accordance with the manufacturer's instructions and recommendation.

C. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances for proper installation of instruments.

1. General contractor.
2. Electrical or Instrumentation contractor.
3. Endress+Hauser factory trained authorized service provider or representative.
4. Site (owner/operator) personnel.
5. Engineer.

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 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 manufacturer authorized service provider – 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 75 43

SECTION 40 90 00 - INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

A. Requirements

Requirements specified in Division 01 of these Specifications form a part of Division 26. This Section covers the general requirements for furnishing and installation of the instrumentation, control and monitoring (ICM) system complete in every detail for the purposes specified and shall form a part of the other Sections of Division 26 unless otherwise specified. The other Sections of this Division shall supplement this Section as necessary.

1. Work Included
   a. The intent of Division 40 is to require that the complete Instrumentation, Control and Monitoring System, including other Sections of Division 40 shall be furnished by a single Control Systems Integrator (CSI) to assure system uniformity, subsystem compatibility and coordination of system interfaces.
   b. The new SCADA system shall deliver a complete and functional system as described herein, as per the Contract Documents, and as shown on the Contract Drawings. The SCADA system shall be capable of monitoring and performing controls (as indicated on the drawings) of Homesteads Pollution Control Facility equipment. And shall be capable of communication with the existing Piedmont Water master SCADA workstation to depict the new facility I/O points and new HMI graphics. All equipment, materials, incidentals, software, supervision, and labor shall be provided under this Contract.
   c. Furnish the tools, equipment, materials, and supplies and perform the labor required to complete the furnishing and installation of, including instrumentation signal and power conduit and wiring not specifically shown on the electrical drawings, validation, start-up and operational testing of a complete and operable ICM system as indicated on the Contract Drawings and as specified herein.
   d. Provide the equipment components, interconnections and the services of the manufacturers' engineering representatives for the engineering, implementation, startup, operation, and instruction, to ensure that the Owner receives an integrated and operational ICM system as herein specified.
   e. Coordinate with the requirements of Division 26 – Electrical, and provide for operator restart of all equipment on restoration of loss-of-power condition. Sequence automatically equipment restart and provide for time delays as necessary to prevent breaker trips on inrush from multiple equipment concurrent starting.
2. As a minimum, the CSI shall perform the following work:
   a. Implementation of the ICM system:
      i. Prepare shop drawing submittals.
      ii. Design, develop, and electronically draft loop drawings and control panel designs.

iii. Prepare the test plan, the training plan, and the spare parts submittals.
iv. Procure hardware.
v. Fabricate panels.
vi. Program the ICM system as shown on the Contract Drawings.
vii. Perform factory tests on panels.
viii. Perform bench calibration and verify calibration after installation.
ix. Oversee and certify installation.
x. Oversee, document, and certify loop testing.
xi. Oversee, document, and certify system commissioning.
xii. Conduct the performance test.
xiii. Prepare operations and maintenance manuals.
xiv. Conduct training classes.
xv. Prepare record drawings.
xvi. Prepare calibration sheets.
xvii. Certify the installation of the ICM system.

b. Integration of the ICM system with instrumentation and control devices being provided under other Sections:
   i. Develop all requisite loop drawings and record loop drawings associated with equipment provided under other Divisions and Owner equipment.
   ii. Resolve signal, power, or functional incompatibilities between the ICM system and interfacing devices.

3. Work Not Included
   a. Process piping, installation of in-line instrumentation, i.e., final control elements in process pipelines, air compressors, main air supply headers, and mechanical work as specified in other Divisions.
   b. Electrical power distribution specifically included under Division 26, circuit protection devices, power conduit and wiring indicated, local equipment control stations, and miscellaneous electrical requirements as specified in Division 26.

B. System Responsibility
1. The ICM system as specified in Division 40 is an integrated system and therefore shall be provided by a competent, qualified CSI who shall have total responsibility for the Work of Division 40. Entire system installation including calibration, validation, start-up, operational testing, and training shall be performed by qualified personnel, possessing all the necessary equipment and who have had experience performing similar installations. The System shall be integrated using the CSI's latest, most modern proven design and shall, as far as practical, be by one manufacturer.
2. The Contractor shall perform the Work under this Division 40, through the use of a qualified CSI who shall perform said Work but it shall be understood that this shall not relieve the Contractor from any responsibility under the Contract.
3. The Contractor shall be responsible for the correct installation of all hardware and systems specified in Division 40.

4. The Contractor shall be responsible to see that all instrumentation components of other Divisions, including primary measuring, indicating, transmitting, receiving, recording, totalizing, controlling, alarming devices and appurtenances are compatible and shall function as outlined, and he shall furnish and install such additional equipment, accessories and appurtenances as are necessary to meet these objectives at no additional cost to the Owner.
5. The Contractor shall use the instrument tag and equipment numbering scheme as shown in Contract Documents, for identifying components which are part of this system.
6. Due to the complexities associated with the interfacing of numerous control system devices, the CSI or vendor shall be responsible to the Contractor for the integration of the ICM system with existing devices and devices provided under other Divisions and provide a completely–integrated control system free of signal incompatibilities; this includes providing review and comment to other vendor equipment submittals and overall coordination of the system.

C. Certification of Intent:
1. Fifteen days after notice to proceed, the Contractor shall submit a certification from the selected CSI. The certification shall be typed on letterhead paper of the CSI. The certification shall be signed by an authorized representative of the CSI. The certification shall include the following statements:
   a. (Company name) "hereby certifies intent to assume and execute full responsibility to the Contractor to perform all tasks defined under Paragraph 1.01 Scope, in full compliance with the requirements of the Contract Documents."
   b. "It is certified that the quotation to the Contractor includes full and complete compliance with the requirements of the Contract Documents without exception."

D. Documentation of Instrumentation Subcontractor Qualifications:
1. General
   a. The entire control system installation including panel building, calibration, validation, start-up, operational testing, and training shall be performed by a control systems integrator (CSI) staffed with qualified personnel, possessing necessary equipment and experience in performing similar installations.
   b. The system shall be integrated using the latest, most modern proven design and shall, as far as practical, be of one manufacturer.
   c. The equipment, level of detail, and overall quality of the control system shall be consistent a typical industrial type control system.
   d. Overall system performance shall be guaranteed.
   e. Software packages shall be latest versions available.
2. System Integrator qualifications:
   a. The following system integrator is pre-qualified to perform the control system work described in Division 40:
      i. **Southern Flow Inc., Alpharetta, GA**
3. Training and Certification:

a. Completion of the following training courses (or appropriate portions thereof) or possession of the following certifications may be substituted for portions of the System Integrator's personnel experience requirements described above.
b. Project manager: Control System Engineer (CSE) registration, Professional Engineer (PE) registration, or completion of the relevant core courses in the Engineering Skills Training program.
c. Systems engineer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration, or completion of the relevant core courses in the Engineering Skills Training program.
d. Programmer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration, or completion of the relevant core courses in the Technical Skills Training program.
e. Field instrument technician: Certified Control Systems Technician (CCST) registration or completion of the relevant core courses in the Technical Skills Training program.
f. Training program curriculums as offered by ISA.
g. Training or certification does not satisfy the related project experience requirements described above.
h. Submit training and registration evidence with the above experience evidence.

E. Contract Drawings
1. Information on the Drawings
a. The following information relative to the Work of Division 40 is indicated on the Division 26 Contract Drawings.
i. Location of primary elements, control panels, and final control elements.
ii. Instrumentation signal and power conduit runs between control panels and field instruments and devices.
iii. Quantity and sizes of instrumentation conductors and cables are indicated on the drawings, but shall be verified by the Contractor.
iv. Location of all equipment having alarm and equipment status contacts.
v. Major instrument conduit runs.
2. Information Not on the Drawings
a. The following information relative to the Work of Division 40 may not be shown on the Drawings, but shall be the responsibility of the Contractor to determine, furnish, coordinate with other Trades, and submit for acceptance, based upon the systems specified.
i. Tubing for pneumatic signals, and/or power between main headers and control panels, field mounted primary elements, field instruments and final control elements.
ii. Number or sizes of tubing required for pneumatic and hydraulic signals.
iii. Point of connection to any hydraulic or pneumatic supply lines.

1.02 REFERENCES

A. Publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by basic designations only.
   1. Instrument Society of American (ISA).
      a. ISA S5.4 – Instrument Loop Diagrams.
   2. National Electrical Manufacturers Associations (NEMA).
      a. NEMA – Electrical Code.
   3. American Standard Code for Information Interchange (ASCII).
   4. Institute of Electrical and Electronic Engineers (IEEE).
      a. IEEE C62.41 – Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits.

1.03 SUBMITTALS

A. General.

Refer to the General Conditions of the Contract Documents for required method of preparation and transmittal and conform to requirements herein.

1. Pre-submittal Conference
   a. Arrange a conference with CSI, the Engineer, and the Owner within thirty (30) days after award of the Contract for the purpose of informally discussing in detail and verifying the correctness of the CSI's system engineering methods and equipment and to generally provide a framework for communication and coordination. This conference shall be attended by CSI, and duly authorized representatives of the Contractor, Engineer, and Owner.
   b. Submit 4 copies of the following items for discussion at the Pre-submittal Conference:
      i. A list of equipment and materials required for the ICM system and the manufacturer's name and model number for each proposed item. Identify items by tag number, description, function, manufacturer, model number, descriptive literature and statement as to whether item is "as specified" or "equivalent." Items identified as "equivalent" shall be accompanied by a comparative listing of the published specifications for the item specified and for the item proposed. Equivalent items shall only be accepted by the Engineer if the specified item is no longer manufactured.
      ii. A list of proposed clarifications to the Contract Documents along with a brief explanation of each. Resolution shall be subject to a separate formal submittal and review by the Engineer.
      iii. A sample of each type of submittal specified herein.
      iv. A flow chart showing the steps to be taken in preparing and coordinating each submittal.
      v. A bar-chart type schedule for all system related activities from the Pre-submittal Conference through start-up and training. Dates of submittals, design fabrication, programming, factory testing, deliveries, installation, field testing, and training shall be shown. The schedule shall be subdivided

to show activities relative to each major item or group of items when everything in a given group is on the same schedule.

vi. An overview of the proposed training plan. The Engineer will review the overview and may request changes. All changes to the proposed training shall be resolved at the Pre-submittal Conference. The overview shall include the following for each proposed course:

a) Course title and objectives.

b) Prerequisite training and experience of attendees.

c) Course content – a topical outline.

d) Course duration.

e) Course format – lecture, laboratory demonstration, etc.

vii. A preliminary copy of the ICSI Qualification submittal.

c. Take minutes of the Pre-submittal Conference, including all events, questions, and resolutions. Before adjournment, all parties must concur with the accuracy of the minutes and sign accordingly.

B. Shop Drawings

Before proceeding with any manufacturing, submit Shop Drawings for acceptance in complete bound sets indexed by specification number. Describe the items being submitted. Manufacturer's specification or data sheets shall be clearly marked to delineate the options or styles to be furnished. Submit only complete systems, not pieces of equipment from various systems. Show dimensions, physical configurations, methods of connecting instruments together, mounting details, and wiring schematics. Schematics shall be complete with tag and terminal numbers. Submit fabrication drawings, nameplate legends, and control panel internal wiring and piping schematic drawings clearly showing equipment and tag numbers on panels. Submit panel graphic drawings where applicable. Include material specifications lists where applicable. Include a draft of the theory of operation for relay logic circuits including those implemented via programmable controllers. Submit detailed field instrument installation drawings for each instrument.

C. Design Related Submittals

1. In accordance with the requirements of Section 01 - Submittals, provide the following submittals:

a. Catalog Cuts

i. Catalog information, descriptive literature, wiring diagrams, and shop drawings shall be provided for all devices, whether electrical or mechanical, furnished under Division 40. This includes, but is not limited to, primary elements, transmitters, analytical equipment, gauges, valves, controllers, indicators, power supplies, switches, lights, relays, timers, etc.

2. Component Data Sheets

a. Data sheets, specification sheets, and an instrument list shall be provided for components provided under this Section. The purpose of this material is to supplement the generalized catalog information by providing the specifics of each component (e.g., part numbers, scales, ranges, service, materials of

construction, component location, options, and the individual tag number as noted in the Contract Drawings and in Contract Documents.

b. Include such other necessary data as would provide a complete and adequate specification for reordering an exact duplicate of the original item from the manufacturer at some future date. More than one tag numbered item may be included on a sheet.

3. Sizing Calculations
   a. Complete sizing calculations shall be provided for all flow elements. The calculations shall include the process data used, minimum and maximum values, permanent head loss and all assumptions made. Equations shall be submitted for all computing modules and function generating modules and shall include the actual scaling factors and units used.
4. Panel Construction Drawings
   a. Shop Drawings and Catalog Cuts
      i. Provide detailed shop drawings and catalog cuts for panels, instrument racks, and enclosures. Drawings shall show the location of front panel and internal sub-panel mounted devices to scale and shall include a panel legend and bill of materials. Layout drawings shall show major dimensions as well as elevations, in inches from the base up, of the rows of components.
      ii. Shop drawings shall indicate location and size of available spare mounting space for rear-of-panel devices.
      iii. The panel legend shall list and identify front of panel devices by their assigned tag numbers, nameplate inscriptions, service legends, and annunciator inscriptions.
      iv. The bill of materials shall include devices mounted within the panel that are not listed in the panel legend, and shall include the device tag number, description, manufacturer, and complete model number.
   b. Color Schedule
      i. Provide a color schedule with color samples for control panels for the Owner's selection/approval.
5. Power Requirement and Heat Dissipation
   a. Provide a summary of the power requirements and heat dissipation for control panels. Power requirements shall state required voltages, currents, and phase(s) Heat dissipations shall be maximums and shall be given in BTU/Hr. Summary shall be supplemented with calculations.
6. Panel Wiring Diagrams
   a. Wiring diagrams shall be similar to those diagrams shown in the Contract Drawings, but with the addition of all auxiliary devices such as additional relays, alarms, fuses, lights, hand switches and interlocks.
   b. Provide complete terminal identification of external primary elements, panels, and junction boxes that interface directly to the panel wiring being shown. Polarity of analog signals shall be shown at each terminal.
   c. External wiring that the electrical contractor must provide and wire shall be shown as a dotted line. Special cables that are provided with the instrument shall be clearly identified.

d. Panel wiring diagrams shall identify wire numbers and types, terminal numbers, and tag numbers. Wiring diagrams shall show each circuit individually. Common or typical diagrams shall not be allowed.

e. Provide panel power wiring diagrams for panels. The diagrams shall include grounding requirements.

7. Interconnecting Wiring Diagrams

   a. Diagrams shall show component and terminal board identification numbers, external wire and cable numbers. The drawings shall show intermediate terminations between field elements and panels (e.g., terminal junction boxes) This diagram shall be coordinated with the Contractor and shall bear his mark showing that this has been done.

8. Loop Diagrams

   a. Provide an individual wiring diagram for each analog loop showing terminal numbers, the location of the DC power supply, the location of any dropping resistors, the location and connection of the surge protection devices. The loop diagrams shall meet the minimum requirements of ISA S5.4 plus the following requirements:

   b. Each loop diagram shall be divided into three areas for identification of device locations: panel face, back-of-panel, and field respectively. Each loop diagram shall list (1) Transmitter Drive Capability, (2) Loop Impedance, (3) Transmitter Reserve Drive Capability. Loop diagrams shall be on 11-inch by 17-inch Drawings.

9. Instrument Installation Details

   a. The CSI shall review the Contract Documents and develop and submit for review, complete installation details for each field mounted device and panel prior to shipment and installation. Common details, not requiring any modification, may be referenced by an index showing the complete instrument tag number, service, location, and device description. Installation details shall be provided as required to adequately define the installation of the ICM system components.

10. Operator Interface Submittal

    a. This submittal shall cover the specific plant control schemes as well as the details of the plant reports and process graphic displays.

    b. The submittal shall contain the semi-final details of all logs, reports, and process graphic displays. The specifics of what shall appear on each display and what calculations are required to support them shall be developed and submitted.

    c. Submitted process graphic displays shall be no smaller than 8.5-inches by 11-inches and in full color.

    d. A complete listing of all signals to be collected for long term historical information shall be provided. This listing shall also include frequency of data sampling and duration for which the data shall be immediately accessible.

    e. A complete listing of all signals to be collected for trend display shall be provided. This listing shall also include frequency of data sampling and duration for which the data shall be immediately accessible.

11. Process Control Strategy Submittal:

a. The process control schemes shall be developed in a ladder logic diagram or functional block (logic) diagram presentation based on information from the Contract Documents. Included with each diagram shall be:
   i. Brief Scope of the Control Function.
   ii. Listing of all scanned inputs to the control function.
   iii. A short narrative of the control strategy.
   iv. Any assumptions made in developing the program.
   v. Listing of all inputs and outputs (i.e., AI, DI, AO. DO) from the control function.
   vi. Cross reference list of all I/O showing to which I/O modules or software modules they are linked.
   vii. Listing of all operator inputs/outputs to and from the control function. Any special CRT displays related to the function shall be illustrated. A description of the operation of any panels shall be described as it relates to the control function.
   viii. Failure contingencies shall be described in detail.
   ix. A flowchart representing the control strategy.

b. This submittal shall cover all of the associated logic developed under the CSI required to implement the control functions specified.

c. The System Integrator shall submit annotated logic on 8-1/2-inch x 11-inch format and as an ASCII file on compact diskettes for all logic developed. Annotation shall be 3 lines of 6 characters each for every logic contact. In addition, each network or rung shall be annotated so that a non-technical person can read and easily comprehend what control function the rung or network is performing.

d. This submittal shall also include copies of the PLC I/O configuration tables, I/O reference usage table, complete cross reference to specific rung used of all inputs, outputs, internal coils, data registers, and special purpose coils. In addition, any special switch settings or hardware configuration requirements such as com port configurations shall be described in detail and submitted.

D. Test Related Submittals

Provide five (5) copies of the following:

1. Operational Field Acceptance Test (OAT) Documentation.

   The CSI shall submit an example of each type of Instrument Calibration Sheet and Loop Status Report that will be used for the OAT.

   After acceptance of the examples, the CSI shall prepare Loop Status Report Sheet(s) for each loop and an Instrument Calibration Sheet for each active ICM system element (except simple hand switches, lights, etc.) These sheets shall be submitted after the tests are completed.

   a. Instrument Calibration Sheets.
      i. Provide a written report to the Engineer on each instrument certifying that it has been calibrated to its published specified accuracy. This report shall include all applicable data as listed below plus any defects noted, correction

action required, and correction made. Data shall be recorded on prepared forms and shall include not less than the following items:

a) Facility identification (Name, location, etc.)
b) Loop identification (Name or function)
c) Equipment tag and serial numbers.
d) Scale Ranges and units.
e) Test mode or type of test.
f) Input values or settings.
g) Expected outputs and tolerances
h) Actual readings at 10%, 50%, and 90% of span.
i) Explanations or special notes as applicable.
j) Date, time, and weather.
k) Tester's certification with name and signature.

2. Functional Acceptance Test Documentation.

The CSI shall prepare two types of test procedures and forms as follows.

a. Loop Test Documentation

For functions that can be demonstrated on a loop-by-loop basis, the form shall include:

i. Project Name.
ii. Loop number.
iii. Loop description.
iv. Test procedure description, with a space after each specific test to facilitate sign off on completion of each test.
v. For each component: tag number, description, manufacturer, and data sheet number.
vi. Space for sign off and date by the CSI, the Contractor, and the Engineer.

b. Functional Test Documentation

For those functions that cannot be demonstrated on a loop-by-loop basis, the test form shall be a listing of the specific tests to be conducted. With each test description the following information shall be included:

i. Specification page and paragraph of function demonstrated.
ii. Description of Function.
iii. Test procedure description.
iv. Space after each specific test to facilitate signoff on completion of each test.

E. Testing

1. Factory Testing, field Testing, and Final Acceptance Testing shall be provided.
2. System Commissioning Assistance.

a. Provide the services of a factory trained and field experienced instrumentation engineer to assist Owner's personnel during each startup of the various systems. Purpose of this assistance is to support in making final adjustments of settings on the instrument systems.

F. Operation & Maintenance Manuals.

Furnish Instruction Manuals and Parts Lists for instrumentation equipment in accordance with the requirements of Division 1 and as noted herein.

1. Schedule.
   a. Deliver manuals not later than the equipment shipment date. After installation is complete, update the manuals to reflect any changes which occurred during installation and deliver balance of manuals to Engineer.
2. Material Content. Include in the manuals not less than the following applicable information for each instrument, equipment, subsystem and/or control loop. The O&M Manuals shall consist of, at least, the following material:
   a. Bill of Materials.
      i. A listing of all the panels, racks, instruments, components, and devices supplied. Components shall be grouped by component type, with the component types identified in a similar manner to the component identification code used in these specifications. The list shall contain, as a minimum:
         a) Instrument, panel, rack or device tag number.
         b) Description.
         c) Quantity supplied.
         d) Reference to component data sheet and/or catalog cut.
         e) Component type.
   b. Component Data Sheets.
      i. See Paragraph 1.03 C.2 specified herein before.
   c. Catalog Cuts.
      i. See Paragraph 1.03 C specified herein before.
   d. Component O&M Manuals.
      i. An O&M manual shall be submitted for instruments and devices supplied. The O&M manuals shall contain, as a minimum:
         a) Operating procedures.
         b) Installation procedures.
         c) Maintenance procedures.
         d) Troubleshooting procedures.
         e) Calibration procedures.
         f) Internal device schematics and wiring diagrams.
         g) Shut-down procedures.
         h) Component parts list.
         i) Detailed circuit operational description including annotated programmable controller ladder diagrams.
   e. Spare Parts and Expendables List

i. The spare parts and expendables list shall include not only those items supplied, but also the additional items recommended for successful long term operation.

f. "As-Shipped" Drawings

i. Drawings shall be a record of work "As-Shipped" from the factory and shall be labeled as "As-Shipped". One copy of applicable schematics and diagrams shall be placed in each control panel in a protective envelope or binder. Provide the following "As-Shipped" drawings as a minimum:

a) Panel Fabrication Drawings.

b) Panel Wiring and Interconnection Drawings.

G. Final Record Documentation's

1. Reproducible Drawings. Contractor shall submit reproducible's of finished schematics, wiring diagrams and installation drawings to include installed field and panel instruments, mounting details, point to point diagrams with a cable, wire, and termination numbers. Drawings shall be a record of work as actually constructed and shall be labeled as "RECORD DOCUMENTS", in accordance with the requirements of Section 01 – Contract Closeout. One copy of applicable schematics and diagrams shall be placed in each control panel in a protective envelope or binder.

a. Loop Diagrams.

1) See Paragraph 1.03 C.8 specified herein before.

b. Panel Fabrication and Wiring diagrams.

1) See Paragraph 1.03 C.4 and 1.03 C.6 specified herein before.

c. Interconnecting Wiring Diagrams.

1) See Paragraph 1.03 C.7 specified herein before.

d. Instrument Installation Details.

1) See Paragraph 1.03 C.9 herein before.

2. Process and Instrumentation Diagrams (P&ID's).

a. The Engineer will supply the Contractor with P&ID's on magnetic media for revisions to reflect the final installed system.

b. The P&ID's shall be updated by the Contractor who may use these drawings for producing the final documentation.

3. Software Documentation. In addition to the reproducible hard copy of drawings and literature generated specifically for the project, Contractor shall submit electronic copy to the Engineer with all custom files specifically created to generate the drawings, data sheets, bill of materials, operating procedures etc. Drawing format shall be compatible with AutoCad ver. 2018 or newer.

H. Training Requirements.

1. General:

a. Contractor shall provide the services of a CSI factory trained and field experienced instrumentation engineer to conduct group training of Owner's designated personnel in the operation of each instrument system. Obtain Owner's written consent that the training has been adequate. Include instruction covering basic system theory, operating principles and adjustments, routine

maintenance and repair, and "hands on" operation. The text for this training shall be the P & ID's, graphic operation interface, PLC and SCADA software, panel wiring diagrams and layouts, and the operation and maintenance manuals furnished under these Specifications.

2. Duration:
   a. Training specific to the system control panel hardware and software. This training shall be for a minimum time period of 30-8-hour days and 6 trips. This training shall be separate from start-up and testing.
3. Operator Training:
   a. Operator training shall include instruction in the use of Control Panels and Field Panels furnished.
4. Maintenance Training:
   a. Maintenance training shall include instruction in the calibration, maintenance, and repair required for all instruments.

I. Post-Contract System Support.
1. Maintenance Contract:
   a. Duration.
      i. Provide a 1 year maintenance contract for components furnished starting from the date of acceptance.
   b. Schedule.
      i. Develop a program of preventive maintenance visits that includes verification of instrument performance on a monthly basis and complete calibration of instruments on a semi-annual basis. After every visit, submit to the Owner records of instrument verification and calibration on appropriate forms.

J. Guarantee and Warranties
1. The equipment manufacturers shall warrant and guarantee against defective equipment, workmanship, and materials under normal use, operation and services, unless otherwise noted in other Division 40 Sections shall be for a period of 2 years after acceptance from the final date or final resolution of the Owner acceptance of Work as substantially complete. For equipment bearing a manufacturer's warranty in excess of two years, furnish a copy of the warranty to Engineer with Owner named as beneficiary.

PART 2 - PRODUCTS

2.01 HARDWARE REQUIREMENTS

A. Job Conditions.
1. Contract Drawings are diagrammatic and show the intended arrangement for system operation, piping, and appurtenances. Conform to Contract Drawings as closely as possible and exercise care (1) to secure neat arrangement of piping, valves, conduit, and like items, and (2) to accommodate structural features. Verify dimensions and

conditions at the project site, and install materials and equipment in the available spaces.

B. Materials and Standard Specifications.

1. Provide instruments, equipment and materials suitable for service conditions and meeting standard specifications such as Instrument Society of America (ISA). The intent of this Specification is to secure instruments and equipment of a uniform quality and manufacture throughout the facilities, instruments supplied by the Contractor, of the same type shall be by the same manufacturer. All panel mounted instruments shall have matching style and general appearance. All meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise required to match existing equipment. This allows the stocking of the minimum number of spare parts.

C. Product Delivery, Storage, and Handling.

1. Box, crate, or otherwise enclose and protect instruments and equipment during shipment, handling, and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids and gases or any element which could degrade the equipment. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Repair any damage as directed and approved.

D. Mountings.

1. Mount and install equipment as indicated. Where not shown, mount field instruments according to best standard practice on pipe mounts, pedestal mounts, or other similar means in accordance with suppliers recommendation. Unless specified otherwise all mounting hardware shall be stainless steel. Where mounted in control panels, mount according to manufacturer recommendations.
2. Equipment specified for field mounting shall be suitable for direct pipe mounting, pedestal mounting, or surface mounting. Non in-line indicators and equipment with calibration adjustments or requiring periodic inspection shall be mounted not lower than three (3) feet nor higher than five (5) feet above walkways, platforms, and catwalks. Such equipment shall be weather and splash proof, and corrosion resistant and electrical equipment shall be in Type 316 stainless steel NEMA 4X cases unless otherwise noted.

E. Instrument Identification.

1. Components provided under this Section, both field and panel mounted, shall be provided with permanently mounted name tags bearing the entire ISA tag number of the component. Panel mounted tags shall be plastic; field mounted tags shall be stamped stainless steel.
2. Nameplates for panels and panel mounted equipment shall be as specified on the design documents.
3. Field mounted tags shall be 16-gauge, Type 304 stainless steel with 3/16-inch high characters.
4. Tags shall be attached to equipment with a commercial tag holder using a stainless steel band with a worm screw clamping device or by a holder fabricated with

standard stainless steel hose clamps and meeting the same description. In some cases where this would be impractical, use 20 gage stainless steel wire.

5. For field panels or large equipment cases use stainless steel screws, however, such permanent attachment shall not be on an ordinarily replaceable part. In each case, the tag shall be plainly visible to a standing observer and not obscure adjustment ports or impair the function of the instrument. Field mounted control stations, recorders or indicators shall have a nameplate indicating their function and the variable controlled or displayed. Nameplate shall be attached by one of the above methods.

F. Electronic Equipment.

1. If the equipment is electronic in nature, provide solid state equipment to the greatest extent practicable. Select components of construction for their suitability and reliability. Employ adequate component derating to preclude failures because of transients and momentary overloads reasonably expected in normal operation. Where conduit connection is provided for mounting a surge/lightning suppresser directly to the instrument, the arrestor shall be so mounted. Field equipment shall have a Joslyn (or accepted equal) surge suppresser mounted on the instrument housing, if such mounting is provided on the instrument, otherwise a threaded surge suppresser connection shall be provided on the conduit as close as practical to the instrument. See Section 16473 – Low Voltage Surge Suppression Devices.

G. Equipment Operating Conditions.

1. Equipment shall be rated for normal operating performance with varying operating conditions over the following minimum ranges:
2. Power:
   a. Electrical. 115 VAC +/- 10%, 60 Hz +/-1 Hz except where specifically stated otherwise on the drawings or in the specifications.
3. Field Instruments:
   a. Atmospheric contaminants (All Areas):
      i. Hydrogen Sulfide: 0.1 mg/l.
      ii. Chlorine: 0.01 mg/l.
      iii. Ammonia: 0.5 mg/l.
      iv. Dust: 50.0 µg/m3.
   b. Outdoor Areas:
      i. Ambient Temperature: -20°F to +120°F.
      ii. Ambient Relative Humidity: 10% to 100%.
      iii. Weather: Rain, wind, sun and blowing sand.
4. Indoor Environmentally Uncontrolled Areas:
   a. Ambient Temperature: 40°F to +105°F.
   b. Ambient Relative Humidity: 20% to 80%.
5. Indoor Environmentally Controlled Areas:
   a. Ambient Temperature: 55°F to +85°F.
   b. Ambient Relative Humidity: 20% to 80%.

c. Short term excursions to temperature limits for non-environmental controlled areas.

6. Provide, as necessary, enclosures, heat tracing, heaters and sunshields, etc. to assure normal operations under these conditions.
7. Corrosive Areas: Provide instrument enclosures and hardware suitable for the corrosive location.
8. Hazardous Areas: All equipment used in areas designated as hazardous shall be designed for the Class, Group, and Division as required on the Contract Drawings for the locations. All Work shall be in strict accordance with codes and local rulings, should any work be performed contrary to said rulings, ordinances and regulations, the Contractor shall bear full responsibility for such violations and assume all Owner costs arising there from.

H. Power Supplies.
1. Provide electrical instruments and control devices for operation on 120 VAC, 60 Hz current. Protect each device power supply with properly sized fuses.
2. Unless otherwise indicated provide battery backed up Uninterruptable Power Supply (UPS) with AC inversion for each control panel and PLC. UPS shall be sized to run the peak tributary load for a period of not less than 30 minutes. UPS shall be mounted in the respective panel. Minimum UPS size shall be 990 watt-hour. Provide bypass switch for panels to run directly from power source or through UPS with front of panel mounted indicator light showing current models.
3. Output overvoltage and overcurrent protective devices shall be provided for DC power supplies to protect instruments from damage due to power supply failure and to power supply from damage due to external failure. Power supplies shall be provided with NEMA 1 enclosures. Power supplies shall be mounted such that dissipated heat does not adversely affect other components. Source of operating power shall be 120 VAC, 60 Hz commercial power. Units shall be mounted within the control panels. Power supply fusing shall be provided with blown fuse indicators.

I. Signal Isolators, Converters and Conditioners.
1. Insure that input-output signals of all instruments and control devices (new and existing) are compatible. Analog signals between field and panels shall be 4-20 mA unless specifically accepted otherwise. Granting such acceptance does not relieve the Contractor from the compatibility requirement above. Provide signal isolators and converters as necessary to obtain the required system performance. Mount the devices behind control panels or in the field at point of application, as required for accurate signal acquisition.

J. Auxiliary Contacts by Others.
1. Provide instruments and equipment to connect to auxiliary contacts provided by others for alarms, status of equipment, interlocking, and other functions as indicated and as specified herein.

K. Painting.
1. Provide factory paint for instruments and equipment except where in pipelines.

L. Electrical.

1. Work shall include the power supply wiring, instrumentation wiring, interconnecting wiring and equipment grounding as indicated, specified and required and not specifically included under Division 26.
2. Wiring installations shall include cables, conductors, terminals, connectors, wire markers, conduits, conduit fittings, supports, hardware and all other required materials not specifically included in the Work of other Divisions.
3. Provide the materials and complete the required installations for equipment grounding as specified in Division 26 of these Specifications and indicated on the Contract Drawings.
4. Incidental items not specifically included in the Contract Documents that can legitimately and reasonably be inferred to belong in the instrumentation work shall be provided and installed by the Contractor at no additional cost to the Owner.
5. Field Wiring. For wiring materials, refer to Division 26 and Details on the Contract Drawings. Test signal wiring for continuity prior to termination. Provide wire number tags marked in indelible waterproof form of slip-on type heat shrink label or equal for each termination.

M. Process Connections.

1. Provide instrument piping, tubing, and capillary tubing to meet the intended process service and ambient environmental condition for corrosion resistance, etc. All instrument pneumatic tubing shall be Type 316 stainless steel. Slope lines according to service to promote self draining or venting back to the process. Terminate connection to process lines or vessels in a service rated block valve that will permit closing off the sense line or removal of the element without requiring shut down of the process. Include drip legs and blow-down valves for terminations of sense lines at the instruments when mounted such that condensation can accumulate. Process vessels, line penetrations, connecting fittings, and block valves shall be furnished and installed under other Divisions of these Specifications but coordinated by Division 40.

N. Electrical Transient Protection.

1. Instrument and control equipment mounted outside of protective structures (field mounted equipment) shall be equipped with surge-arresting devices to protect the equipment from damage due to electrical transients induced in the interconnecting lines from lightning discharges or nearby electrical devices. Both power and signal circuits shall be protected with surge and transient protectors installed at the source and destination ends of the circuits. Protective devices used on 120 VAC inputs to field mounted equipment shall be secondary surge protectors conforming to the requirements of IEEE C62.41 8/20μs wave form.
2. Surge and transient protectors shall be normally connected to the electrical system ground. When an electrical system ground is not available near the device, the protectors shall be connected to a ground rod located within 10 feet of the device. The ground rod shall meet all the requirements of Section 26 05 26 - Grounding and Bonding, in Division 26, Electrical.

3. Protectors for analog signal circuits on or near field instrument housings shall be Innovative Technology Model OEM D22TX, Phoenix Contact Surge Trab Series, or accepted equal.
4. Protectors shall be provided for conductors penetrating panel enclosures for power circuits protectors shall be Innovative Technology Model HS-P-5P secondary arrestor, Phoenix Contact PT Series, or accepted equal. For analog and data circuits protectors shall be rail mounted Innovative Technology Model HS, or accepted equal. Protectors for data utilizing coaxial connections shall be Innovative Technology, or accepted equal. Provide multi-stage gas tube and solid state Innovative Technology, or accepted equal, protectors for digital circuits.

O. Spares and Maintenance Materials.
1. Furnish the following items as specified herein. Deliver to Engineer, as directed, with itemized list in a letter of transmittal accompanying each shipment.
2. Materials shall be delivered in the manufacturer's original containers labeled to completely describe contents and equipment for which it is furnished.
3. One Fuse of each size and type for every five used but no less than five of each type.
4. One Relay of each type for every five used but no less than two of each type.
5. One Panel Indicating Light Bulb for every five used but no less than four of each type.
6. One Transient Protector for every five used but no less than four of each type.

PART 3 - EXECUTION

3.01 PRODUCT HANDLING

A. Shipping Precautions: After completion of shop assembly, factory test, and acceptance, all equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weight shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.

B. Special Instructions: Special instructions for proper field handling, storage, and installation required by the Manufacturer shall be securely attached to each piece of equipment before packaging and shipment.

C. Tagging: Each component shall be tagged to identify its location, instrument tag number, and function in the system. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as given in the tabulation, shall be provided on each piece of equipment in the ICM system. Identification shall be prominently displayed on the outside of the package.

D. Storage: Equipment shall not be stored outdoors. Equipment shall be stored in dry permanent shelters, including in-line equipment, and shall be adequately protected

against mechanical injury. If any apparatus has been damaged, such damage shall be repaired by the Contractor at no additional cost to the Owner. If any apparatus has been subject to possible damage by water, it shall be thoroughly dried out and put through tests as directed by the Engineer. Such tests shall be at no additional cost to the Owner, and if the equipment fails the tests, it shall be replaced at no additional cost to the Owner.

E. Protection during Construction: Instrumentation and Controls shall at all times during construction be adequately protected against mechanical injury, water damage, corrosion, dirt, dust and foreign material. Equipment equipped with internal electrical heaters shall have them energized to keep the equipment dry. Doors to control panels and cabinets shall be kept closed at all times when work on them is not being done. Control Panels, Analyzers, sensitive electronic or computer equipment and/or controls or other materials not sealed and/or suitable for continuous outdoors storage shall not be stored out-of-doors. Such Instrumentation and Controls shall be stored in dry permanent shelters.

F. Paint Finish: Any damage to factory applied paint finish shall be repaired using touch-up paint furnished by the instrument or equipment manufacturer.

3.02 MANUFACTURER'S SERVICES

A. Furnish the following Manufacturer's services for all instrumentation provided:
   1. Perform bench calibration.
   2. Oversee installation.
   3. Verify installation of installed instrument.
   4. Certify installation and reconfirm Manufacturer's accuracy statement.
   5. Oversee loop testing, prepare loop validation sheets, and certify loop testing.
   6. Oversee pre-commissioning, prepare pre-commissioning validation sheets, and certify pre-commissioning.
   7. Train the Owner's personnel.

3.03 INSTALLATION

A. General:
   1. All instrumentation, including instrumentation furnished under other Divisions, shall be installed per the manufacturers' instructions and Division 40.
   2. Equipment Locations: The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the Owner exercises the right to require changes in location of equipment that do not impact material quantities or cause material rework, make such changes without additional cost to the Owner.

B. Conduit, Cables, and Field Wiring
   1. All conduit shall be provided, in accordance with Section 26 05 33.

2. All 4-20 mA signal circuits, process equipment control wiring, signal wiring to field instruments, remote I/O, PLC I/O, and other non-specialty field wiring and cables shall be provided and installed, in accordance with Section 26 05 05.
3. All ICM system specialty cables, data highway fiber optic cable and specialty cable termination devices shall be provided under Division 40 and installed, in accordance with Section 26 05 05..
4. All field cables and wiring terminations and wire identification at ICM system equipment furnished under this or any other Division shall be provided in accordance with the requirements of Section 26 05 05. All terminations shall be checked by the equipment supplier and the electrical contractor.

C. Instrumentation Tie-Downs: All instruments, control panels, and equipment shall be anchored by methods that comply with seismic requirements that apply to the site.

D. Existing Instrumentation: Each existing instrument to be removed and reinstalled shall be cleaned, reconditioned and recalibrated by an authorized service facility of the instrument Manufacturer. Provide certification of this Work before reinstallation of each instrument. Provide replacement for interim period as required.

E. Ancillary Devices: The Contract Documents show all necessary conduit and instruments required to make a complete instrumentation system. The Contractor shall be responsible for providing any additional or different type connections as required by the instruments and specific installation requirements at no additional cost to the Owner. All such additions and all such changes, including the proposed method of installation, shall be submitted to the Engineer for acceptance before commencing the Work. Such changes shall not be a basis of claims for extra work or delay.

F. Installation Criteria and Validation: All field-mounted components and assemblies shall be installed and connected according to the requirements below:
1. Installation personnel have been instructed on installation requirements of the Contract Documents.
2. Technical assistance is available to installation personnel at least by telephone.
3. Installation personnel have at least one copy of the accepted and approved shop drawings and data.
4. Instrument process sensing lines shall be installed similar to conduit. Individual tubes shall run parallel and near the surfaces from which they are supported. Supports shall be used at intervals of not more than 3-feet of rigid tubing.
5. Bends shall be formed to uniform radii with the proper tool without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square-cut and cleaned before being inserted in the fittings. Bulkhead fittings shall be provided at all panels requiring pipe or tubing entries.
6. All differential pressure elements shall have three valve manifolds.
7. All flexible cables and capillary tubing shall be installed in flexible conduits. The lengths shall be sufficient to withdraw the element for periodic maintenance.
8. All power and signal wires shall be terminated with crimped type lugs.
9. All connectors shall be, as a minimum, water tight.

10. All wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.
11. All wire and cable shall be arranged in a neat manner and securely supported in cable groups and connected from terminal to terminal without splices unless specifically accepted by the Engineer. All wiring shall be protected from sharp edges and corners.
12. All mounting stands and bracket materials and workmanship shall comply with requirements of the Contract Documents.
13. Verify the correctness of each installation, including polarity of electric power and signal connections, and making sure all process connections are free of leaks. Certify in writing that for each loop or system checked out, all discrepancies have been corrected.
14. The Owner will not be responsible for any additional cost of rework attributable to actions of the Contractor or the CSI.

3.04 CALIBRATION

A. General: All devices provided under the instrumentation Sections shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.

B. Calibration Points: Each instrument shall be calibrated at 20, 40, 60, 80 and 100% of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to National Institute of Testing Standards.

C. Bench Calibration: Instruments that have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the Engineer.

D. Field Calibration: Instruments that were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument loop diagrams or specification data sheets.

E. Analyzer Calibration: Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. All samples and sample gases shall be furnished by the manufacturers.

F. Calibration Tags: A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the Engineer. Have the Instrumentation Supplier sign the tag when calibration is complete. The Engineer will sign the tag when the calibration and testing has been accepted.

3.05 LOOP TESTING

A. General: Individual instrument loop diagrams per ISA Standard S5.4 - Instrument Loop Diagrams, expanded format, shall be submitted to the Engineer for review before the loop tests. The Contractor shall notify the Engineer of scheduled tests a minimum of 30 days before the estimated completion date of installation and wiring of the ICM. After the

Engineer's review of the submitted loop diagrams for correctness and compliance with the specifications, loop testing shall proceed. The loop check shall be witnessed by the Engineer.

B. Control Valve Tests: All control valves, cylinders, drives and connecting linkages shall be stroked from the operator interface units as well as local control devices and adjusted to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position. Control valve actions and positioner settings shall be checked with the valves in place to ensure that no changes have occurred since the bench calibration.

C. Interlocks: All hardware and software interlocks between the instrumentation and the motor control circuits, control circuits of variable-speed controllers and packaged equipment controls shall be checked to the maximum extent possible.

D. Instrument and Instrument Component Validation: Each instrument shall be field tested, inspected, and adjusted to its indicated performance requirement in accordance its Manufacturer's specifications and instructions. Any instrument that fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the direction of the Engineer at no additional cost to the Owner.

E. Loop Validation: Controllers and electronic function modules shall be field tested and exercised to demonstrate correct operation. All control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the graphic displays associated with the SCADA and PLC. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested. Specified accuracy tolerances for each analog network are defined as the root-mean-square-summation of individual component accuracy requirements. Individual component accuracy requirements shall be as indicated by Contract requirements or by published manufacturer accuracy specifications, whenever Contract accuracy requirements are not indicated. Each analog network shall be tested by applying simulated analog or discrete inputs to the first element of an analog network. For networks that incorporate analog elements, simulated sensor inputs corresponding to 20, 40, 60, 80 and 100% of span shall be applied, and the resulting element outputs monitored to verify compliance to calculated root-mean-square-summation accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation and setting of discrete devices. Provisional settings shall be made on controllers and alarms during analog loop tests. All analog loop test data shall be recorded on test that include calculated root-mean-square-summation system accuracy tolerance requirements for each output.

F. Loop Validation Sheets: Prepare loop confirmation sheets for each loop covering each active instrumentation and control device except simple hand switches and lights. Loop confirmation sheets shall form the basis for operational tests and documentation. Each loop confirmation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete loop provided by the CSI:

1. Project name.
2. Loop number.
3. Tag number, description, manufacturer and model number for each element.
4. Installation bulletin number.
5. Specification sheet number.
6. Loop description number
7. Adjustment check.
8. Space for comments.
9. Space for loop sign-off by Instrumentation Supplier and date.
10. Space for Engineer witness signature and date.

G. Loop Certifications: When installation tests have been successfully completed for all individual instruments and all separate analog control networks, a certified copy of all test forms signed by the Engineer as a witness, with test data entered, shall be submitted to the Engineer together with a clear and unequivocal statement that all instrumentation has been successfully calibrated, inspected, and tested.

3.06 PRE-COMMISSIONING

A. General: Pre-commissioning shall start after acceptance of all wire test, calibration tests and loop tests, and all inspections have demonstrated that the instrumentation and control system complies with all Contract requirements. Pre-commissioning shall demonstrate proper operation of all systems with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.

B. Pre-commissioning Procedures and Documentation: All pre-commissioning and test activities shall follow detailed test procedures and check lists accepted by the Engineer as submitted by the CSI. All test data shall be acquired using equipment as required and shall be recorded on test forms accepted by the Engineer, that include calculated tolerance limits for each step. Completion of all system pre-commissioning and test activities shall be documented by a certified report, including all test forms with test data entered, delivered to the Engineer with a clear and unequivocal statement that all system pre-commissioning and test requirements have been satisfied.

C. Operational Validation: Where feasible, system pre-commissioning activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal final control element operating conditions in terms of applied process loads, operating ranges, and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. All hardwired and software control circuit interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady-state operation of final control elements running under the control of field mounted automatic analog controllers or software based controllers shall be assured by adjusting the controllers as required to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of field mounted, and software based automatic

analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any) and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates.

D. Loop Tuning: All electronic control stations incorporating proportional, integral or differential control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset, or rate settings as required to achieve a proper response. Measured final control element variable position/speed set point settings shall be compared to measured final control element position/speed values at 20, 40, 60, 80 and 100% of span and the results checked against indicated accuracy tolerances.

E. Pre-commissioning Validation Sheets: Pre-commissioning shall be documented on one of two types of test forms as follows:
   1. For functions that can be demonstrated on a loop-by-loop basis, the form shall include:
      a. Project name.
      b. Loop number.
      c. Loop description.
      d. Tag number, description, manufacturer and data sheet number for each component.
      e. Space for sign-off and date by both the CSI and the Engineer.
   2. For functions that cannot be demonstrated on a loop-by-loop basis, the test form shall be a listing of the specific tests to be conducted. With each test description, the following information shall be included:
      a. Specification page and paragraph of function demonstrated.
      b. Description of function.
      c. Space for sign-off and date by both the CSI and the Engineer.

F. Pre-commissioning Certification: Submit an ICM system pre-commissioning completion report that shall state that all Contract requirements have been met and shall include a listing of all instrumentation and control system maintenance and repair activities conducted during the pre-commissioning testing. Acceptance of the instrumentation and control system pre-commissioning testing must be provided in writing by the Engineer before the performance testing may begin. Final acceptance of the control system shall be based upon plant completion as stated in the General Conditions.

3.07 ONSITE SUPERVISION

A. Furnish the services of an on-site service engineer to supervise and coordinate installation, adjustment, testing, and start-up of the ICM system. The Engineer will be present during the total period required to affect a complete operating system. A qualified team of the Instrumentation Subcontractor personnel shall be on site as required to check all equipment, perform the tests indicated in this Section, and furnish startup services.

3.08 PERFORMANCE TEST

A. The entire ICM system shall operate for 30 days without failure.

B. Furnish all necessary support staff as required to maintain the system and to satisfy the repair or replacement requirements.

C. If any component fails during the performance test, it shall be repaired or replaced within 4 hours and the ICM system shall be restarted. If the system is not repaired and running within four (4) hours or more than six component failures within the four (4) hour repair period, the system shall be restarted and operate for an additional 30 days without failure.

3.09 TRAINING

A. Test entire ECM system.

B. General: Train the Owner's personnel on the maintenance, calibration and repair of all instruments provided under this Contract.

C. Instructions: The training shall be performed by qualified representatives of the equipment manufacturers and shall be specific to each piece of equipment.

D. Duration: Each training class shall be a minimum of 8 hours in duration and shall cover, as a minimum, operational theory, maintenance, troubleshooting/repair, and calibration of instruments. Include a minimum of 4 hours training per instrument or control device; for PLC, and software include 8 hours for each type supplied.

E. Schedule: Training shall be performed during the pre-commissioning phase of the project and 30 days after acceptance. The training sessions shall be scheduled a minimum of 3 weeks in advance of when the courses are to be initiated. The Owner and Engineer will review the course outline and the training manual as submitted by the CSI for suitability and provide comments that shall be incorporated.

F. Agenda: The training shall include operation and maintenance procedures, trouble shooting with necessary test equipment, and changing set points, and calibration for that specific piece of equipment.

G. Documentation: Within 10 days after the completion of each session the Contractor shall submit the following:
   1. List of all Owner personnel who attended the session.
   2. Evaluation of Owner personnel via written testing or equivalent evaluation.
   3. Copy of the training materials used including all notes, diagrams, and comments.

3.10 ACCEPTANCE

A. For the purpose of this Section, the following conditions shall be fulfilled before the Work is considered substantially complete:
   1. All submittals have been completed and accepted.
   2. The ICM system has been calibrated, loop tested and pre-commissioned.

3. The Owner training has been performed.
4. All required spare parts and expendable supplies and test equipment have been delivered to the Owner.
5. The performance test has been successfully completed.
6. All punch-list items have been corrected.
7. All record drawings in both hard copy and electronic format have been submitted.
8. Revisions to the operations and maintenance manuals information that may have resulted from the field tests have been made and reviewed.
9. All debris associated with installation of instrumentation has been removed.
10. All probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

3.11 WARRANTY

A. Supplier shall warrant design, materials, and workmanship for customary period applicable for the equipment involved, but in no case for less than 24 months from date of acceptance, in accordance with the requirements of Paragraph 1.03, J, 1.

B. During warranty period, if mechanical defects occur, or equipment fails to perform in accordance with specified performance requirements under conditions of normal use within the design limitations of the equipment, supplier shall, upon request of the company, repair or replace equipment or parts as required and shall place equipment in proper working condition, assuming all expenses involved.

C. A written prepaid maintenance contract executed by the CSI shall be provided to the Owner for on-site warranty and travel maintenance services, in accordance with the requirements of Paragraph 1.03, H, and Paragraph I, 1. This maintenance contract shall include all travel and living expenses, labor, parts, and emergency calls providing on-site response within 4 hours, to provide complete system maintenance for a period of one year after the date of final acceptance of the system.

D. The maintenance contract shall include a minimum of 4 (quarterly) preventive maintenance visits by a qualified serviceman of the Supplier who is familiar with the type of equipment and software provided for this project. Each preventive maintenance visit shall include routine adjustment, calibration, cleaning, and lubrication of system equipment and written verification of calibration and correct software operation.

E. An annual fee shall be quoted 90 days before completion of the first year maintenance contract for annual maintenance subsequent to the first year of operation. Standard per diem rates for providing breakdown service shall be set forth in the contract. Such rates shall be fair and reasonable and reflect the lowest rates offered to most favored customers. The fee quoted shall be firm for a minimum of 90 days from day of issue.

END OF SECTION

SECTION 40 94 03 - PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

PART 1 - GENERAL

1.01 SCOPE

A. General - This section describes the Programmable Logic Controller (PLC), Input/Output (I/O) equipment, Operator Interface Terminal (OIT), fiber optic industrial Gigabit Ethernet and associated network communication equipment, and associated hardware and equipment, PLC programming software, Human Machine Interface (HMI) SCADA application software including all engineering and programming and development required for monitoring and control. All devices, accessories, programming, and appurtenances required for proper operation of a complete and functional Instrumentation Control and Monitoring (ICM) system shall be provided.

1. The SCADA system shall be designed, coordinated, and supplied by a Control System Integrator (CSI) consisting of PLC based data acquisition and operator interface graphic display systems, who shall guarantee satisfactory operation of the installed ICM system.
2. Develop and provide the PLC and SCADA HMI and OIT graphic display applications programs and hardware configuration needed to monitor and control the process equipment to perform the functional requirements as specified in Division 40 Sections or as required by the process equipment manufacturers and as required by and described in these Contract Documents.
3. SCADA PLC's shall be configured and provided with hardware necessary to communicate with Ethernet enabled process instrumentation and equipment as required in these specifications.
4. In general, communication network from structure to structure shall be via industrial redundant, self-healing Ethernet optical fiber network. Each PLC and Operator Workstation shall be provided with a UPS with a 30-minutes full load minimum. In the event of local power failure, the PLC shall automatically stop fault sequencing, PID windup, and continue accumulation of data and process calculations while notifying the operator via the HMI screens. Communication shall continue with PLC and workstations.

1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1. National Electrical Manufacturers Association (NEMA).
2. Instrument Society of America (ISA).

1.03 SUBMITTALS

A. The Contractor shall make submittals in accordance with Divisions 01 and 40.

B. The following information shall be provided:

1. Electronic copy of each of the following shall be submitted:
   a. Manufacturers complete data.
   b. Shop drawings, which include the following:

i. Outline drawings of all components and a composite drawing.
ii. Schematic drawings of auxiliary piping and wiring.

2. Electronic copy of each of the following shall be submitted:
   a. Operation and maintenance manual.
   b. Training documentation.

1.04 TESTING

A. Factory testing, field testing, and final acceptance testing of computers and programmable logic controllers shall conform to the requirements of Section 40 90 00.

1.05 WARRANTY

A. Conform to warranty requirements of Division 40.

B. The equipment manufacturers shall warrant and guarantee against defective equipment, workmanship, and materials under normal use, operation and service, for a period of 2 years after acceptance from the final date or resolution of the Owner accepting Work as substantially complete.

1.06 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as required. In addition, the following specific spare parts items shall be provided:
   1. One of each type of CPU and co-processor module for PLC equipment furnished under this Contract.
   2. One of each type of input/output module for PLC equipment furnished under this Contract.
   3. One of each type and size of PLC and equipment power supply furnished under this Contract.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Provide Programmable Logic Controller including necessary equipment and appurtenances as manufactured by the following acceptable manufacturer:
   1. Allen Bradley – CompactLogix.

2.02 PROGRAMMABLE LOGIC CONTROLLER AND I/O HARDWARE

A. General
   1. Provide PLC hardware including processors, power supplies, rack assemblies, interconnecting cables, grounding system, communication modules, hot standby modules, and accessories required to perform the control and monitoring functions.

B. Programmable Logic Controller (PLC)
   1. The PLC shall be provided with the following minimum features:

a. The processor shall be the slot mount type, include at least 2MB available user memory. Minimum CPU shall be CompactLogix series.

b. The PLC system shall be able to accommodate the quantity and type of I/O points shown and described including future I/O points. In addition, provide 20% spare I/O points for each type, where a certain type of I/O is not required such as analog output, provide at least one such I/O module.

c. The PLC system shall include one Ethernet communication module. Ethernet communication module shall be used for permanent system-type communications from PLC to PLC and to HMI operator workstations throughout the plant. Data transfer rate shall be up to 100Mbit/s.

d. The PLC system shall operate over 0 to 60 degree Celsius temperature range, and a 0 to 95% (non-condensing) humidity range.

e. The processor shall include diagnostic indicators for power, mode, low battery, communications ports, and memory and I/O errors.

f. The PLC system shall allow on-line and off-line programming.

g. The CPU's shall have executive firmware which may be upgraded in the field using an upgrade/download procedure which does not require the removal and/or insertion of IC chip.

h. The PLC system shall be capable of communicating with third party devices such as Motor Control Centers, including Variable Frequency Drives (VFD), and packaged vendor equipment systems via Ethernet IP.

2. The PLC system in each control panel shall include a single or redundant processor (when shown on the drawings), power supply, and hot standby module. If the primary PLC system fails the standby PLC system shall assume primary control functions within 48 milliseconds of the failure. A failed component shall be able to be removed, replaced, and reloaded (with software) without shutting the on-line PLC system down. No special application programming shall be required to implement the hot standby PLC systems.

3. A power supply (quantity and size as required) shall be provided to supply power to the processor and I/O modules. The supply voltage to the power supply shall originate within the control panel and shall be 120 VAC. A separate 24 VDC power supply shall be provided to power the analog loops.

4. I/O modules shall be provided as required to accommodate the types and quantities of I/O points identified. Sample I/O point types include; dry contact outputs, 4-20 mAdc analog inputs, 4-20 mAdc analog outputs, and 120 VAC discrete inputs. Discrete inputs shall use 120 VAC as the voltage signal, and analog loop signals that leave the control panel shall use a 4-20 mAdc current signal. I/O module point density shall not exceed 16 points per module. Each I/O module shall include front panel mounted diagnostic indicators for point status, fault conditions, and active conditions. The I/O modules shall be able to be replaced while under power and shall be keyed to prevent the wrong type of module from being inserted in the wrong slot. All I/O modules shall have removable terminal blocks for termination of field wiring. All terminal blocks shall be 'keyed' to prevent application of terminal block to wrong I/O module. All I/O modules shall report to the CPU should a terminal block fail or be removed.

5. The PLC and I/O modules rack assemblies shall be housed in the control panels as specified.

6. The control panels shall be provided with sufficient I/O modules to allow 20% spare installed and wired I/O points. Spares shall be provided for each different type of I/O.

7. The PLC and I/O equipment shall be a standard industrial grade product mechanically and electrically suitable for use in an industrial environment with a satisfactory product history of at least five years.

2.03 PROGRAMMABLE CONTROLLER APPLICATION & DEVELOPMENT SOFTWARE

A. The PLC programming and configuration software shall be the manufacturer's latest version, and compatible with the Windows 10 operating system. The software package shall consist of all programming, configuration, and documentation software needed to place the control and information system in satisfactory operation. The software shall allow on-line and off-line program development and documentation. Programming shall be accomplished through the use of ladder logic and other IEC 1131.3 languages. PLC programming software shall include electronic documentation.

B. Third-party programming software shall be acceptable if recommended by the manufacturer and if that software exceeds the capabilities of the PLC manufacturer's standard software package.

C. All configuration and programming software necessary shall be provided on each operator workstation computer specified, including the Portable Laptop Programming Terminal, for connection to any PLC processor on the Ethernet network or via direct connection to the processor communications port. All necessary hardware drivers required to perform PLC configuration and programming shall be provided.

D. If available, the configuration and programming software shall support communication over the network to implement its functions remotely from an operator workstation. All configuration and programming software necessary to implement this functionality shall be provided on the SCADA System Operator Workstations. All necessary hardware and software drivers required to allow the operator workstation to perform PLC configuration and programming shall be provided.

E. The ladder logic instruction set for the PLC shall include the following, as a minimum:
   1. Relay type instructions.
   2. Counter and timer instructions.
   3. Comparison instructions (equal, greater than, limit tests, etc.).
   4. Integer and floating point mathematical instructions.
   5. Advanced math and trigonometric functions.
   6. Statistical instructions.
   7. Matrix and array instructions.
   8. Logical instructions (and, not, or, etc.).
   9. BCD conversion instructions.
   10. Bit modification, moving, and shift instructions.
   11. File instructions (search, copy, fill, etc.).
   12. Diagnostic instructions.
   13. Sequencer instructions.
   14. Program control instructions (jump, goto, subroutine, etc.).
   15. PID control loops.
   16. Block read and write capability.

17. Send/receive messages.
18. Immediate I/O and communications update instructions.

F. The PLC programming & configuration software shall be the latest version of RSLogix as required.

2.04 SCADA HMI APPLICATION SOFTWARE

A. Provide an operator interface software package that, when combined with the operator station computer hardware, will gather, display, and store real-time operating information. The operator interface software package shall be sized according to the appropriate I/O point count and shall be able to accommodate 20% additional I/O in the future, but as a minimum shall accommodate 10,000 I/O.

B. HMI Application Software

1. The operator interface software package shall provide the following minimum functions:
   a. Compatible with Windows 10 Pro operating system.
   b. The software package shall be provided with the appropriate Ethernet driver software, Ethernet hardware interfaces, and required Ethernet communication/configuration interface software as required.
   c. The SCADA software shall utilize existing HMI software package.
   d. Database management shall be performed using Microsoft SQL Server Database. The ability to store historical data (analog or digital) to daily, weekly, or monthly files and the ability to archive historical data to tape.
   e. Report writing software shall be the latest version of XLReporter by SyTech, Inc., or accepted equal. The system integrator shall coordinate directly with the owner on types of required report as well as the reports format, etc.
   f. Analog data shall be configured to be stored as average, minimum, maximum, or instantaneous values, in the proper engineering units.
   g. A complete alarm handling package shall be provided that shall annunciate alarms in an alarm queue and allow them to be displayed on the process graphic displays with messages or by changing colors or otherwise massaging graphic display symbols. An alarm summary screen shall be provided. Alarms shall be able to be acknowledged by an operator at the operator station CRT on an individual or screen basis and nuisance alarms shall be able to be disabled. Alarms shall be logged to the alarm printer.
   h. Password protection for the various levels of access (day-to-day functions versus configuration changes), Log in and Log out at all times and Auto log off with set time.
   i. The data base points shall be identifiable by tag numbers.
   j. The entire system configuration, including database, shall be able to be backed up on Cloud Storage (cloud services shall be prepaid by the system integrator for at least 3 years) as well as a local External Drive.
2. Real Variables Processing.
   a. Real Variables shall represent process data for which there are analog signal inputs to the system. The system shall sample each of these input signals at their selected scan frequency, and perform the proper conversions and scaling to obtain the instantaneous

engineering values. These values then shall be used to update real-time data on CRT displays, check for alarm conditions, and store for use in the historical files.

3. Calculated Variables Processing:
   a. Calculated variables shall represent process parameters for which there are no direct analog inputs to the system. These variables shall utilize Real Variables, and manually entered constants or laboratory data to compute their value.
   b. There shall be two types of calculated variables defined:
      i. Calculated Variables that utilize one or more Real Variables and/or manually entered constants. These variables shall be treated in the same manner as Real Variables and shall have the same attributes as Real Variables (including alarming and control), with the exception that the calculation shall be performed automatically every 5 seconds.
      ii. Calculated Variables which are used only for the Daily, Monthly, and Annual Operation Summary reports, and which utilize laboratory input data shall be computed once a day for inclusion in the Daily report and stored for use in the Monthly and Annual reports. The capability to display these variables shall be provided.
   c. The System shall provide for a minimum of 4096 calculated variables.
4. Manual Input Data Handling.
   a. The application software shall provide the capability to enter data manually from any operator's keyboard. This data shall consist of additional values for the current data file (e.g., laboratory analyses), inserting alarm limits, set point changes, adjustments to process constants, control system set point changes and system tuning parameter adjustments.
   b. All manually entered data shall be entered and stored in the appropriate engineering units. All data entered shall be displayed for confirmation on the data entry device prior to incorporation to the data base.

2.05 MANAGED ETHERNET SWITCHES

A. The managed Ethernet switch will be IEEE 802.3 compliant.

B. The switch shall be powered by a nominal 24VDC supply.

C. The switch will have a permissible voltage range of 18.5 VDC to 30.2 VDC

D. Switch will support redundant power inputs that allow immediate switchover without switch operation interruption.

E. The switch shall have an operating temperature range of 0°C to +55°C.

F. The permissible storage temperature range for the switch will be -20°C to +70°C.

G. The switch will withstand a maximum continuous operating humidity of 95% without condensation.

H. Units should be of fan-less design to increase reliability

I. Switching Capabilities:
   1. Auto-negotiation.
      a. All Copper TX ports will support auto negotiation.
      b. Each TX port will be able to interface to 10/100/1000 Mbps or full/half duplex devices.
      c. Fiber optic ports will support continuous 10/100/1000 Mbps full duplex communications.
   2. Auto Cross.
      a. All TX ports will support MDIX providing cable autocross capability.
   3. Auto Polarity.
      a. The switch will support automatic port polarity change in the event a pair of twisted pair receive cables (RD+/RD-) are connected incorrectly.
   4. Serial Interface.
      a. The device will have a V.24 RS232 communications interface.
   5. Accuracy & Capacity of switching table.
      a. The switch will only forward valid Ethernet frames using the store and forward, or equivalent method.
      b. The MAC address table will have a storage capacity of 8000 addresses.
   6. Configurations.
      a. The switch will support a removable memory device for the storing of switch settings, and the ability to share settings among like switches.

J. Diagnostics:
   1. Port Status LED's.
      a. Link: Each port will have an LED indication that there is a proper electrical connection to the attached device as well as providing indication that there is port activity.
      b. Communication: Each port will have an LED indication for detection of packet collisions, and showing communication duplex mode.
      c. To simplify the process of troubleshooting, the status indication of heavy communications traffic vs. the status of an active link with no communications traffic will be unambiguous.
   2. LED Display.
      a. The switch will employ a multi-position diagnostic display for reporting various startup and operational states, or error conditions that may occur.
   3. Alarm Contact.
      a. Switch to be equipped with an alarm contact to enable automatic audible or visual alarm in the event of loss of port communication, or either (or both) power supply inputs.
      b. Switch to be equipped with an LED to indicate the status of the alarm contact.
   4. Power Supply LED.
      a. Switch will have a separate power indication LED for each power supply connection.

K. Internal Switch Functions:
   1. Simple Network Management Protocol (SNMP).
      a. The switch will support SNMP v1, v2 for network monitoring and configuration.

b. The switch will operate with any industry MIB browser.
c. Switch will have a system of fully configurable SNMP Trap messages.

2. Device Addressing.
   a. The switch will, by default, support dynamic device addressing via BootP.
   b. The switch will be capable of operation with a static IP address assignment.
   c. Support for switch IP address assignment via DHCP will be available.
   d. Switch address can be set via serial port connection.
3. Redundancy.
   a. Rapid Spanning Tree Protocol (RSTP).
      i. The switch will conform to the IEEE standard 802.1w for redundancy.
      ii. The switch will support redundant port connections and loops without causing network operation failure
      iii. The system of redundancy will be applicable for any network topology
      iv. Entire redundancy method will be integral to the individual switch and not dependent upon a separate management device.
   b. Fast Ring Detection (FRD).
      i. The Switch shall support the RSTP extension Fast Ring Detection to enable data channel recovery times faster than standard RSTP.
   c. Media Redundancy Protocol (MRP).
      i. Switch will support MRP in accordance with the IEC protocol 62439.
4. Web-Based Management.
   a. The switch will be programmed with an embedded web server.
   b. The web server will provide a comprehensive configuration, and diagnostic mechanism for the switch.
5. Security.
   a. The switch will provide the user the ability to entirely disable the Web-based management interface.
   b. Switch will support an IP address based method for restriction of Web server access.
   c. Modifications to switch settings will be protected by a user selectable/changeable password.
   d. The switch will support an optional MAC address based mechanism for controlling port access.
6. Port Mirroring.
   a. The switch will have the capability to send a copy of all network packets seen on one switch port to a network monitoring connection on another switch port.
   b. The switch will support mirroring of both ingress and egress traffic.
7. Firmware Administration.
   a. The switch will be structured so that future functionalities can be added through firmware upgrades.
   b. The switch will have the capability to receive firmware upgrades as a field serviceable process.

c. Firmware upgrades will be performed via the integrated web server in conjunction with any TFTP server software, or via the serial connection.

8. IGMP Snooping and Query.
   a. The switch will be capable of passively monitoring IGMP (multicast) messages and dynamically creating appropriate groups for proper message forwarding.
   b. The query interval and snoop aging times will be user configurable to up to 60 minutes.
   c. The switch will support up to 128 multicast groups.
9. Large Ring Networks.
   a. The switch will support a configurable "Large Tree" extension to the Rapid Spanning Tree option, making a ring topology suitable for 28 switches along the relevant path from the Root.
   b. This support option will provide the capability of constructing an RSTP ring topology of up to 57 switches, when all switches are configured with same function.
10. Traffic Prioritization.
   a. The switch will support multiple priority queues for adjusting the internal packet processing sequence.
   b. The switch will employ "Strict Priority" for transmitting data telegrams to ensure all high-priority data packets are transmitted.
   c. Switch will have a user settable internal prioritization for individual ports, so that the processing of Ethernet data for a particular port can be optimized.
11. Power over Ethernet (PoE).
   a. Switch shall provide support of Power over Ethernet in compliance with IEEE standard 802.3af.
12. Virtual LAN (VLAN).
   a. The switch is able to maintain up to 32 concurrent VLANs.
   b. The switch will support GARP VLAN Registration Protocol (GVRP) for dynamic VLAN implementation.
13. Link Layer Discovery Protocol (LLDP).
   a. The switch will support LLDP according to IEEE 802.1ab, for topology detection of devices that also have LLDP activated.

L. Managed Ethernet switches shall be Allen Bradley, N-Tron, Cisco, Phoenix Contact, Hirschman, or accepted equal.

2.06 UNMANAGED ETHERNET SWITCH SPECIFICATION

A. Ethernet Interfacing & Switching Capabilities
   1. The Unmanaged Ethernet switch will be IEEE 802.3 compliant.
   2. The switches must be capable of reading and processing high priority Ethernet packets before low priority during times of heavy network traffic in accordance with the priority levels of IEEE 802.1P/Q.
   3. Auto-negotiation:
      a. All Copper TX ports will support auto negotiation. Each TX port will be able to interface to 10/100 meg or full/half duplex devices.

4. Auto Cross:
   a. All TX ports will provide cable autocross capability.
5. Accuracy & Capacity of switching table.
   a. The switch will only forward valid Ethernet frames using the store and forward or equivalent method.
   b. The address table will have a minimum capacity of 4000 addresses.

B. Diagnostics.
1. Port Status LED's.
   a. Link Active: Each port will have a LED indication that there is a proper electrical connection to the attached device.
   b. Communications Status: Each port will have an LED indication of communications activity.
   c. To simplify the process of troubleshooting, the status indication of heavy communications traffic vs. the status of an active link with no communications traffic will be unambiguous.

C. Installation Requirements.
1. Mounting.
   a. The Switch will be din rail mountable out of the box and without the need to add/assemble adaptor or similar mounting plates.
   b. All power connections will be wired using removable connectors.
2. Port Security.
   a. The switch will be configured to accept optional security frames. When installed, these frames will lock inserted cables or plugs into place, then requiring the use of a small mechanical key for cable or plug removal.

D. Environmental Specifications & Agency Approvals.
1. Temperature & Humidity.
   a. The Switch will have an operating temperature range of 0 to 60c or greater. For extended application life, the maximum temperature will be a minimum of 10 degrees C lower than the specified operating temperature of the internal switch chips.
   b. The switch will withstand a maximum continuous operating humidity of 95% without condensation.
2. Electrical Noise Immunity.
   a. The switch will conform to the IEC61000-4-2 to 4-8 series of noise specifications as specified below:
      i. IEC 61000-4-2 Electrostatic Discharge: Criterion B.
      ii. IEC 61000-4-3 Radiated Noise Immunity: Criterion A.
      iii. IEC 61000-4-4 Fast Transient (Burst) Withstand: Criterion B.
      iv. IEC 61000-4-5 Surge Voltage: Criterion B.
      v. IEC 61000-4-6 Conducted Noise Interference: Criterion A.
      vi. IEC 61000-4-8 Electromagnetic Field withstand: Criterion A.

3. Shock & Vibration.
   a. The operating shock rating will conform to IEC60068-2-27 and withstand a shock pulse of 25G or more for 11ms.
   b. The operating vibration spec will conform to IEC60068-2-6 (Criterion 3) at 5G 150Hz, in all 3 axis.
4. Agency Certifications.
   a. The switch will be certified for UL/Cul 508.

E. Unmanaged Ethernet switches shall be Allen-Bradley, N-Tron, Hirschman, Phoenix Contact, Weidmuller, or accepted equal.

2.07 ETHERNET COMMUNICATION NETWORKS

A. General
1. Ethernet links shall be provided to connect all PLC's to Network Interface Panels (NIP), Motor Starters (MCC), and Control Panels as shown on the Contract Drawings. The Ethernet communication system shall use modular rack or back of panel mounted components for interfacing with required field connections. Provide necessary racks, interface modules, gateways, segment couplers, power supplies, Fiber-to-Ethernet converters, fiber patch panels and all other components as necessary for a complete and operable Ethernet communications system.

PART 3 - **EXECUTION**

3.01 PROGRAMMABLE LOGIC CONTROLLER APPLICATION SOFTWARE & DEVELOPMENT

A. Provide programming to produce completely annotated application programs. Application programs shall be produced on equipment supplied by the Contractor as part of the Work. The application programming shall be developed as follows:
1. The application programs shall be developed in a neat, professional, logical, and efficient manner such that the available PLC memory is not wasted. The application programming shall be completely documented with detailed rung comments and address comments that correspond to tag numbers provided on the Contract Drawings or in the description of operation. Application programming that manipulates analog signals shall utilize values that are scaled in the proper engineering units and are of the correct magnitude. Formulas utilized shall be described in detail.
2. Use the system descriptions from Contract Drawings, process equipment manufacturer supplied information, and other application-oriented documents to develop the application programs.
3. The application programming shall account for the fact that an HMI operator interface will be communicating with the PLC. The programming and addressing schemes shall allow efficient and logical block mapping of points between the various pieces of equipment.
4. Provide programming package software and hardware tools at the conclusion of the Project, including USB Memory drives and reference manuals.

B. The manufacturer's license agreements for software packages shall be made out to the Owner.

3.02 SCADA HMI APPLICATION SOFTWARE DEVELOPMENT

A. Data Management.

1. The workstations shall scan the PLC's on demand and as necessary to retrieve and send analog, discrete and virtual input information for displays, control and related operator workstation functions. The current database shall be resident in the distributed network devices as appropriate.
2. Elapsed running time values shall be maintained in the database for all process drives. This data shall be expressed in hours and tenths of hours and shall be updated every sixty seconds using the last scanned value for each associated discrete input. Accumulated runtime data shall be periodically updated (once per hour) in disk memory. The exact time and date of initiation shall be maintained for each runtime accumulation. The operator may, at any time, from any operator workstation, access historical or current accumulated runtime values and either display or print reports containing accumulated runtime for certain specified equipment (i.e., sorted by accumulated hours, equipment ID, etc. within a user specified range) or all equipment. The operator shall be able to selectively reset any or all runtime accumulations to zero (or other legal values). The specified spreadsheet and database software shall be furnished with all required macros/applications to perform the reporting functions.
3. For reporting purposes, the database shall perform averaging and integration on a point basis over the following time periods:
    a. Five second – derived from readings accumulated at scan rates, stored for 3 days.
    b. Five minutes – derived from above 5-second valves, stored for 3 days.
    c. Hourly – derived from above five-minute values, stored for 1 year.
    d. Daily – derived from above one-hour values, stored for 1 year.
    e. Monthly – derived from above shift values, stored for 1 year.
    f. Annually – derived from above monthly values, stored for 1 year.

B. Graphic Display Organization - General

1. The display system described in the following paragraphs only defines those types of displays commonly used during normal operations and overall display organization. Displays shall be based upon information contained on the process flow diagrams, mechanical sheets, electrical drawings, other related drawings, and written narrative descriptions contained in the Specifications. The Contractor shall provide sufficient displays to satisfy all specified plant instrumentation and control system requirements
2. The description of the workstation operation in the remainder of this Section is based on the use of a mouse with screen icons. Should an alternate device be provided, operation shall be functionally equivalent to the procedures outlined below.
3. Alternative, but equivalent, graphic display formats and organization may be submitted for acceptance by the Engineer. However, any such substitutions shall conform to all functional requirements specified herein.
4. Each display format may consist of more than one page. If so, the display shall contain the message MORE (or other suitable descriptive text) as an icon on the bottom line and the next page shall be obtained by a strike on the "page forward" (PF) or the MORE icon. Backpaging shall be accomplished by a strike in the "page back" (PB) icon.

5. The Page Forward (FRWD) and Page Back (BACK) icons shall permit the user to page forward and backpage on a multipage listing. If a listing is larger than the capacity of a single CRT page, a MORE icon shall appear on the display. MORE means that there is more data for this display which can be accessed a page at a time with the MORE or FRWD icon. The BACK icon shall be used to reverse the forward display sequence, a page at a time. FRWD or BACK icons shall not be used on a single page display.
6. For map based and/or site plan displays, system pan/zoom features as well as system vertical horizontal and vertical scroll bars may be used for this purpose.
7. Vector targets shall be employed to move vertically and laterally between related displays or, alternatively, the vertical and horizontal window can be used, where appropriate.
8. The formats for all schematic diagrams (e.g., unit process, process partition and control strategy diagrams) shall be based on the site plan, mechanical and electrical power distribution drawings and shall be submitted to the Engineer for review. Process displays shall generally be site plan oriented, unless otherwise accepted by the Engineer.
9. The operator screens shall be made of any number of the following components, as appropriate:
    a. Static and dynamic alphanumeric information.
    b. Static and dynamic graphic objects.
    c. Dynamic bar graph displays.
    d. Dynamic analog trending displays.
    e. Password protected operator actions.
    f. Screen navigation commands.
10. Dynamic analog information shall be capable of at least eight value related color changes with or without flashing in response to a change in value, state, or alarm condition for linked tags. Dynamic displays linked to digital tags shall be capable of displaying at least three states with corresponding color/flash indications.
11. All data displayed in operator screens on each workstation shall be valid and current. Current values displayed in operator screens shall be instantly replaced with an error indication for "bad" data, loss of data or loss of communications for each individual tag. These conditions shall be treated as alarms, with specified reporting and routing.
12. When communications are restored and/or errors are cleared, data displays shall automatically display actual values, and "change in status" messages shall be routed to all alarm reports and files.
13. While viewing screens, and through password access, operator interaction with individual, modifiable data points shall include: value changes; placing points on/off scan; manual/automatic mode changes; alarm acknowledge; alarm enable/disable; etc.
14. A "pick" point in an operator screen indicates possible operator interaction for data entry, screen navigation or task switching. When the mouse pointer is "dragged" across operator "pick" points, a highlight box shall appear around each. In addition to pointing and clicking, the operator may press the "down" arrow key, to select a "pick" point and then press enter.
15. Point-click procedures shall be available for all operator/screen interface for navigation, data entry, etc. Operator data entry procedures shall be configured as keyboard entry; point-click calculator; multiple choice point-click, up/down ramping or data value slide.

16. Provide user changeable lower, upper and rate-of-change limits on all screen setpoint entry points. Initial limits shall be set at: lower = 10%, upper = 85% and rate-of-change = 10% of value. The user shall not be able to enter setpoint changes beyond these valid limits.
17. Configure the software at each workstation to check, verify and require appropriate password login prior to each start/stop action, setpoint change, tuning parameter change or any other equipment control or functional change.
18. The system shall respond to each operator request to perform any of these actions in the following manner:
    a. Present a "pop up" start/stop faceplate screen with start and stop push buttons for each individually or grouped equipment start/stop system requirement.
    b. Present a "pop up" setpoint entry faceplate screen for each system setpoint change requirement.
    c. Present a "pop up" control parameter tuning faceplate screen for each system control parameter tuning requirement.
    d. English language operator prompting prior to any system response to operator request. Prompting shall inform the operator of the action about to be taken and provide a confirming "proceed" or "quit" choice.
    e. Each action and system response shall be clearly displayed in the appropriate "pop up" screen.
    f. System response indication shall be the most positive feedback required by this specification. At a minimum, the actual PLC register containing the data to be verified shall be displayed and shall be used for any sequential, interlocked or other related control scheme.
    g. At a minimum, each "pop up" screen shall provide for operator input/action and positive feedback indication. Each digital and feedback control display shall provide an English word rather than a digital number indicating conditions. These shall be: start, stop, enable, disable, etc.
    h. Each variable input shall allow operator keyboard or vertical slide bar data entry. Each variable, input, and feedback shall be displayed in number and bar graph formats, both individually and in color-coded multiple bar chart for system evaluation.
19. Objects in screens shall indicate field status, such as "stopped" or "running" by appropriate animation, positioning and color coding.
20. The software at all workstations shall be configured to allow password protected user screen configuration without the use of dedicated programmers, the need to change or reconfigure hardware or cabling, or the need to reboot.

C. Graphic Screen Navigation
    1. Each operator screen display shall be configured with a multiple choice Menubar at the top of the screen. Each selection button shall display a related pull down menu of additional selections, screen navigation, system administration, diagnostics and task switching with appropriate password protection.
    2. Each selection shall be made by a single point-click or by pressing the "down" arrow to the appropriate selection and then pressing [ENTER]. None of these selections shall cause screen updating, database updating, data collection, alarm monitoring or any other system function to pause or stop.

3. When a Menubar selection is made, the Menubar button and text for that selection shall protrude and become bold to positively indicate user's selection, and the pull-down menu shall be displayed. When pull-down menus are closed or when a new operator screen is displayed, Menubar selections return to previous, normal states.
4. Menubar selections and related pushbutton menu selections and functions shall include:
    a. SYSTEM Menubar selection: shall display a pull down menu with the following selections:
        i. SECURITY LOGIN selection: shall display a password login dialogue box, enabling the system user to login by entering an assigned login name and password.
        ii. SYSTEM ADMINISTRATION selection: shall provide a pull down menu with the following selections:
            a) SECURITY CONFIGURATION selection: shall display workstation security configuration dialogue boxes enabling the user, through password protection, to modify or disable/enable workstation security functions.
            b) FILE MANAGEMENT selection: shall provide the user with password protected access to Windows file manager.
            c) TASK MANAGER selection: shall provide the user with password protected access to the Windows Task Manager through which any Windows program can be run.
            d) HISTORICAL CHART CONFIGURATION selection: shall provide password protected access to workstation historical chart, pen and time group configuration through which the user shall be able to view, add and modify historical data charts.
            e) SYSTEM BACKUP selection: shall provide password protected access to the workstation on-board CD-ROM or tape drive backup function, through which the user shall be able to partially or totally backup workstation software files.
        iii. MESSAGE CENTER selection: shall provide access to a personal message center, through which users shall be able to provide brief messages to other users at any workstation on the network.
        iv. DIAGNOSTICS selection: shall display a pull down menu providing the following selections:
            a) NETWORK STATUS selection: shall provide workstation network diagnostics indicating status of all network sessions, activity and trouble.
            b) I/O COMMUNICATION STATUS selection (available on the field I/O server workstations): shall provide password protected interactive display indicating data request/transmit communications status and error conditions between the field I/O server workstation and the PLC data highway.
            c) COMPUTER DIAGNOSTICS selection: shall provide password protected total workstation review and diagnoses of computer hardware, memory, drives, ports, etc. This function shall also provide hard copy reporting of the entire diagnostics review or any portion thereof.
        v. FIELD I/O AND PLC CONFIGURATION selection: shall provide a set of screens for each PLC including:
            a) Manufacturer

b) Model Number
c) Rack I.D.
d) Model number, type and location for each rack module.
e) I/O device, associated database tag, and module position for all field I/O points.

vi. SYSTEM ACTIVITY selection: shall provide a password protected pop-up display of live system activity including alarms, alarm resets, operator entries, communication errors, system messages and database configuration activity. This display shall be used to provide real time feedback for operator requests, troubleshooting, alarm management assistance, etc. This pop-up display shall be sized, moved, closed and set to be always "on-top" during screen navigation by user request and at any time without pausing or stopping data updates, data collection or alarm monitoring.

b. ALARM Menubar selection; shall provide user interactive alarm summary screen as specified in the alarms section of this specification.

c. HELP Menubar selection: shall provide project-specific full-function Microsoft Windows help including: "contents", "search", "back", etc.

d. TREND Menubar selection: shall provide a pull down menu selection listing for:
   i. LIVE TREND choice: shall provide a multiple trend menu of predefined live trends.
   ii. HISTORICAL TREND selection: shall provide a menu selection listing of predefined historical trends.

e. REPORTS Menubar selection: shall provide access to a menu listing for all configured reports with features as described herein.

f. DISPLAY MENU Menubar selection: shall display a menu of all plant area displays for screen navigation.

g. OVERVIEW Menubar selection: shall display the plant overview screen.

h. PRINT Menubar selection: shall print the current display.

i. CONTROL PANEL Menubar selection: shall provide date and time display and access to Microsoft Windows Control Panel. A single point-click action from a supervisor's security level or above shall display the Control Panel icon group through which modification can be made for:
   i. System Date and Time.
   ii. System Fonts.
   iii. Printers Setup.
   iv. Other Standard Windows Control Panel Functions.

D. Process Overview Display(s)

1. The process overview graphic display shall be obtained by selecting the OVERVIEW icon. One or more targets or icons shall be provided for each unit process and shall permit the operator to directly access an associated unit process display. The plant site plan layout shall be used as the basis for the process overview display, which shall provide display vectoring functions to subordinate unit process displays. A separate display containing a text-based listing of all system graphic displays shall also be provided, accessible from the Overview Display or a separate Menubar selection.

2. Intermediate process overviews shall be provided to summarize information from a number of similar or identical unit process equipment items (e.g., filter overview showing all filters, aeration system overview, etc.). These intermediate overview displays shall allow vectoring to/from the plant overview(s) and the individual equipment detail displays, and shall show appropriate summary process data.

E. Functional Area Display (s)

1. Functional Area Display(s) Unit Process Graphic Displays shall be provided to show all plant process areas and equipment in detail. Except where specified otherwise, all operator control actions shall be performed at the Unit Process Display level. Any unit process display shall be selectable from the process overview display or from an adjacent process area or otherwise related process display. A unit process display shall be a schematic representation of a process and use standard symbols to represent process equipment such as pumps, tanks, motors, etc. Process status shall be indicated using both color and alphanumeric annotations. Symbol color coding for all displays shall be based on the following convention:
2. All text shall be shown in white except alarm condition statements that are illuminated in either yellow or magenta.
    a. Yellow blinking = device has a noncritical alarm not yet acknowledged.
    b. Yellow = device has a noncritical alarm that has been acknowledged.
    c. Magenta blinking = device has critical alarm not yet acknowledged.
    d. Magenta = device has a critical alarm that has been acknowledged.
    e. Cyan = device off or not available. This may represent future equipment or equipment that has been taken off line for maintenance purposes.
    f. Red = device is on, running, energized, open.
    g. Green = device is available, ready to run, de-energized, closed.
    h. White with a black target background = device is in automatic (or semi-automatic) control mode.
    i. White with a blue target background = device is in manual mode.
3. The displays shall show all ID number, current status values and setpoints associated with a given process display and shall be updated with current values every five seconds or less.
4. The control status of each controllable device shall be modifiable and shall be displayed in text adjacent to that device. Control status shall be AUTO, MANUAL, AVAILABLE, etc., and shall be updated continuously. When the operator wishes to take control of the device or modify setpoints, the procedure shall be as follows:
    a. The operator shall click on the device symbol with the mouse.
    b. A dialog box shall appear which provides the current state or setpoint and enables the operator to make the appropriate change.
    c. For two-state devices, the dialog box shall allow the operator to start or stop, open or close, or otherwise change the state of the device.
    d. For setpoints and modulating final control devices (analog outputs), the dialog box shall display the old value, and shall allow the operator to enter a new value using standard Windows editing techniques. It shall also be possible for the operator to ramp the current value up and down by clicking on ramp targets.

e. Prior to the execution of the operator-commanded action, a confirmation message and target shall be displayed stating the old and new values and asking the operator to confirm the modification.

f. Control strategies shall be changed from AUTO to MAN or OFF (or vice versa) in the same manner as two-state devices.

F. Alarm & Event configuration

1. The operator workstation software shall be configured to provide alarm handling, reporting and archiving. Alarm grouping, printing and display shall be coordinated with Engineer and Owner prior to configuration.
2. Alarm management shall be provided for each database field input and shall include:
   a. Alarm reporting enable or disable.
   b. Alarm suppression to avoid nuisance alarms such as start up spiking.
   c. Re-alarming.
   d. Alarm routing to specific workstations and printers as appropriate.
   e. Alarm grouping for specific visual and audible group notification.
   f. Analog alarm types to include at least: low low; low; high; high high; rate of change; deviation; deadband; bad input; and off scan.
   g. Discrete alarm types to include at least: change from normal; return to normal; change of state; bad input; and off scan.
   h. Alarm acknowledgement and condition clear format.
3. The operator workstation software shall provide date and time stamped alarm reporting to at least five destinations. These destinations shall be:
   a. Operator screen alarm summaries.
   b. Alarm printers.
   c. System alarm and history file.
   d. System alarm and history display.
   e. Workstation network.
4. All points or modules that have the capability of being alarmed for amplitude or rate of change limit violations, and all discrete alarm inputs shall be linked to an associated discrete point for alarm suppression under specified conditions. For example, when there is no flow through a flow meter, the "not running" signal from the associated prime mover shall be used to suppress all alarms associated with the flow signal. Time delays shall be provided as necessary to eliminate transient alarm annunciation under start-up/shutdown conditions.
5. All alarms shall be OLE and Windows Sound System enabled. Sound files shall be individually assigned to each alarm point.
6. The system shall provide an alarm summary display as a pre-defined dynamic link within the graphics package. This alarm summary display shall show a list of the pending alarms in the system. As new alarms are detected, entries shall be made to the display list. As the alarm conditions clear, the entries shall be removed from the list.
7. The alarm summary display shall be user-configurable to the extent that the user can select the placement of tag name, current value, descriptor, time of alarm, and alarm status on the line as well as the color codes to be used to indicate the various alarm conditions.

8. Only alarms, including the loss of network, data highway and individual field I/O point communications, shall be reported to operator screen alarm summaries, which shall allow the operator to sort alarms in descending or ascending time order. The operator shall also be allowed to apply various priority level filters and to reconfigure alarm summary columns for detailed analyses, while viewing.
9. Alarms shall be acknowledged from the alarm summary display either individually (by clicking on an alarm acknowledgement field) or by a full page using a menu pull-down. The system shall support up to twenty (adjustable) alarm messages in the summary display.
10. Each graphic display shall be configured with the indication of the last three alarms at the bottom of the screen.
11. An unacknowledged alarm shall flash in configured foreground/background colors until it is acknowledged. When an alarm is acknowledged, it shall stop flashing but remain displayed until the alarm condition is cleared.
12. When an alarm condition has been both acknowledged and cleared, the alarm statement shall be removed from the alarm summary.
13. Alarm summaries shall use system colors and provide at least the following column information:
    a. Date and time.
    b. Workstation name.
    c. Tag number.
    d. Tag description.
    e. Alarm condition.
    f. Tag value.
14. Configure alarm summaries with a distinctive color format for:
    a. Background color.
    b. High value alarms.
    c. Low value alarms.
    d. Rate-of-change alarms.
    e. Digital status alarms such as change of state, change from normal, etc.
    f. Plant area/access alarms.
15. The following color codes shall be used in conjunction with alarm displays:
    a. Cyan = normal.
    b. Yellow, blinking = noncritical, not acknowledged alarm.
    c. Yellow = noncritical, acknowledged alarm.
    d. Magenta, blinking = critical, not acknowledged alarm.
    e. Magenta = critical, acknowledged alarm.
16. The following alarm condition statements shall be provided as a minimum:
    a. RTN NRML - Return to Normal.
    b. HIHI LMT - Second High Limit.
    c. HI LMT - High Limit.
    d. LO LMT - Low Limit.
    e. LOLO LMT - Second Low Limit.

f. ROC LMT - Rate of Change Limit.
g. STAT CHGE - Status Change.
h. OFF SCAN - Off Scan.
i. OPEN FAIL - Open Failure.
j. CLOSE FAIL - Close Failure.
k. START FAIL - Start Failure.
l. STOP FAIL - Stop Failure.
m. FAULT – Fault.
n. HI DEV - High Deviation.
o. LO DEV - Low Deviation.
p. DISCREP – Discrepancy.
q. UNAVAIL – Unavailable.

17. Date and time stamped alarm reporting shall be sent to alarm printers with similar formatting, configuration and routing procedures as specified for alarm summaries.
18. Configure alarm and history files for sequential date and time stamped activity reporting for the entire system, on each workstation. This file shall be a daily text file with a file name indicating the date that the file was created, and shall include all system wide activity including:
    a. Alarms.
    b. Alarm acknowledgement.
    c. Loss and recovery of network, data highway and individual field I/O point communications.
    d. Status changes.
    e. Alarm clear and return to normal messages.
    f. Operator keyboard entries.
    g. Other system related activity (system startup, save/reload database, etc.).
19. Information format shall include:
    a. Date and time.
    b. Description.
    c. Condition.
    d. Current value.
20. Alarm and history files shall be saved to computer backup media including CD's or tapes if selected by the operator.
21. The alarm and history display shall provide live viewing of alarm and history file entries, giving the operator instantaneous activity review and operator action verification.
22. The system alarm and history display, with on-line height and width adjustment capabilities, shall be displayed as part of operator screens, upon demand. The operator shall be able to size and move the display, as desired. Further, the operator shall be able to close this display, upon demand, or cause it to be continually displayed as the operator navigates through operator screens.

23. The opening, closing, moving or resizing of this display shall not cause screen updating, database updating, historical data collection, alarm monitoring or any other system function to pause or stop.
24. Workstations shall be configured to report all alarm conditions, operator activity, etc. to all other workstations.
25. The system shall be configured to provide a periodic date stamp on the alarm printout at the alarm printer to provide clear date/time evaluation of printed alarms.
26. Each workstation shall be configured for alarm and history activity file backup and archiving to the on-board tape or CD drive. Provide alarm and history file backup, and disk space management procedures.

G. System Security
1. Observer.
   a. Graphic display viewing and navigation.
   b. Historical data display.
   c. Password login and logout.
   d. Observer shall be the system default security mode.
2. Operator.
   a. Observer privileges.
   b. Password protected start/stop, setpoint entries, system activity display, etc.
   c. Lead Operator/Supervisor.
   d. Operator privileges.
   e. Historical data chart configuration.
   f. Report viewing, modification and exporting/printing.
   g. Task switching to the Windows operating system.
   h. Software system shut down.
   i. Windows NT Task Manager access.
3. System Administrator/Engineer.
   a. All privileges.
4. The software at each workstation shall be configured to automatically log in the observer group upon system startup.
5. The security system at each workstation shall be configured to not allow SCADA software shut down or Windows NT security access unless requested through Supervisors' or System Administrator security privileges.
6. The security configuration shall be exportable to a text file, which shall not include passwords. This text file shall have a user defined acronymic, mnemonic file name and shall be capable of being imported into the system to modify or create workstation security configuration.
7. All workstation security activity, including violations, shall be reported in a date and time stamped format to a daily text file for review and evaluation at any time. This security text file shall have a file name indicating the date that the security file was created. It shall be possible for any text editor to edit these files.

8. Each workstation shall be configured for security activity file backup and archiving to the on-board tape drive.

H. Trend Configuration

1. The system shall provide multiple sets of live trends in operator screens. Each set of live trends shall be capable of the following:
   a. Displaying up to eight pens.
   b. Being temporarily modified, while viewing.
   c. Displaying straight line or varying data value "target" curves.
   d. Full screen trend curve displays when trend screen is opened.
2. Each live trend chart shall allow temporary, on-line pen, range and chart X-Y parameter changes by the user. Each trend display shall allow on-line user modifiable straight-line "target" curve for each trended data point and, as specified, a user selected varying data value "target" curve based on pre-defined modeling for trended data points.
3. Trends shall automatically shut down and release system resources when closed.

I. Historical Data Management Configuration

1. The operator workstation SCADA, database, spreadsheet and reporting software shall be configured to provide historical data gathering for system and operations validating, testing, maintenance and regulatory reporting.
2. The system shall provide multiple choice options for historical data file size and shall automatically assign file names indicating the date and duration for data contained in each file. The installed system shall be configured for sequential data files beginning at midnight.
3. For data and system resource management the system shall allow the assignment of any number and type of database tags and tag groups for historical data collection with the following attributes:
   a. Collection rate and phasing.
   b. Data collection start/stop condition.
   c. Data collection deadband.
4. For additional resource management, the operator workstation software shall be configured to automatically delete historical data files when they reach a certain age, which is user selectable from a multiple choice options list. Set initial automatic file deletion at 20 days with backup and archiving procedures occurring prior to deletion.
5. Configure each workstation for historical data files backup and archiving to Cloud Storage and local external Drive.
6. Provide historical data files backup, and disk space management procedures.
7. All attributes of each historical display chart shall be able to be configured or modified at any time.
8. In addition, the user shall be able to make temporary, view only modifications, while viewing historical trend charts.
9. The system shall be configured for the following on-line historical data user functionality, without pausing or stopping any system function:
   a. Zoom to any specific area of a chart.
   b. Automatic real time update of historical data, upon demand.

c. Reset to original trend chart parameters, upon demand.
d. Request completely different start/stop time and duration parameters, upon demand.
e. Chart data display update forward or backward in time, by a single point-click for two sets of modifiable time increments in each direction.
f. Export displayed trend chart data into a text file with a user defined acronymic, mnemonic file name.
g. Print any displayed historical trend chart, upon demand.
h. Display multiple historical trend charts at the same time with time synchronizing for detailed analyses.
i. Data trend charts configured by combining any pen and time groups.
j. Trend chart display format changes including colors, titles, legends, etc.

10. When configuring tag pen groups, the system shall provide for user configuration of at least:
    a. Individual tag and related attributes.
    b. Default or specific data value range.
    c. Individual color for each tag pen.
    d. A specific letter to further document each pen related curve.
    e. Trend chart display format.
11. Time group configuration shall include at least the following:
    a. Start/stop dates and times.
    b. Duration.
    c. Sample, average value, high value and low value displays individually or together.
    d. Trend chart display format.
12. Historical data files shall be saved to computer backup media including diskettes, tapes or optical disks if the operator chooses this option. The system shall allow these files to be restored to the appropriate system file path and reviewed with all system functions at any time, as if they had continued to be hard disk resident.
13. The collection of historical data shall begin automatically upon software system start-up.
14. All analog and digital field inputs shall be historically collected. Provide collected data in the "sample" mode with collection rate, phasing, etc. attributes assigned to maximize data collection and system resources.
15. Provide the following time groups:
    a. The previous hour.
    b. The previous twenty-four (24) hours.
    c. The previous thirty (30) days.
16. Operator access for viewing or printing any individual project specific, pre-defined historical trend chart shall be through a single point-click action while viewing operator screens via the TREND Menubar selection.

J. Reports Configuration

1. The report generator shall employ the specified electronic spreadsheet, report writing and database programs to provide the user with an interactive method to define, change, and replace report formats. The specified database, spreadsheet, and reporting software shall be

furnished with all required applications and macros to perform the specified reporting functions.

2. The report generator shall permit arithmetic, relational, logical and statistical operations on individual or groups of data values contained in the distributed database and shall be employed to build shift, daily, equipment runtime and other specified reports utilizing network based dynamic data exchange access to the databases.
3. The reporting module shall provide the user with all standard Excel-type interactive spreadsheet formats, functions, linking, various kinds of charts, live spreadsheet/database interaction, fonts, math functions, macros, print options, and report saving.
4. All tags in the Control and Information System, including inputs, outputs, calculations and historical data shall be available for use in reports. Points shall be referenced in report formats by tag names or pen/time groups, and linking to reports shall be automatic and transparent to the user.
5. Each report shall be capable of linking and displaying the following:
    a. All attributes of database tags including:
        i. Current value.
        ii. Engineering units.
        iii. Descriptors.
        iv. Field I/O equipment addresses.
        v. Alarm parameters.
    b. Any combination of historian pen/time groups.
    c. Manually entered data.
    d. Text.
    e. Date and Time.
6. The report package shall allow on-line user selection of a value or groups of values, and instantaneously create charts in X-Y, bar graph, pie and other formats. Charts shall be modifiable upon viewer demand. Chart printouts, on demand, shall be provided.
7. Reports shall display entries indicating "no data" and "bad data" to distinguish error conditions from zero values for individual report data links.
8. Report generation or configuration shall not cause screen updates, database updates, historical collection, alarm monitoring nor any other system operation to pause or stop.
9. The report module shall open on top of operator screens, so that, upon exiting, the previous operator screen shall be automatically displayed, and shall be fully functioning and updating.
10. The reporting of system operating data shall occur once per day at user-specified times. Data recorded on these reports shall be extracted from the operator workstation data files as required. Report data shall consist of the arithmetic average and sums of variable readings taken by the control system on scans made during the previous 24-hour period and from manually entered data. Where applicable, total, average, maximum, and minimum values shall be provided for each column of data on each report.
11. User access to any individual report shall be provided by means of a single point-click from a menu of all project specific reports.
12. Password protected access to reports shall also enable the user to create and/or modify reports through standard Microsoft Excel configuration and system macro procedures.

13. No reports access, work, viewing or any other reports related activity shall require the suspension, modification or the stopping/starting of the reports scheduler. Nor shall this activity cause any pausing or stopping of data updating, data collection, alarm monitoring, or any other Control and Information System function.

3.03 SYSTEM CONFIGURATION AND EXPANSION

A. The system shall provide an on-line installation and configuration program for configuring the various computers on the network. This configuration software shall allow assigning unique node names to each computer as well as selecting the functions that the machine will perform.

B. The system shall allow additional computers to be added to the network while on-line, without disrupting the operations of the other machines.

3.04 DIAGNOSTICS

A. The system shall provide on-line diagnostics that display the current status and operation of the local area network and its nodes. The diagnostic display shall include the LAN adapter status for the machine showing the display, as well as the current number of messages, errors and retries.

B. An additional display shall show the current session status (established, pending, offline) of all stations on the network. A session monitor program that automatically monitors and recovers communications shall be supplied with the system.

3.05 LICENSE AGREEMENTS/SECURITY

A. The manufacturer's license agreements for software packages shall be made out to the Owner.

B. Contractor developed application programs shall become the property of the Owner at the conclusion of the Contract. There shall be no license agreements of any kind for these programs.

C. The Owner shall be provided with passwords required to access the PLC application programs and operator interface configuration data. There shall be no Contractor programmed security schemes that prevent access to the application programs or configuration data.

END OF SECTION 40 94 03

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 SUBMERSIBLE PUMPS

A. Identification

1. INFLUENT PUMPS (P2010, P2020)
2. SCUM PUMP (P4310)

B. Manufacturers:

1. INFLUENT PUMPS
   a. Flygt.
   b. KSB.
   c. Or Pre-Approved Equal.

2. SCUM PUMP
   a. ABS
   b. Or Pre-Approved Equal.

C. Design Criteria:

1. INFLUENT PUMPS
   a. Quantity of Pumps: 2
   b. Design Point of Each Pump: 1,570 GPM @ 49 ft
   c. Static Head: 40 ft
   d. Motor: 30 HP, 460V, 3 Phase, 60 Hz
   e. Inlet Size: 200 mm
   f. Discharge Size: 6 in
   g. Impeller Size: 244 mm

h. Impeller Material: Ductile iron

2. SCUM PUMP
   a. Quantity of Pumps: 1
   b. Design Point of Each Pump: 130 GPM @ 18 ft
   c. Static Head: 8 ft
   d. Motor: 1 HP, 460V, 3 Phase, 60 Hz

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 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.

2.2 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 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.

2.3 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.

2.4 CONTROLS & CONTROL PANEL

A. Furnish and install one automatic pump control center (FCP2200) in NEMA 4X stainless steel enclosure .

1. Pumps shall be controlled by the level monitor system specified below as a standard triplex pumping station (the third pump will not be installed under this contractor but provision shall be made in the panel to accommodate a third pump in the future.
2. For each pump there shall be included individual motor circuit breakers, variable frequency drives, three phase overload protectors, manual reset, hand-off automatic selector switches, running lights, ammeters and elapsed time meters.
3. Provide phase failure / undervoltage relay to de-energize motors and include auxiliary contacts for remote indication
4. Provide alarm system consisting of an alarm light and horn, with silencing switch
5. Provide 24 volt control circuit transformer with disconnect and overload protection
6. Provide duplex weather proof convenience outlet
7. Provide terminal strips for interface wiring between control panel and pumping station
8. Controls shall automatically alternate the operation of the pumps
9. Provide one 20 amp, one pole breaker in the control panel to serve the slab heater for the backflow preventer.
10. Provide two 20 amp, one pole breakers in the control panel as spares.

B. Automatic Mode

1. The pump(s) shall operate/run based on wet well water level limits. The pumps shall operate at variable speed based on an operator-entered flow value. The pumps shall also alternate automatically between lead pump and lag pump cycles.

C. Hand Mode

1. In the hand mode, the pumps shall be operated via start and stop push buttons locally at the control panel.

D. Wet Well Low Level

1. In no case shall the pumps continue run below the wet well low level float switch.

E. 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.

F. 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.

G. 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

H. 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

SECTION 43 41 45 - POLYETHYLENE TANKS AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes polyethylene tanks for storage of the following chemicals:

1. Sodium Hypochlorite

B. Related Requirements:

1. Section 03 30 00 - Cast-In-Place Concrete.
2. Division 40 – Process Interconnections.
3. Division 43 – Process Gas and Liquid Handling, Purification, and Storage Equipment.
4. Section 46 – Water and Wastewater Equipment

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
2. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
3. RTP-1 – Reinforced Thermoset Plastic Corrosion Resistant Equipment.

B. America Society for Testing and Materials:

1. D618 Conditioning Plastics and Electrical Insulating Materials for Testing
2. D638 Tensile Properties of Plastics
3. D790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
4. D883 Definitions of Terms Relating to Plastics
5. D1505 Density of Plastics by the Density-Gradient Technique
6. D1525 Test Method for Vicat Softening Temperature of Plastics
7. D1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics
8. D1998 Standard Specification for Polyethylene Upright Storage Tanks
9. D2765 Degree of Crosslinking in Crosslinked Ethylene Plastics as Determined by Solvent Extraction
10. D2837 Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
11. D3892 Practice for Packaging/Packing of Plastics
12. F412 Definitions of Terms Relating to Plastic Piping Systems

C. ARM (Association of Rotational Molders) Standards: Low Temperature Impact Resistance (Falling Dart Test Procedure)

D. ANSI Standards: B-16.5 Pipe Flanges and Flanged Fittings

E. OSHA Standards: 29 CFR 1910.106 Occupational Safety and Health Administration, Flammable and Combustible Liquids
F. UBC CODE: Uniform Building Code 2006 Edition
G. IBC CODE: International Building Code 2009 Edition
H. CBC Code: California Building Code 2010 Edition

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. Shop Drawings: Submit detailed certified dimensional Shop Drawings showing tank size, layout of accessories, and anchoring system.
D. Manufacturer's Certificate:

1. Certify that products meet or exceed specified requirements.
2. Certify that products are suitable for chemical usage in this application.
3. Submit certified list of tank installations, storing same chemical and concentration, in service for period of not less than five years.

E. Owner Installation Certificate: Obtain from equipment manufacturer's representative and submit, attesting equipment has been properly installed and is ready for startup and testing.

F. Delegated Design Submittals: Submit signed and sealed design calculations and assumptions for determination of shell thickness, nozzle reinforcement, and special elements of vessel construction and support.
G. Test and Evaluation Reports:

1. Submit certified data on physical properties of laminates being used to include laminate tensile modulus and flexural modulus in hoop and axial directions, and data on laminate makeup to include number and thickness of layers and layer glass content.
2. Submit certified factory test results.

H. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including tank handling procedures, anchoring, and layout.
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.
K. Manufacturer Reports: Submit certification after installation that tanks have been installed according to manufacturer's instructions.
L. 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 closeout procedures.
B. Project Record Documents: Record actual locations and final orientation of tank and accessories.
C. Operation and Maintenance Data: Submit maintenance instructions for tank and accessories.

1.5 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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
B. Inspection: Accept tanks on-Site. Inspect tanks for damage.
C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

1.7 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
B. The Contractor shall furnish a warranty extending twelve (12) months after substantial completion date.
C. The Manufacturer shall furnish a three-year warranty for replacement due to breakage, yellowing, abrasion, loss of light transmission, and coating delamination. Furnish three year manufacturer's warranty on fittings and accessories supplied by the tank manufacturer.

PART 2 - PRODUCTS

2.1 TANKS

A. Manufacturers:

1. The equipment, polyethylene tanks, shall be manufactured by:

    a. Snyder Industries, Inc.
    b. Assmann USA.
    c. PolyProcessing, Inc.
    d. Or approved equal.

2. Specifications and equipment arrangements for the polyethylene tanks are based on Synder Industries, Inc. 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. This specification covers upright, cylindrical, flat bottom, single wall tanks molded in a one-piece seamless construction by the rotational molding process (laminated or fabricated tanks will not be accepted). The tanks are designed for above-ground, vertical installation and are capable of containing chemicals at atmospheric pressure. Included are requirements for materials, properties, design, construction, dimensions, tolerances, workmanship, and appearance. Tank capacities are from 500 gallon (1,816 L) up to gallon (62,453 L).
2. Use materials of construction to resist and retain process fluid without leakage or damage to structural integrity of tank; use same resin throughout construction of each tank.
3. Minimum thickness: 0.187 inch.
4. Vertical, non-sloping flat bottom; integral closed top.
5. Furnish liquid level gage sight glass, with flanges, indicating 10 to 90 percent of tank capacity.

C. Tank Designation

1. TB8110

D. Materials

1. Tanks are classified according to type as follows and it is the responsibility of the purchaser to specify Type I or Type II.

    a. Type I – Tanks molded from cross-linkable polyethylene resin.
    b. Type II - Tanks molded from linear polyethylene resin (not cross-linkable resin).

2. The material used shall be virgin polyethylene resin as compounded and certified by the manufacturer. Type I tanks shall be made from crosslinked polyethylene (XLPE) resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties. Type II tanks shall be made from high density linear polyethylene (HDLPE) resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties.
3. All polyethylene resin material shall contain a minimum of a U.V. 15 stabilizer as compounded by the resin manufacturer. Pigments may be added at the purchaser's request, but shall not exceed 0.25% (dry blended) of the total weight.
4. See mechanical properties of Type I and Type II tank materials in Table 1.1 and 1.2 below.

Table 1.1: Type I tank material: Cross-linked (XLPE)

PROPERTY	ASTM	VALUE
Density (Resin)	D1505	0.938-0.946 g/cc
Tensile (Yield Stress 2"/min)	D638	2830 - 3000 PSI
Elongation at Break (2"/min.)	D638	700 - 800%
ESCR (100% Igepal, Cond. A, F50)	D1693	>1000 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	>1000 hours
Vicat Softening Degrees F. Temperature	D1525	250
Flexural Modulus	D790	87,000 – 110,000 PSI

Table 1.2: Type II tank material: High density Linear (HDLPE)

PROPERTY	ASTM	VALUE
Density (Resin)	D4883	0.941-0.948 g/cc
Tensile (Yield Stress 2"/min)	D638	3000 PSI
Elongation at Break (2"/min.)	D638	>1000%
ESCR (100% Igepal, Cond. A, F50)	D1693	550 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	50 hours
Vicat Softening Degrees F. Temperature	D1525	235
Flexural Modulus	D790	130,000 PSI

E. Design Criteria:

1. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation, but shall not be less than 0.187 in. thick.

   T = P x O.D./2 SD = 0.433 x S.G. x H x O.D./2 SD
   T = wall thickness
   SD = hydrostatic design stress, PSI
   P = pressure (.433 x S.G. x H), PSI
   H = fluid head, ft.
   S.G. = specific gravity, g/cm^3
   O.D. = outside diameter, in.

   a. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 73 degrees Fahrenheit for Type I and Type II materials. In accordance with the formula in 9.1, the tank shall have a stratiform (tapered wall thickness) wall.
   b. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.
   c. The standard design specific gravity shall be 1.5 or 1.9.

2. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support.
3. The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. The top head of tanks with 2000 or more gallons of capacity shall be designed to provide a minimum of 1300 square inches of flat area for fitting locations.
4. Tanks with 2000 or more gallons of capacity shall have a minimum of 3 lifting lugs integrally molded into the top head. The lifting lugs shall be designed to allow erection of an empty tank.

5. The tank shall be designed to provide a minimum of 4 tie-down lugs integrally molded into the top head. The tie-down lugs shall be designed to allow tank retention in wind and seismic loading. Refer to section 12.8 for tank tie-down accessories.

Note: The designed specific gravity of the tank shall be based upon the actual chemical, its' concentration and temperature. From these factors it can be determined if polyethylene can be used and if so which family of polyethylene is to be used. There are chemical applications where both the (cross-linked - Type 1) XLPE and HDLPE (high-density linear - Type 2) resin will work. There are also applications where only one of these families of resin is recommended. If FDA or NSF 61 is required the Type II HDLPE resin will be required.

2.2 NOZZLES AND ATTACHMENTS

A. Fittings - Threaded Bulkhead

1. Threaded bulkhead fittings are available for below liquid installation depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from the tank knuckle radius' and flange lines. Consult the manufacturer for placement questions. The maximum allowable size for bulkhead fittings placed on a curved sidewall section of tanks 48 in. to 142 in. in diameter is 2 inch size. Tank wall thickness must be considered for bulkhead fitting placement. The maximum wall thickness for each fitting size is shown below. The following chart is based upon PVC and CPVC fittings. Contact the manufacturer for other fitting materials

Fitting Size	Maximum Wall Thickness
1/2 in.	2 in.
3/4 in.	2 in.
1 in.	2 in.
1 1/4 in.	2 in.
1 1/2 in.	2 in.
2 in.	2 in.
3 in.	2.125. (Flat Surface Only)

2. The bulkhead fittings shall be constructed of PVC or other specified material. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton, or other specified material.

B. Fittings - Bolted Double 150 lb. Flange Fittings

1. Bolted double flange fittings are required for below liquid level installation for sizes above 2 in. depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult the manufacturer for placement questions. Bolted double flange fittings provide the best strength and sealing characteristics of any tank fitting available. Allowable fittings sizes based on tank diameter for curved surfaces are shown below.

Tank Diameter	Maximum Bolted Fitting Size Allowable
48 in. - 86 in.	3 in.

90 in. - 102 in.	6 in.
120 in.- 142 in.	8 in.

a. The bolted double flange fittings shall allow tank wall thickness up to 2 1/2 in.

2. The bolted double flange fitting shall be constructed with 2 ea. 150 lb. flanges, 2 ea. 150 lb. flange gaskets, and the correct number and size of all-thread bolts for the flange specified by the flange manufacturer. The flanges shall be constructed of PVC Type I, Grade I, or other specified material.
3. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton or other specified material. There shall be a minimum of 4 ea. full thread bolts.
4. The bolts diameter is to meet ASNI standards based upon the flange size. The bolts may have gasketed flanged metal heads or bolt heads encapsulated in Type II polyethylene material. The encapsulated bolt shall be designed to prevent metal exposure to the liquid in the tank and prevent bolt rotation during installation. The polyethylene encapsulation shall fully encapsulate the bolt head. The polyethylene shall be color coded to distinguish bolt material (white - 316 S.S., yellow - Hastelloy C276, green - Titanium). Each encapsulated bolt shall have a gasket to provide a sealing surface against the inner flange.
5. Standard orientation of bolted double flange fittings shall have bolt holes straddling the principal centerline of the tank in accordance with ANSI/ASME B-16.5 unless otherwise specified.

C. Fittings - Bolted Stainless-Steel Fittings

1. Bolted stainless steel fittings are available for below liquid level installation depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult the manufacturer for placement questions. Allowable fittings sizes based on tank diameter for curved surfaces are shown below.

Tank Diameter	Maximum Bolted Fitting Size Allowable
48 in.	3 in.
64 n. - 142 in.	4 in.

a. The bolted stainless-steel fittings shall allow tank wall thickness up to 2 1/2 in.

2. The bolted stainless-steel fittings shall be constructed with a minimum of 4 fully threaded 3/8 in. studs. Each fitting shall have one gasket and two flanges. The gasket shall be compressed between the inside of the tank wall surface and the inside flange of the fitting. The stainless-steel fittings come standard with female x female pipe threads. The fittings shall be constructed of Type 316 stainless steel. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton or other specified material.

D. Fittings - Siphon Tube Fittings

1. Siphon tubes may be added to the fittings specified in sections 11.1, 11.2 and 11.3. Siphon tubes will allow these fittings, when used as drainage fittings, to provide better tank drainage.

E. Fittings - Molded Outlet

1. The outlet fitting shall be an integral part of the tank and provide complete drainage of liquid through the sidewall of a flat bottom container without the use of a special support structure or concrete pad.
2. The tank attachment shall be constructed from a PVC schedule 80 male adapter and is standard in 2,3,4 or 6 in. sizes on select tank sizes. This provides a schedule 80 pipe socket attachment (Except for the 6 in. size). Other outlet attachments are available in a variety of materials. The fitting orifice shall not be less than schedule 80 interior pipe size per ANSI B36.10-1979. O-rings shall be constructed of 70 +/- 5 durometer Viton, FKM, FPM, or approved equal. The inside diameter of the outlet is to be molded and is not to be drilled out to increase chemical flow.

F. Fittings - Self-Aligning Threaded Bulkhead

1. Self-Aligning fittings are available for installation in vapor phase applications on curved surfaces depending on the spherical dome radius and the placement of the fitting on the tank dome. Fittings must be placed away from tank radiuses. Consult the manufacturer for placement questions. The maximum allowable size for self-aligning fittings placed on a spherical section of the tank is shown below.

Tank Diameter	Maximum Fitting Size Allowable
45 in. - 48 in.	2 in.
64 in. - 142 in.	3 in.

2. Tank thickness and fitting angle may need to be considered for self-aligning fitting placement. The maximum thickness and installation angle for fitting sizes are shown below.

Fitting Size	Maximum Angle	Maximum Thickness
1 in.	27 degrees	1.000 in.
2 in.	25 degrees	0.750 in.
3 in.	20 degrees	1.0 in.

3. The self-aligning fittings shall be constructed of PVC or CPVC. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton, or other specified material.

G. Vents

1. Each tank must be properly vented for the type of material and flow rates expected. Vents must comply with OSHA 1910.106 (f) (2) (iii) or other accepted standard. All tanks must be vented for atmospheric pressure as well as any pressure created by filling and emptying the tank. Some applications may require a sealed tank with a vent line going to a scrubber system for proper chemical safety. Venting equipment should be sized to limit pressure or vacuum in the tank to a maximum of 1/2" of water column (0.02 psi). U-Vents are offered in sizes from 1 in. to 6 in. with or without mesh insect screening. U-Vents with mesh screening may require additional sizing due to reduced air-flow rates. Consult the manufacturer for necessary venting and placement information.

2. All u-vents shall be constructed of PVC or other specified materials.
3. When a tank is being filled from a pressurized tanker truck or rail car steps need to be taken to avoid pressurizing the tank. The tank may require a secondary surge protection lid to avoid any pressure build up. The surge protection lid is to be a 14" or 18" hinged and be design that it is self-closing.

H. Flange Adapters

1. Flange adapters may be purchased as optional equipment to adapt threaded or socket fitting outlets to 150 lb. flange connections for connection to piping system components. Flange adapters are available in PVC, CPVC or other specified materials. Flange adapter construction shall utilize schedule 80 components in sizes ranging from ¾" to 8" depending on material required.

I. Flexible Connections

1. All tank fitting attachments shall be equipped with flexible couplers or other movement provisions provided by the tank customer. The tank will deflect based upon tank loading, chemical temperature and storage time duration. Tank piping flexible couplers shall be designed to allow 4% design movement. Movement shall be considered to occur both outward in tank radius and downward in fitting elevation from the neutral tank fitting placement.
2. The flexible connection is to be manufactured of the same material as the tank or a compatible material approved by the project engineer. If an elastomer flexible connection is used control bolts are required if recommended by the manufacturer. The flexible connection is to be designed for a minimum of 4% movement. The flexible connection is to be designed with 150# flange connections to allow for attachment to the tank and the piping system. The flexible connection is to be attached as close as possible to the tank to reduce stress.

2.3 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
B. Factory Test Report:

1. Certify through visual inspection of tanks after fabrication that Acceptance Level II requirements of ASTM D2563 are met.
2. Certify following during shop inspection:

a. Compliance with Drawing dimensions.
b. Surface cure by acetone wipe test; no surface tackiness is permitted.
c. Liquid tightness by minimum 24-hour hydrostatic test.

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.

2.4 ACCESSORIES

A. Reverse Level Indicators

1. Furnish and install liquid level indicators on the exterior of the storage tanks. The level indicator shall be actuated by a float within the tank through a polypropylene tape with high visibility numbers in feet and inches to a weighted indicator on a pulley system. All wetted parts, parts subject to condensation or exposure to the atmosphere within the tank shall be suitable non-corrosive durable material approved by the Engineer. The indicator board shall be marked in one hundred-gallon increments and labeled every 500 gallons. All moving parts shall be vapor tight fully enclosed but easily accessible for maintenance. The indicator shall utilize the 3" top opening in the tank and shall be mounted on the side wall of the tank with appropriate anchor materials.

B. Ultrasonic Level Indicator

1. Per Specification 40 72 13 - Ultrasonic Level Meter
2. The ultrasonic enclosure is to be an all plastic design with a NEMA 4X rating. The ultrasonic transducer is to have a 12" dead band and beam with a 20 ft range. The supply voltage can be 110, 220 VAC or 24 VDC. The connection to the tank is to be 2" or 3" NPT.
3. The ultrasonic level indicator shall provide a visual display of liquid level in the tank showing gallonage in measurement of hundreds of gallons along with 4-20 mA output for other alarm or control systems as well as four independent contacts capable of handling 10 amps each. Each contact can be programmed to operate in different opening and closing methods (7 modes). Contacts can be used to control pumps, valves, alarms, etc.

C. Fill Stations

1. A permanent fill station shall be constructed as shown on the drawings and shall be fitted with quick couplers. Quick Coupler Adaptors and caps for making quick connections shall be Kamlok 633A and 634B, respectively or equal. Couplers for Sodium Hypochlorite shall be titanium

D. Manway and Fill Cap (Non-sealed)

1. Fill caps shall be in a 10 in. vented-threaded style on various tank sizes with a minimum opening diameter of 7.125 in. Cap attachment shall be provided with all standard 10 in. cap placements with a polyurethane cap tie. Check the manufacturer's specification drawing for availability and position.
2. Manways shall be 18 in. vented or non-vented threaded design or hinged style (minimum opening diameter of 15 in.) and a 24 in. vented or non-vented threaded or hinged style (minimum opening diameter of 22 in.) on various tank sizes. Check the manufacture's specification drawing for availability and position.
3. All caps and manways shall be constructed of polyethylene material.

E. Bolted Sealed Top Manway

1. Sealed manways are shall be 18 or 24 in. sizes depending on availability in tank size. Consult the manufacturer for placement positions.

2. The sealed manway shall be constructed of polyethylene material. The bolts shall be polypropylene or other specified material. The gaskets shall be closed cell, crosslinked polyethylene foam and Viton O-rings to seal the bolts.

F. Surge Protection Lid

1. The hinged lid is to be manufactured of polyethylene. The lid will be a 14 in. size with 11 in. access opening or 18" with 15" access. The opening of the lid is to be restricted by a tether. The lid is to be designed so that it will close when the pressure has been released. Check SII specification drawing for availability and position.

G. Down Pipes and Fill Pipes

1. Down pipes and fill pipes shall be prepared per the customer approved drawings and specifications. All down pipes and fill pipes shall be supported at 5 ft. maximum intervals with support structures. Standard support structure design shall utilize bulkhead fitting tank attachments or welded attachments on Type II tanks. All designs shall be done according to the specific needs of the customer.
2. All down pipes and fill pipes shall be constructed of PVC or other specified materials.

H. Tank Attachments – External Fill Pipes - Optional on certain tanks

1. External fill pipes shall be prepared per the customer approved drawings and specifications. All external fill pipes shall be supported at 3 ft. maximum intervals with a support structure independent of the tank (ground supported). All designs shall be done according to the specific needs of the customer.
2. All external fill pipes shall be constructed of PVC or other specified materials.

I. Ladders

1. Ladders shall be constructed of stainless steel or FRP.
2. Safety cages shall be provided with ladders as optional equipment unless required by OSHA standards.
3. All ladders shall be designed to meet applicable OSHA standards. Reference: OSHA 2206; 1910.27; fixed ladders.
4. Ladders must be mounted to the tank to allow for tank expansion and contraction due to temperature and loading changes. All top ladder mounts shall be connected to integrally molded in attachment lugs that allow for tank movement due to temperature and loading changes.

J. Tie Down Systems

1. The tie down system shall be designed to withstand 150 MPH wind loads. Tie down systems must meet seismic requirements per IBC 2009 / CBC 2010 code with seismic loads $\leq$ .445g (Seismic Design Category "D" - Fa=1.0, Fv=1.5, Ss=1.4, S1=0.5). Anchor bolts shall be provided by the contractor per the calculations and the base plates for the system. A registered engineer's wet stamped calculations and or drawings may be required.
2. The tie down system shall be offered galvanized, 304 or 316 stainless steel.
3. Mild steel parts shall be deburred and galvanized.

K. Tank Nameplate

1. Mark each tank with encapsulated paper tag or stainless-steel nameplate not less than 4 by 6 inches in size; attach to outside of tank wall.
2. Print the following information on nameplates:

    a. Name of manufacturer.
    b. Capacity in gallons.
    c. Manufacturer serial number.
    d. Year built.
    e. Maximum specific gravity.
    f. Design pressure and temperature.
    g. Resin.

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 tank accessories and piping connections.

3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
B. Thoroughly clean chemical storage tank pad, removing loose concrete, dust, and other debris. Place two layers of building paper on pad according to tank manufacturer's recommendations prior to placing tank.

3.3 INSTALLATION

A. Install chemical storage tank as indicated on Drawings and according to manufacturer's instructions.
B. Connect piping to tank.
C. Install tank accessories not factory mounted to complete installation.
D. Heat Tracing: Install heat tracing and tank heating systems in accordance with the manufacturers' printed in instructions

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. Field Testing:

1. Hydrostatically test each chemical storage tank by filling with water to the overflow pipe level.
2. Conduct test minimum of 48 hours.
3. No leakage permitted.
4. Adjust, repair, modify, or replace components of system failing to perform as specified, and rerun tests.

D. Furnish services of manufacturer's representative experienced in installation of products supplied for not less than two, eight-hour days on-Site for installation inspection, field testing, and instructing Owner's personnel in maintenance of equipment.

E. Obtain Installation Certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing, and furnish to Owner.

3.5 ATTACHMENTS

A. Polyethylene Storage Tank Schedule:

1. TB8110

a. Material Stored: Sodium Hypochlorite (12%)
b. Chemical Specific Gravity: 1.16
c. Configuration: Vertical Tank
d. Dimensions: 72"Ø x 114" nom
e. Capacity: 2,000 gallon
f. Tank Material: HDLPE or XLPE
g. Fitting Material: PVC
h. Gasket Material: Viton, FKM, FPM, or approved equal
i. Bolt Material: Titanium
j. Accessories: Reverse Level Indicator, Down Pipes and Fill Pipes, External Fill Pipes, Ultrasonic Level Indicator, FRP Ladder and Tank Nameplate.
k. Fittings:

1) 1 – 4" Vent
2) 1 – 3" nozzle, flanged, top mounted for liquid level
3) 1 – 2" nozzle, top mounted, for fill
4) 1 – 3" side bottom drain
5) 1 – 3" overflow positioned above the volume elevation
6) 1 – 18" ID bolted sealed manway in top

END OF SECTION 43 41 45

SECTION 43 53 54 - BLOWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Positive displacement blower package including accessories as specified herein.
   a. Blower Application: Fine Bubble diffusers tank, Quantity: 2
   b. Blower Application: Aerobic Digester, Quantity: 2
   c. All equipment specified in this section shall be designed and furnished by the blower manufacturer, who shall be responsible for the suitability and compatibility of all included equipment per this section.

B. Related Sections:

1. Section 40 90 00 – Instrumentation and Control for Process Systems
   a. Blower package controls are to be supplied by the System Integrator and are not part of the blower package.
2. Div. 26 - Execution requirements for electrical connections to equipment specified by this Section.

1.2 SCOPE

A. Contractor:

1. Furnish, unload, store and install positive displacement blower equipment with accessories necessary to provide a complete operational system as shown on the plans and as specified.

2. Shall be responsible for startup and training activities under the direction of the qualified manufacturer's representative.

1.3 QUALITY ASSURANCE

A. Manufacturers' Qualifications:

1. All equipment furnished under this section shall be manufactured in a plant whose quality management system is certified / registered as being in conformity with ISO 9001 and who shall assume complete responsibility for the design and performance of the blower package.
2. All equipment furnished under this section shall be new, unused, and shall be the standard product of the manufacturer, who shall have a minimum of 10 years' experience in producing blower packages and be able to produce evidence of at least 5 installations of similar size in satisfactory operation in the United States, if requested.

B. Factory Tests:

1. All cast parts to be manufactured in a plant whose quality management system is certified / registered as being in conformity with ISO 9001.
2. All critical dimensions of the blower components provided by the manufacturer shall be verified and documented prior to assembly.
3. On completion of final assembly of the packaged blower and prior to shipment, each blower package shall be mechanically run at the prescribed design conditions to confirm machine operation.
4. Each blower package provided by the manufacturer shall be guaranteed to provide performance to ISO 1217, Annex C.

C. Reference Standard:

1. American Society of Testing and Materials (ASTM)
2. National Electrical Manufacturers Association (NEMA)
3. Occupational Safety and Health Act (OSHA)
4. National Electrical Code (NEC)
5. American Gear Manufacturers Association (AGMA)
6. Anti-Friction Bearing Manufacturers Association (AFBMA)
7. International Organization of Standardization (ISO)
8. International Electrotechnical Commission (IEC)
9. German Institute for Standardization (DIN)

1.4 WARRANTY

A. Manufacturer's standard submittal for establishing compliance to this section shall include the following items; following submittal procedures in accordance with Section 013300
1. Table of contents
2. A complete and detailed list of any and all variations to the specification
3. Descriptive literature, bulletins, and/or catalog cut sheets of the equipment
4. Scope of supply
5. Blower package performance data sheets showing at least the following:
   a. Package model name
   b. Bare blower model name
   c. Design conditions as listed in this section
   d. Air flow in ICFM and SCFM for design conditions listed
   e. Discharge Pressure
   f. Motor size
   g. Brake horse power required for blower
   h. Bare blower speed with percentage of its maximum speed
   i. Process air connection size
   j. Operating Voltage required for both main motor and enclosure ventilation fan
   k. Sound pressure and power levels
   l. Dimensions
   m. Package weight
   n. Discharge temperature
   o. Accessories being supplied
6. Installation Data sheets

7. Manufacturer's standard performance curve showing blower rpm, pressure differential, capacity in ICFM, blower shaft horsepower, temperature rise at standard conditions
8. Blower package drawing showing all important details required for installation including dimensions, anchor bolt locations, size and location of connections to other works and weight of equipment.
9. Motor manufacturer's data sheet showing at least the following:
    a. Motor manufacturer's name and model number
    b. Efficiency class and %
    c. Efficiency at ½, ¾, and full load
    d. Amp draw
    e. Motor RPM
    f. Code letter
    g. Motor frame
10. Electrical connection diagram for motor, enclosure ventilation fan and any blower accessory requiring an electrical connection.
11. Inlet filter documentation
12. Data sheets for supplied instrumentation and accessories
13. Spare parts overview drawing
14. Recommend spare parts list
15. Paint specification for blower package
16. Maintenance overview
17. Blower startup check list
18. Lubrication requirements
19. SDS sheet (oil)
20. Warranty information
21. Manufacturer's standard for equipment standards
22. Compliance with Machinery Standards for sound and performance certificate

B. Manufacturer's standard Operation and Maintenance Manual shall include the following sections; following submittal procedures in accordance with Section 013300
1. Regarding this document
2. Technical Data for the blower package
3. Safety and Responsibility
4. Design and Function
5. Installation and operating conditions
6. Installation
7. Initial Start-Up
8. Operation
9. Fault Recognition and Rectification
10. Maintenance
11. Spare parts, Operating Materials, Service
12. Decommissioning, storage and transport
13. Annex with drawings and diagrams

1.5 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Delivery and handling of Equipment:
1. Manufacturer and Contractor shall coordinate the delivery schedule for just in time delivery to minimize the period the Blower package is on site before installation.

2. Contractor shall unload and inspect all equipment and materials against reviewed shop drawings at the time of delivery. Any damage shall be reported to the freight company immediately upon receipt.
3. Equipment and materials damaged or not meeting the requirements of the reviewed shop drawings shall be immediately returned for replacement or repair.
4. Each box or shipping crate shall be properly marked to show its net weight and its contents.

B. Storage:
1. Contractor shall prepare for storage and label all equipment and materials after they have been inspected. The Contractor shall be responsible for the equipment and materials while in storage.
2. Contractor shall prepare for storage and label all equipment and materials after they have been inspected. The Contractor shall be responsible for the equipment and materials while in storage.

1.6 SPARE PARTS

A. Furnish the following manufacturer's recommended routine maintenance spare parts for each blower package provided:
1. Two (2) integral inlet silencer filter elements
2. Lubrication for first year of operation
3. One (1) belt set
4. One (1) tube of motor grease (50HP or larger)

B. All parts shall be furnished in clearly identified packaging

1.7 WARRANTY

A. The manufacturer shall warrant the bare blower being supplied against all defects in workmanship and materials for a period of sixty (60) months from date of startup, not to exceed sixty-six (66) months from date of shipment from the manufacturer of the blowers. All other package components shall be warranted for a period of twelve (12) months from date of startup, not to exceed eighteen (18) months from the date of shipment.

B. The contractor shall be responsible for proper storage of the equipment so as to remain in "as shipped" condition. If the equipment remains in storage at the job site for longer than six (6) months before installation, the contractor shall provide factory service personnel for a complete inspection of the equipment. Any work necessary to restore the equipment to "as shipped" condition shall be the responsibility of the contractor.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. The equipment specified herein is intended to be standard equipment for use in low pressure air systems and be supplied by a single manufacturer or authorized sales representative to assure uniform quality, ease of maintenance, and minimal parts storage.

B. Manufacturers:

1. Kaeser Compressors, Inc.
2. Or Pre-Approved Equal.
   a. Reference Section 016000 for product substitution procedures for information pertaining to alternate products

C. Plan layouts, weights, and pertinent specification language used in the design have been based upon Kaeser Compressors, Inc. equipment. Any changes required to accommodate equipment other than the basis of design shall be provided by the Contractor at no additional expense to the Owner. Furthermore, a complete and detailed deviation list from the specification shall be provided with proposal.

2.2 DESIGN CRITERIA

A. Standard Conditions for SCFM:
1. Elevation: 14.7 PSIA (0' elevation)
2. Temperature: 68 deg F
3. Relative Humidity 36%

B. Design (site) Conditions for ICFM:
1. Elevation: 14.4 PSIA (507' elevation)
2. Maximum Blower Inlet Temperature: 100 deg F
3. Relative Humidity*: 50%
   *Relative humidity at maximum blower inlet temperature

C. Fine Bubble Diffusers Tank Blowers Performance Data:
1. Quantity: 2
2. Blower Packaged Controlled by a VFD: YES
3. Flow Required: 151 SCFM
4. Blower Package Discharge Pressure: 9.8 PSIG
5. Motor Horsepower: 30 HP
   a. Motor shaft power shall account for belt losses in addition to internal package losses
   b. The motor shall not operate in its service factor at design conditions.
   c. VFD efficiency loss shall be accounted for.
6. Power supply voltage:
   a. Main Motor: 460v/3ph/60hz
   b. Enclosure ventilation fan motor: 115v/1ph/60hz
7. % of Maximum Blower Speed at 60hz: <= 81%
8. Sound pressure level = 73 dB(A) *

9. Sound power level = 91 dB(A) *
*In accordance with ISO 2151, +/- 3 dB(A), with insulated piping.

D. Aerobic Digester Blowers Performance Data:
1. Quantity: 2
2. Blower Packaged Controlled by a VFD: YES
3. Flow Required: 1066 SCFM
4. Blower Package Discharge Pressure: 10.6 PSIG
5. Motor Horsepower: 75 HP
   a. Motor shaft power shall account for belt losses in addition to internal package losses
   b. The motor shall not operate in its service factor at design conditions.
   c. VFD efficiency loss shall be accounted for.
6. Power supply voltage:
   a. Main Motor: 460v/3ph/60hz
   b. Enclosure ventilation fan motor: 115v/1ph/60hz
7. % of Maximum Blower Speed at 60hz: <= 81%
8. Sound pressure level = 73 dB(A) *
9. Sound power level = 91 dB(A) *
*In accordance with ISO 2151, +/- 3 dB(A), with insulated piping.

2.3 BLOWER PACKAGE CONFIGURATION:

A. Installation Location: Outside

B. Inlet Configuration: Ambient

C. All components and instrumentation are to be mounted and pre-piped; no field installation shall be required by the contractor. The manufacturer shall be responsible for all aspects of the engineering, from the blower package's air inlet to its discharge connection.

2.4 DESIGN CRITERIA:

A. Blower Type:
1. The bare blower shall be mounted for vertical air flow, be of the oil-free, positive displacement, rotary three lobe type, designed for air or other inert gas service, and belt driven via electric motor
2. The bare blower assembly must operate at the effective value for vibration velocity in frequency range A and B, according to VDI 3836.

B. Material:
1. AISI, ASTM, GJL, GLS, DIN, etc…., numbers types, and grades specified are typical of material composition and quality, equivalent materials will be considered.

C. Housing:
1. The casing shall be made of high strength, close grained, cast iron, and shall be adequately ribbed to prevent casing deflection and facilitate cooling. Casing shall be of EN GG 20 material.

2. The casing shall be precision machined to allow for minimum clearances.
3. The casing shall include channels integrated on the discharge to reduce blower pulsation and dampen noise
4. The casing shall include threaded atmospheric vent ports between its air-side and oil-side labyrinth seals for safe separation of the conveying and oil chamber.
5. Inlet and discharge ports shall be drilled and tapped for studs to allow solid connection of mating surfaces. Through bolting shall not be allowed. Flange style blower ports, which may be subject to loading, causing cylinder distortion, shall not be allowed.
6. Bearing fits shall be precision machined to ensure accurate positioning of the rotors in the casing.

D. Rotors:
1. The rotors shall be precision machined out of a one piece casting made of EN GGG 50 material. Stub shafts or two-piece impellers shall not be allowed.
2. The rotor assemblies shall be statically and dynamically balanced to ISO standard 1940/1- Q2.5 (turbine rotor). Modifications to the face of the rotors for balancing purposes are not acceptable.
3. The rotors shall be a tri-lobe design in order to minimize pulsation and noise.
4. The rotor must be solid or closed-end to prevent build-up of contaminants inside the rotor causing imbalance.
5. Cored rotors must be closed using threaded iron plugs which are permanently fixed. Impeller end caps of stamped sheet metal shall not be allowed.
6. The rotors shall have an integral sealing strip for improved efficiency.
7. The rotors shall operate without rubbing, liquid seals or lubrication in the air chamber.

E. Cover Plates:
1. The gear-end and drive-end cover plates shall be high strength, close grained, cast iron made of EN GG 20 material. Aluminum cover plates shall not be allowed.
2. The cover plates shall have a precision machined sealing face.
3. The drive-end cover plate shall include at least two precision machined holes to allow for the use of fitting bolts to accurately align the opening for the input shaft seal.

F. Timing Gears:
1. The rotor timing gears shall be precision machined and ground from alloy steel made from case hardened 16 MnCr5 material.
2. Each timing gear shall be straight cut and beveled to quality standard 5f 21, which will eliminate axial bearing loads and ensure long life as well as quiet operation. Helical gears, which cause axial loading, shall not be allowed.
3. Each timing gear shall be manufactured in accordance with:
   a. DIN 3960, Specifications for Spur Gear Sets
   b. DIN 3961 & Din 3962, Tolerances for Spur Gear Mesh
   c. DIN 3964, Specifications for Shaft Centering
4. The timing gear set shall be taper-mounted on the rotors. Keyed, hub mounted, taper-pinned, or splined shaft timing gear mounting designs are not acceptable.

G. Bearings:
1. All four rotor shaft support locations shall incorporate large, heavy-duty, full complement, cylindrical roller bearings with PEEK cages, designed with at least 5-times the dynamic capacity of ball bearings. Ball bearings shall not be allowed.
2. The bearing maximum speeds must be at least two times the maximum recommended blower speed

3. The bearings minimum acceptable L10 design life shall be as follows;
   a. At least 40,000 hours at blower's maximum rated speed and maximum rated differential pressure
   b. At least 100,000 hours at design conditions

H. Lubrication:
1. Both the gear end and the drive end of the blowers shall be oil splash lubricated via a disc slinger for minimal maintenance and long service life. Grease lubricated bearings in the blower are not acceptable.
2. The lubrication design shall ensure adequate lubrication of the timing gears and bearings.
3. The drive-end and gear-end oil chambers must not be interconnected and each oil chamber shall have a domed design sight glass to allow visual inspection of oil level and oil condition, viewable from the front of the blower.
4. Blower to be factory filled with a synthetic lubricating fluid that is rated for the design conditions specified.

I. Rotor Seal Assembly:
1. Each rotor shall include one labyrinth seal assembly on each end, four assemblies in total per blower.
2. Each seal assembly shall consist of the following;
   a. Oil splash guard ring.
   b. Shaft guide wear sleeve with vent holes located between the dual air and oil ring seals. Wear sleeve shall protect the blower casing.
   c. Four piston ring type labyrinth seals made from heat treated GG/42CrMo4 material. Two seals located on the air side and two seals located on the oil side of the grooved rotor sleeve. The use of rubber lip seals shall not be allowed.
   d. Grooved rotor sleeve which will protect the rotor shaft and be used to hold the four piston ring seals.

J. Input Shaft Seal Assembly: (Compak BBC, CBC, DBC, and EBC series)

1. The input drive shaft seal shall be a high temperature radial lip type seal made from Viton elastomer. The seal shall prevent oil leakage from where the input shaft goes thru the drive end cover

2. The seal design shall incorporate a replaceable wear sleeve on the input drive shaft.
   a. The sleeve exterior to be tungsten carbide coated to reduce friction and wear
3. The input shaft seal design must allow for the lip seal and the shaft sleeve to be replaced without removing the drive end cover plate

K. Input Shaft Seal Assembly: (Compak FBC and HBC series)
1. The input drive shaft seal shall be a sliding ring type mechanical seal that will prevent oil leakage from where the input shaft goes thru the drive end cover plate
2. The mechanical seal assembly shall consist of the following;
   a. Replaceable wear sleeve on the input drive shaft
   b. Cover plate with a machined sealing surface
   c. Mechanical sliding ring seal
3. The input shaft seal design must allow for the mechanical seal assembly to be replaced without removing the drive end cover plate

2.5 MOTORS:

A. Drive Motor:
1. Motor shall be designed, manufactured, and tested in accordance with the latest revised editions of NEMA MG-1, IEC, DIN, ISO, IEEE, ANSI, and AFBMMA standards as applicable and shall be capable of continuous operation
2. Motor must meet or exceed Energy Independence and Security Act (EISA 2007) standards for NEMA Premium efficiency. It shall also be marked with a Department of Energy Certification Compliance Number to assure compliance.
3. Motor shall comply with Low Voltage Directive 2006/95/EC or equivalent and be UL listed.
4. Motor must be inverter rated with impulse peak resistance in accordance with IEC 60034-1:2010 or equivalent for operation with an IGBT frequency converter or equivalent
5. Motor horsepower nameplate rating shall not be exceeded at the design discharge pressure when operating at 60hz
6. The temperature rise of the motor windings shall not exceed IEC and NEMA standards when the motor is operated continuously at the rated horsepower, rated voltage, and frequency in ambient conditions at 104°F / 40°C
7. Motor shall be suitable for Full Load/Direct On-line starting, Solid State Ramp starting, VFD, and/or Wye-Delta reduced current starting
8. Motor to be supplied, mounted and aligned by the blower package manufacturer
9. VFD controlled motor (=>75HP) shall have an isolated non drive end "B-side" bearing
10. Motor shall confirm to the following:
    a. Motor Voltage: 460v/3ph/60hz
    b. Type: Squirrel cage induction
    c. Speed: Single
    d. Torque: Constant
    e. Service Factor: 1.15
    f. Enclosure: TEFC
    g. Mounting: Horizontal
    h. Speed: up to 3,600 rpm @ 60 hz (maximum)
    i. Design: A
    j. Duty Cycle: continuous (24hr/day)
    k. Winding Insulation: F
    l. Temperature rise: B
    m. Thermal motor protection: Positive Temperature Coefficient (PTC) thermistors (one per winding) wired in series. The use of thermostats is not allowed
        1) Connection of the PTC thermistors to the control system and signal processing is not part of the blower manufacturer's scope of supply
    n. Conduit box location: Top
    o. Wiring Connection: Terminal strip inside conduit box. Use of wire nuts for connection of motor wiring to power source shall not be allowed
    p. Bearing L10 life: >40,000 hours
    q. Bearing lubrication: Grease
    r. Bearing type:
        1) ≤ 40 HP: Permanently greased
        2) ≥50HP: Regreaseable
            a) Lubrication fittings must be located towards the front of the blower package so that both bearings can be safely lubricated while the blower package is running.

b) Grease drain holes to be closed for protection of the environment. A spent grease cavity in the bearing cover should be large enough to hold spent grease required for 40,000 operating hours.

s. Bearing design: Cantilever forces (belt drive)
t. Condensation winding 110v heater: No

11. Motor shall be as manufactured by Siemens
12. Connection and control of the drive motor to the control system is not part of the blower manufacturer's scope of supply

B. Sound enclosure ventilation fan motor:
1. Motor voltage: reference Performance Data – power supply voltage
2. Motor shall be UL listed
3. Motor starter/ overload protection is the responsibility of the control system provider
4. The fan motor should turn "on" when the main motor starts and turn "off" 10 minutes after the main motor stops. Controlling the fan motor via a thermostat shall not be allowed.
5. Connection and control of the fan motor to the control system is not part of the blower manufacturer's scop e of supply

2.6 BLOWER PACKAGE

A. Drive:
1. The blower shall be driven by the drive motor through a V-belt drive assembly designed to meet the blower conditions specified with a 1.2 or larger service factor
   a. V-belts shall have a XPZ/XPB profile with embedded low-stretch polyester tension cords. The v-belts shall be designed for high rotational speeds and be heat and oil resistance. Ribbed, banded, or multi groove belts shall not be allowed
   b. Sheaves shall have a SPZ/SPB profile and be balanced to G16 for below 30m/s and G6.3 for sheaves above 30m/s
   c. Keyed taper bushing shall be used for easy installation and removal. QD type bushings shall not be allowed
2. The blower drive must have a fully enclosed guard which protects the operator when the blower package enclosure is open while in operation
   a. Belt guard shall be OSHA approved
   b. The belt guard made from the manufacturer's standard sheet metal, shall be designed to duct the cooling air flow from the drive motor fan across the front of the blower to supplement blower input shaft seal cooling
   c. The mounting fasteners for the belt guard shall be retained on the housing to prevent loss during maintenance
3. Belt tension shall be accomplished by the use of a motor swing base and automatic tensioning assembly
   a. The drive motor shall be mounted on a pivoting swing base with an axial adjustment for proper alignment of the v-belts. The weight of the drive motor shall provide the primary belt tension. The use of a sliding motor mount shall not be allowed
   b. A tensioning assembly consisting of a threaded rod with spring shall be used to adjust the v-belt tension to prevent belt slippage and efficiently transmit power to the blower. It shall include a visual indication showing whether or not the v-belt tension is within the correct belt tension range

c. Adjustment of the tensioning assembly shall be accomplished without removal of the guard or loosening of the motor mounting bolts
d. The design of the swing base with tensioning assembly shall prevent the swing base from falling and creating a personnel hazard in the event of a belt failure. The tensioning assembly adjusting nut shall raise the motor swing base facilitating v-belt changes without the use of pry bars or jacks

B. Inlet Silencer:
1. An inlet silencer designed for the frequency range of the blower, shall be provided to reduce the noise of the blower package as specified
a. The inlet silencer shall be of carbon steel construction and be of the wear-free absorptive type, directly connection to the inlet port of the blower, and shall be mounted horizontally
b. The inlet silencer shall be lined with replaceable polyether absorptive material.
c. The inlet silencer shall have an integral filter designed to protect the blower from particulates. It shall be located between the absorptive material and the blower inlet
1) The filter element shall be a washable and reusable polyester element for minimal pressure drop
2) The filter efficiency shall meet ASHRAE 52.2 MERV7 50-70%% @ 3-10 microns corresponding to EN779 G4
3) The filter element integral to the silencer shall be supplied no matter if the inlet configuration of the silencer is ambient or piped. If required on piped inlet configuration, any additional filtration or screening at the inlet location of the piped inlet air source is not the responsibility of the blower manufacturer
4) Filter element shall be removable without disconnecting the inlet duct
d. The filter maintenance cover and element must be removable by hand (without the use of tools)
e. The pressure loss thru the inlet silencer assembly shall be accounted for in the motor horsepower selection of the blower package

C. Base frame with integrated discharge silencer:
1. The blower base frame with integrated discharge silencer shall be designed for the frequency range of the blower, shall be provided to reduce the noise of the blower package as specified
a. The blower base frame shall be of formed steel construction and designed for horizontal mounting of blower with vertical air flow. Flange-mounting only of the bare blower to the blower base frame shall not be allowed, additional support by use of the base frame shall be required; preventing the loading of the blower casing and discharge silencer shell
b. The blower base shall incorporate the pivoting motor swing base and tensioning assembly to insure proper alignment of the drive assembly
c. The discharge silencer shall be an integral part of the base frame
d. The discharge silencer type shall be a combination of absorption, reflection and diffusion
1) The design of the discharge silencer shall incorporate a solid outer and perforated inner cylinder with absorptive material in between the cylinders
a) Absorptive material shall be long, flexible, knotted polyester fibers to allow for lowering the noise and heat emissions inside the sound enclosure. The use of mineral wool shall not be allowed

2) The discharge silencer shall have connections ports for pressure relief, discharge pressure, and discharge temperature. Unused ports shall be capped or plugged

e. The pressure loss thru the discharge silencer assembly shall be accounted for in the motor horsepower selection of the blower package

D. Blower Sound Enclosure:

1. A sound enclosure shall be provided which fully covers the blower, motor, drive assembly, inlet silencer, blower base frame with integrated discharge silencer, and be shipped fully assembled
   a. The sound enclosure shall be the product of the blower manufacturer to insure proper integration of blower package components
   b. The sound enclosure shall meet the sound level specified
   c. The sound enclosure acoustic material shall comply to FMVSS 302 with a burning rate B or lower than 100 mm/min
   d. The sound enclosure assembly shall be of self-supporting bolted steel panel construction on a fabricated steel skid
      1) All maintenance removable panels or doors shall be located in the front of the sound enclosure and must have a slotted key lock. A door key shall be provided. All maintenance panels shall meet OSHA weight requirements
      2) The enclosure base shall be designed to enclose the full bottom of the sound enclosure and include fork lift guides for easy transportation and installation
   e. The sound enclosure ventilation cooling air circuit shall be separate from the process air circuit. Mixing of the two air circuits within the enclosure shall not be allowed
   f. The sound enclosure shall have a set of inlet louvers positioned on the blower-side of the enclosure to allow for the flow of ambient cooling air across the blower oil sumps
   g. A screened inlet louver shall be located on the back of the enclosure and designed to provide a laminar flow of ambient cooling air across the blower drive motor
   h. The sound enclosure ventilation air exhaust and the ventilation fan shall be located at the top of the sound enclosure
      1) The ventilation fan shall be sized to provide adequate cooling of the blower package at all blower speeds
      2) The ventilation fan voltage shall be as specified and run concurrent with the main motor. The ventilation fan shall not be controlled by a thermostat
   i. The back of the sound enclosure shall have predrilled holes with grommets for easy pass-thru of electrical wiring
   j. When installed outdoor, reference Blower Package Configuration Part 2.3. An outdoor stainless steel weather hood shall be installed on top of the enclosure to protect the unit from the elements. The weather hood shall be designed to allow access to the sound enclosure and panel mounted instruments

E. Blower Package Accessories:

1. Pressure Relief Valve
   a. The relief valve(s) shall be factory installed within sound enclosure. Relief valve may not be shipped loose for field installation in the discharge piping.
   b. The relief valve(s) shall be spring type and must be sized for 100% of the design flow specified. Weighted relief valves shall not be used

c. The relief valve(s) shall be set to protect the blower from excessive differential pressure based on the design conditions specified. A seal shall be affixed that must be broken if set point is changed
d. The relief valve(s) exhaust shall be vented out of the sound enclosure. Exhaust vented into the sound enclosure shall not be allowed
e. The relief valve shall be ASME Section VIII, UV, CE, and PED certified
f. The relief valve shall be manufactured by Kunkle

2. Check Valve
   a. A check valve to prevent back flow through the blower shall be factory installed and not shipped loose for field installation in the discharge piping
   b. The check valve flapper shall be swing type made from a steel disc embedded in a high temperature silicone elastomer. The valve shall be designed so that, in the event of failure, the valve element is retained in the valve housing. Split disc or center hinged designs shall not be used
   c. The check valve capacity shall exceed the blower package's maximum discharge pressure and temperature
3. Flexible Connector
   a. An elastomeric compensator/flex connector shall be provided to isolate the connection of the blower package to the self-supporting system piping. Restraining rods shall not be used. Flex connectors located between the bare blower and silencers shall not be allowed
   b. The flexible connector capacity shall exceed the blower package's maximum discharge pressure and temperature
   c. Discharge connection
      1) 4" and smaller connection, a web reinforced silicone rubber sleeve with corrosion resistant clamps shall be provided. (Compak BBC, CBC, and DBC series)
      2) 6" and larger connection, an ANSI/DIN flanged arch-type EPDM web reinforced connector shall be provided. (Compak EBC, FBC, and HBC series)
   d. Piped Inlet connection – When required, Reference Blower Package Configuration 2.3.
      1) 6" or smaller connection, a web reinforced silicone rubber sleeve with corrosion resistant clamps shall be provided. (Compak BBC, CBC, DBC and EBC series)
      2) 8" and 10" piped inlet connection, an arch-type EPDM web reinforced sleeve with corrosion resistant clamps shall be provided. (Compak FBC series)
      3) 10" ANSI/DIN flanged inlet connection, an ANSI/DIN flanged arch-type EPDM web reinforced connector shall be provided. (Compak HBC series)
4. Blower instrumentation gauges
   a. The following gauges shall be pre-piped and panel mounted on the front of the sound enclosure. Gauges shall not be shipped loose for field installation
   b. Discharge pressure gauge
      1) The discharge pressure gauge shall measure the pressure at the discharge of the blower.
      2) The discharge pressure gauge shall be dual unit (English – PSI / Metric – Bar) with a range of 0 – 23 psi (0 – 1.6 bar). Minimum dial diameter shall be 2 ½", made with a stainless steel case and be glycerin filled for pulsation dampening
   c. Discharge temperature gauge with adjustable switch

1) The discharge temperature gauge shall measure the temperature at the discharge of the blower package
2) The discharge temperature gauge shall be dual unit (English - °F / Metric - °C) with a range from 32 – 392°F (0 – 200°C) and include an adjustable set point dial. Minimal dial diameter shall be 2 ½", made with a black plastic case and have a liquid filled measuring system that is converted by a Bourdon tube into a rotary movement of the pointer. The rotary movement of the pointer spindle shall operate a SPDT microswitch through a lever system. Voltage rating up 220v, 5amps
3) The high temperature set point shall be as recommended by the blower manufacturer
4) Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated

d. Filter differential pressure gauge
1) The filter differential pressure gauge shall measure the pressure difference from ambient to the back side of the filter that is integral to the blower package's inlet silencer. When the filter starts to become dirty, the resistance shall be shown on a resettable red dial indicating when the filter shall be changed

5. Oil Drains
a. An oil drain from the blower drive-end and gear-end lubricating oil sumps shall be separately piped to the front of the blower base with flexible tubing. Common fill and drain shall not be allowed
b. Each oil drain shall include a drain valve installed for ease of maintenance. The drain valves shall be 90° nickel plated brass valves and include a fully retained gasketed threaded cap to prevent accidental discharge of the blower lubricant

6. Vibration Isolators
a. Vibration isolators shall be provided between the base frame with integrated discharge silencer and sound enclosure skid to prevent transmission of vibration to the foundation
b. A ground wire shall be installed between the blower base and the sound enclosure base to allow for grounding of the complete blower package

F. Optional Blower Package Accessories – the following options shall be supplied
1. Unloaded start valve
a. The blower package when started with a "wye-delta" or "soft/reduced start" starter shall include a diaphragm operated, mechanical unloaded start valve that is mounted between the blower and the discharge check valve
b. The unloaded start valve shall allow the blower drive motor to accelerate unloaded up to full speed before the discharge check valve opens

2. Inlet filter differential pressure switch
a. The blower package shall include an installed filter differential pressure switch that shall measure the pressure differential across the integral inlet silencer's filter
b. The filter differential pressure switch shall be field adjustable up to .73 PSI (50 mbar) and factory set at .5 PSI (35 mbar)
c. The filter differential pressure switch shall be a SPDT switch, Voltage rating up to 250v, 10A
d. Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated

3. Discharge Pressure Switch
   a. The blower package shall include an installed discharge pressure switch that shall measure discharge pressure of the blower
   b. The discharge pressure switch shall be field adjustable
   c. The discharge pressure switch shall be a SPDT switch, Voltage rating up to 250v, 1A
   d. Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated
4. Enclosure Safety Switch
   a. The blower package shall include an installed enclosure safety switch that shall thermostatically measure the temperature inside of the blower package's enclosure
   b. The enclosure safety switch shall be field adjustable and set at 140 deg F (60 deg C)
   c. The enclosure safety switch shall be a SPDT switch, Voltage rating up to 250v, 2.5 A
   d. Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated. It shall not be wired to turn on the enclosure vent fan
5. Oil Temperature Switch (Compak DBC, EBC, FBC and HBC series)
   a. The blower shall include an installed oil temperature switch, one for each oil sump that shall measure the oil temperature in each oil sump of the blower
   b. The oil temperature switch shall be preset at 248 deg F (120 deg C)
   c. The oil temperature switch shall be a SPST switch, Voltage rating up to 250v, 10 A
   d. Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated
6. Oil Level Monitoring (Compak DBC, EBC, FBC, and HBC series)
   a. The blower shall include and installed oil level monitoring, one for each oil sump that shall measure the oil level in each oil sump of the blower
   b. The oil level monitor shall be preset for low oil condition
   c. The oil level monitor shall be a SPST switch, Voltage rating up to 250v, .5 A
   d. Connection of the monitor to the control system is not part of the blower manufacturer's scope of supply. The monitor shall be wired to shut down the blower package when actuated
7. Enclosure Heater Assembly
   a. The blower package when installed where temperatures could be between 5 to 23° F shall include an installed 115v/1ph/60hz enclosure heater with a thermostatically controlled switch that shall heat the inside of the enclosure
   b. The enclosure heater switch shall be field adjustable and be factory set to come on at 41 deg F (5 deg C)
   c. Connection of the enclosure heater system to the control system is not part of the blower manufacturer's scope of supply
8. Instrumentation Junction Box
   a. The blower package shall include an instrumentation junction box where all the provided instrumentation is wired to a terminal strip making for a central electrical connection point (except for the main blower drive motor)
   b. Connections from the instrumentation junction box to the control system are not part of the blower manufacturer's scope of supply

G. Nameplates:
1. The blower package shall have at least two weather proof corrosion resistant type nameplates which includes the manufacturer name, model number, year, max pressure difference, equipment number, part number, serial number, voltage, phase, HP, motor rpm, rated temperature, and FLA attached on the outside and inside of the blower package

H. Anchor Bolts and Hardware
1. Anchor bolts, washers, hex nuts, and all other fastening hardware shall be stainless steel and be supplied by the contractor

I. Paint Specification:
1. The blower manufacturer is responsible for surface preparation, priming and finish coating of the blower package and components requiring paint in accordance with the manufacture's standard procedures. Field painting of blower equipment or supplying components that are only prime painted is not acceptable
   a. Cast parts are to be painted with a two part gray epoxy primer and two part top coat
   b. Fabricated parts are to be painted with a two part gray epoxy primer and two part top coat
   c. Sound enclosure parts are to be powder coated
      1) Panels and base paint finish shall be pretreated by de-greasing and phosphate cleaning, then powder coated to a thickness of 70 µm -100 µm on both sides
2. The blower package to be painted the blower manufacturer's standard colors

PART 3 - EXECUTION

3.1 INSTALLATION

A. The blower package shall be handled and installed in accordance with the manufacturer's recommendations and instructions as shown in the location on the drawings

B. Contractor shall field verify all dimensions and elevations. The engineer shall be notified of any specific differences

C. The blower package shall arrive on site ready for installation. Aligning, adjusting and filling the blower with lubrication shall not be required by the contractor

3.2 FIELD QUALITY CONTROL

A. Furnish the services of a manufacturer's authorized representative for proper installation to inspect and approve the installation, and to supervise a test run of the blower package.

B. After the installation and test run has been completed; the blower package shall be given a field test in the presence of the Engineer to verify that operation is satisfactory and in compliance with the Specification. If the blower package does not meet the Specification, corrective measures shall be taken to ensure the machine meets compliance

3.3 TRAINING

A. Furnish the services of a manufacturer's authorized representative, who will instruct plant personnel in the operation and maintenance of the blower package. All procedures shall be covered including preventive maintenance, method of controlling the blower package and troubleshooting.

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:	8.4 MGD
B.	Channel Width:	36 inches
C.	Channel Depth:	60 inches
D.	Screen Grid Opening:	1 inches (25 mm)
E.	Screen Angle:	45°

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 15 – MECHANICAL SCREEN AND SCREENINGS WASHER/COMPACTOR

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanically cleaned perforated plate screen.
2. Screenings washers/compactor.

B. Related Requirements:

1. Section 01 33 00 – Submittal Procedures
2. Section 01 40 00 – Quality Requirements
3. Section 01 60 00 – Product Requirements
4. Section 01 70 00 – Execution and Closeout Requirements
5. Division 40 – Process Interconnections
6. Division 26 – Electrical

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. Provide headloss information.

D. Shop Drawings:

1. Indicate system materials and component equipment.
2. Submit wiring and control diagrams, installation and anchoring requirements, fasteners, and other details.

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 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 screenings washers/compactors.

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.

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. All equipment specified in this Section 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 mechanical screen and screenings washer/compactor on-site in original packaging. Inspect for damage.

D. Store materials according to manufacturer's instructions.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish a warranty extending twelve (12) months after substantial completion date of the project in its entirety for mechanical screen, screenings washer/compactor, and accessories.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The equipment shall be manufactured by:

1. JWC Environmental
2. Hydrodyne
3. Huber
4. Or Pre-Approved Equal

    a. Specifications and equipment arrangements for the mechanical screening and compacting equipment are based on JWC Environmental. 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 MECHANICAL SCREEN (SCR1010)

A. Description:

1. The manufacturer shall supply one (1) continuous belt type screens with perforated plate grid.
2. Screen shall automatically discharge screenings into header of screenings washer/compactor.
3. Each screen shall consist of a screen frame with screen mounting brackets, an adjustable continuous screen belt, a screen belt cleaning system, spray wash system, covers, and seals to eliminate the bypass of flow or screenings.
4. Mechanical screen and components shall be stainless steel.

B. Design Requirements

1. Number of Screens: one (1)
2. Peak Flow per screen: 4.2 MGD
3. Avg Flow per screen: 1.0 MGD
4. Screen Opening: 0.125 inches (3 mm)
5. Channel Depth: 60 in.
6. Channel Width: 36 in.
7. Inclination angle: 65 degrees
8. Screen Drive Motor: 2 hp (max), 460 V, 3 phase
9. Brush Drive Motor: 1 hp (max), 460 V, 3 phase
10. Wash Water Requirement per screen: 42 gpm, 50 psi (max)
11. Downstream Water Depth at Peak Flow: 9 inches
12. % screen panel blinding: 50%

13. Head drop at 50% blinding: 24.91 inches
14. Water level upstream at 50% blinding: 33.91 inches at peak flow
15. Hydraulic flow regime: Subcritical flow (standard open channel flow)

C. Components

1. Screen

   a. The rotating screen shall consist of perforated panels intermittently rotating through the wastewater flow. Debris combs shall be intermittently affixed to panels as required
   b. Screen panels shall be manufactured from stainless steel or UHMWPE. Each screen panel shall be provided with side seals mounted on each end of the panel.

2. Chain, Sprockets, and Drive Shaft Assemblies

   a. Each screen panel shall be mounted to the stainless steel roller chains driven by stainless steel sprockets mounted on the drive shaft.
   b. The chains shall be roller type with stainless steel side plates. The rollers, pins and bushings shall be hardened stainless steel or polyamide.
   c. The stainless steel drive shaft shall be supported on each side by grease lubricated take-up bearing assemblies.

3. Side Frames

   a. The screen shall include side frames and bracing designed to support the chain, screen panels, spray wash, discharge, and drive assemblies.
   b. Each side frame shall be designed to house the replaceable stainless steel or UHMW polyethylene tracking system.
   c. The tracking system in each frame shall be UHMW polyethylene in the vertical, UHMW polyethylene for the outer and stainless steel for the inner track at the bottom.

4. Covers

   a. The portion of the screen above the operating floor level shall have stainless steel covers.
   b. The covers shall provide quick access to the equipment for maintenance.

5. Spray Wash Assembly

   a. Each screen shall have a spray wash assembly consisting of a spray wash manifold, solenoid operated valve, manually operated ball-valve and Y-strainer, supplied by the screen manufacturer.
   b. Spray wash manifold shall consist of stainless steel pipes and fittings.
   c. The manually operated ball valve shall provide adjustment for the spray wash water flow.
   d. The Y-strainer shall have a plugged blow-off outlet
   e. Screen spray wash water requirements shall be 42 gpm at 50-60 psig.

6. Rotating Brush Assembly

a. A rotating brush assembly shall be used to help with the removal of the screenings from the panels. The brush assembly shall have a separate drive.
b. The brush assembly shall be mounted on an adjustable pivot for easy access and adjustments.

7. Stationary Seal Assembly

a. A replaceable stationary brush and flexible rubber seal assembly shall be used to eliminate debris from bypassing the screen at the bottom

8. Drive Assemblies

a. The screen drive assembly shall be a shaft-mounted reducer with electric motor.
b. The brush drive assembly shall be a shaft-mounted reducer with an electric motor.

9. Discharge Chute

a. An enclosed discharge chute shall receive screened debris that has been removed from the screen panels and transport the discharge to the washer/compactor.

2.3 SCREENINGS WASHER/COMPACTOR (SWC1015)

A. Description:

1. Screenings washer/compactor shall wash out organics and dewater screenings in an automatic sequence.
2. Screenings shall enter top of unit and be agitated by a rotating compaction screw under a spray of wash water.
3. Washed screenings shall be transferred into a compactor section, then exit through a discharge pipe to the discharge location indicated on the Drawings.
4. Unit shall consist of wash water spray, screenings screw, compactor with motor, discharge assembly, and other components to make a complete and operable system.
5. Screenings washer/compactor and components shall be stainless steel.

B. Design Requirements

1. Discharge Drain Connections: Number and size of drain connections to be determined by manufacturer.
2. Maximum Solids Capacity (Continuous): 206 ft^3/hr.
3. Maximum Water (Launder) Capacity: 160 GPM including Wash Press spray water.

C. Wash Tank

1. Wash tank shall consist of tank with removeable cover and end plates, allowing for removal or installation of compaction screw from either end or above.
2. Construction material: 304 stainless steel
3. Inspection ports and covers: Three ports for viewing, located on either side of tank and on top cover.
4. Spray water manifolds: Spray pipes located on either side of perforated screen for washing of material.

D. Perforated Screen:

1. Screen shall provide separation of solids and water through use of perforated holes that control particle size throughput.
2. Welded or removable.
3. Drain pan shall be removable.
4. Screen perforated hole diameter shall be 1/8 inch (3 mm) with 40% open area, Construction Material: 304 stainless steel.

E. Spray Water Control Assembly:

1. Spray water control assembly shall filter, control, and regulate spray water to the tank spray water manifold and hopper spray water manifold.
2. Water requirements: 30 gpm at 40 psig
3. Delivery, frequency and duration shall be programmable through the controller.
4. Basket strainer: Primary filtration of spray water with 20 mesh screen. Basket strainer shall have 136 stainless steel housing and 304 stainless steel screen.
5. Y-Strainer: Secondary filtration of spray water with 80 mesh screen.
6. Solenoid Valves: Control flow of water to manifolds with 120VAC coil, explosion proof.
7. Ball Valves: Manual regulation of water flow and shut off. Ball valves shall be stainless steel.
8. Pressure Gauge: Visual indication of operating pressure.

    a. Freeze resistant design.
    b. Range: 0-100 PSI

9. Pressure Regulating Valve: regulate the pressure of the spray water to the desired operating pressure.
10. Reinforced hose shall be used to connect Wash Water Control Assembly to spray water manifolds.

F. Paddle Compaction Screw:

1. Screw design shall provide disruptive movement of the material creating a turning or flipping action that enhances the wash process by continually exposes additional surface area to the wash water. Compaction screw shall be constructed with specific purpose flight zones for pre-wash zone, wash zone and compaction zone.
2. Pre-wash zone flights: 12-inch outer diameter with min. ¼-inch thick sectional flights. No brush shall be used in this zone to prevent solids buildup.
3. Wash zone flights: 12-inch outer diameter with min. ¼-inch thick sectional flights and three 3/8-inch-thick paddle sections for disruptive movement of material.

    a. Flight brush shall be segmented for each full pitch of spiral to scrub perforations in wash zone.

        1) Base: HDPE
        2) Bristles: Level cut nylon

    b. Paddle brush shall be segmented for each paddle

        1) Base: HDPE

2) Bristles: Crimped nylon

4. Compaction zone flights: Dual helix design, 11-1/4 inch diameter with a nested 1-inch thick outer spiral and a ½ inch thick inner spiral.

   a. Second helix for one full pitch of spiral.
   b. Hard face weld applied with two layers to face of dual helix flights using Stoody 2134, Lincoln electric wear shield 60, or Hardox 400.

5. Torque Tube: 3-inch diameter tube inserted and welded through center of all flight zones.

   a. End of tube shall have dome shaped protrusion to create "donut" form of solid plug in compaction zone for easier transport.
   b. Hard face weld applied with two layers to dome using Stoody 2134 or Lincoln electric wear shield 60.

G. Compaction Elbow:

1. 45-degree bend aiding formation of solids plug and inclined to lift solids to discharge point.
2. Construction Material: 304 stainless steel.

H. Tapered Transport Tube:

1. Transport tube tapered 12-1/2 to 13-5/8-inch diameter to allow for reduced restriction on movement of capered solids and allow proper air flow to further dry material.
2. Transport tube lifting bracket shall be designed to lift tube empty or full with solids.
3. Construction Material: 304 stainless steel.
4. Manufacturer shall fabricate transport tube to convey screenings to the dumpster as required. Drawings show the intent of screenings transport to the dumpster but manufacturer shall verify all details and supports required.

I. Straight Transport Tube:

1. Transport tube 13-5/8 inch diameter to provide additional length to discharge.
2. Construction material: 304 stainless steel

J. Discharge Tip:

1. Discharge tip shall be mounted to end of tapered transport tube or straight transport tube to directional discharge material plug in a downward direction.
2. Construction Material: 304 stainless steel.

K. Shaft Seal:

1. A shaft seal shall provide sealing for Paddle Compaction screw shaft and wash tank.
2. Tungsten carbide dynamic and static seals faces.
3. Bearing shall provide support for axial thrust loads.
4. Static and dynamic race housings: AISI 304 stainless steel.
5. Elastomers: BUNA-N (Nitrile).

L. Speed Reducer:

1. Reduction ratio and design: 123.3:1, helical bevel shaft mounted.
2. Lubrication: Synthetic oil.

M. Motor:

1. TEFC Motor: Baldor Electric Company

   a. Horsepower (max): 5 HP.
   b. RPM: 1750.
   c. Motor Service Factor: 1.15 minimum
   d. Motor Efficiency Factor (at full load): 89.5 minimum

2.4 CONTROL PANEL (FCP1010)

A. Control Panel Description

1. A control panel shall be provided for each screen that controls the screen and the associated washer/compactor.
2. The screenings washer/compactor shall be interlocked with the mechanical screen for automatic operation.
3. Control panel shall have a stainless-steel enclosure.
4. The control panels will be mounted locally at the mechanical screens and screenings washer/compactor on top of the headworks structure.
5. Control panel shall be NEMA 4X and UL listed
6. Control panel shall contain a programmable logic controller (PLC). PLC shall be Allen Bradley Micrologix.
7. The PLC shall include a Modbus TCP communications card.
8. Control panel shall contain an HMI.
9. Control panel shall be provided with sun shield.
10. The control panel shall contain the motor starters. Starters shall comply with Division 26 – Electrical.
11. Surge protection shall be according to Specification 26 43 13 – Surge Protection for Low-Voltage Electrical Power Circuits
12. The panel shall include a fiber optics switch to provide connectivity to the plant SCADA System.
13. All other electrical components shall be in accordance with Division 26 – Electrical.

B. Mechanical Screen Controls

1. The mechanical screen controls shall include the following:

   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) Differential level system: If the screen starts by differential level, the screen shall run until the differential drops below the set point and the off timer times out. If one of the level transducers has an error, the screen shall run continuously.
b) Timer (backup)
c) Input error from transducer (loss of echo)
d) High level alarm: If the screen starts on high level it shall run until the high level drops below the set point and the off timer times out.
e) High level start

b. H-O-A switch for wash water system of mechanical screen.

1) When HAND mode is selected, the spray shall be continuous.
2) When the OFF mode is selected, the spray shall stop.
3) When the AUTO mode is selected, the spray shall run while the screen is running.

c. CONTROL POWER ON indicating light.
d. RUN indicating light for screen.
e. Torque OVERLOAD indicating light for screen.
f. Reset pushbuttons
g. Elapsed Time Meter.
h. Main Disconnect Switch.
i. Emergency Stop Push Button.
j. Hardwired Interlock: Level Switch
k. Local Control Station (FCP1010A)

1) Each screen and washer/compactor shall have a local control station mounted locally to the screen and contain the following:

a) HAND/OFF/AUTO selector switch for screen
b) HAND/OFF/AUTO selector switch for washer/compactor
c) FORWARD/OFF/REVERSE selector switch for screen
d) FORWARD/OFF/REVERSE selector switch for washer/compactor
e) Emergency stop pushbutton

C. Screenings Washer/Compactor Controls

1. The screenings washer/compactor controls shall include the following:

a. H-O-A switch for operation of compaction screw.

1) When HAND mode is selected, the screw shall run continuously.
2) When OFF mode is selected, the screw shall not run.
3) When AUTO mode is selected, the screw shall operate in accordance with pre-configured operating parameters as controlled by a Run Permissive signal from an upstream feed device.

b. H-O-A switch for wash water system.

1) When HAND mode is selected, the spray wash shall run continuously.

2) When OFF mode is selected, the spray wash shall stop.
3) When AUTO mode is selected, the spray wash shall run while the compaction screw is running.

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. Reset Pushbutton.
i. Emergency Stop Pushbutton
j. All required timers.
k. Programmable run sequences to optimize washing and compacting.
l. Power monitor
m. Programmable wash water duration and frequency.

2.5 DIFFERENTIAL LEVEL CONTROL SYSTEM

A. Manufacturer shall provide a differential level control system consisting of ultrasonic transducers to start the mechanical screen and screenings washer/compactor system.

2.6 NAMEPLATES

A. Conform to the requirements of Section 46 05 53 – Identification for Water and Wastewater Equipment.

2.7 SPARE PARTS

A. Furnish one set of manufacturer's recommended spare parts.

B. Furnish special tools and other devices required for Owner to maintain screening equipment and screenings washer/compactor.

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 mechanical screen and screenings washer/compactor.

3.2 INSTALLATION

A. Install mechanical screen and screenings washer/compactor 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 mechanical screen and screenings washer/compactor.

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 73

SECTION 46 23 23 - GRIT REMOVAL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Work described in this section includes furnishing all labor, equipment, materials, tools and incidentals required for a complete and operable installation of the grit removal system as shown on the drawings and specified herein. The manufacturer shall supply the equipment and the general contractor shall install the equipment.

B. Related Requirements:

1. Section 05 50 00 - Metal Fabrications: Fasteners, brackets, and other miscellaneous metal fabrications as required by this Section.
2. Section 09 90 00 - Painting and Coating: 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 46 05 13 - Common Motor Requirements for Water and Wastewater Equipment: Execution requirements for motors specified in this Section.
5. 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. Sample Warranty

1.3 COORDINATION

A. 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.

B. 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.

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.

1.7 QUALITY ASSURANCE

A. Certificate of Compliance
1. The MANUFACTURER shall warrant that the Grit Removal System to be supplied shall be manufactured in strict compliance with the Contract Specifications.

B. The system shall be furnished by a MANUFACTURER who is ISO 9001:2015.

C. MANUFACTURER shall be successful in the experience of manufacture, operation, and servicing of Grit Removal Systems of type, size, quality, performance, and reliability equal to that specified for a period of not less than ten (10) years.

D. If equipment other than that shown on the Drawings is submitted to the Engineer for consideration as an equal, it shall be the responsibility of the MANUFACTURER requesting approval to submit with the request a revised design and layout of the mechanical equipment acceptable to the ENGINEER. Revised drawings shall show the proposed location of the alternate unit, and area required for withdrawal space of replacement or serviceable components. This drawing shall also show clearances of adjacent equipment and service area required by that equipment.

E. Changes in architectural, structural, electrical, mechanical and plumbing requirements for the alternate shall be the responsibility of the Manufacturer requesting approval. This shall include the cost of redesign by affected designers. Any additional cost incurred by affected subcontractors shall be the responsibility of the MANUFACTURER and not the OWNER. Seller shall warrant its products against infringement upon, or violation of, any patent, copyright, trade secret, or any other proprietary right of any third party. In the event of a claim by any third party against the Owner, the Owner shall promptly notify the Seller. The Seller

shall then defend such claim, in the Owner's name, but at Seller's expense, and shall indemnify the Owner against any loss, cost, expense or liability arising out of such claim whether or not such claim is successful.

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. 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 MANUFACTURER

A. The entire Grit Removal System shall be manufactured by Hydro International, Hillsboro, OR.

B. Or Pre-Approved Equal

1. Specifications and equipment arrangements for the equipment referenced are based on Hydro International. 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 GRIT CONCENTRATOR

A. Design Data

1.	Number of Units:	1
2.	Size:	6' diameter
3.	Number of Trays per Unit:	6
4.	Surface Area/Unit:	170 ft^2
5.	Peak Loading Rate:	16.8 gpm/ft^2

6.	Performance at Ave Flow:	95% removal of all grit (specific gravity 2.65) ≥ 75 microns at average flow
7.	Performance at Peak Flow:	95% removal of all grit (specific gravity 2.65) ≥ 150 microns at peak flow
8.	Average Flow/Unit:	2 MGD with no more than 3" headloss
9.	Peak Flow/Unit:	4.11 MGD with 12" headloss
10.	Discharge:	Weir
11.	Underflow Connection:	4"
12.	NPW Connection:	1" NPT
13.	Materials of Construction:	304SS Support structure/duct/underflow; LDPE trays

B. Operation

1. Flow shall transition from the inlet channel or pipe to the trays via an inlet duct positioned above the trays. Each tray shall be connected to the inlet duct by a horizontal nozzle with a rectangular cross section and large clear openings. Round nozzles which reduce cross sectional area shall not be allowed. Designs with hydraulic turns greater than 45 degrees shall not be allowed.
2. The Grit Concentrator shall have a maximum surface loading rate of 18.4 gpm/square foot to ensure adequate surface area for settling and specified particle removal efficiency. No exceptions shall be allowed.
3. The Grit Concentrator shall be characterized by a controlled boundary layer flow to enhance settleable solids concentration and removal.
4. The Grit Concentrator shall be all-hydraulic consisting of self cleaning corrosion resistant, non-metallic trays with no moving parts within the unit.
5. All flow passages shall be self-cleaning and free of sharp projections or fittings that may snag stringy or fibrous materials.
6. Water shall be intermittently supplied to the solids underflow sump.

C. Construction

1. The inlet flume shall be constructed of Minimum 14 gauge formed stainless steel sheet with minimum 3" clear openings. Multiple flexible connections to the trays shall not be allowed. Units using a piped upflow influent distribution design shall not be accepted. Designs with hydraulic turns greater than 45 degrees shall not be allowed.
2. Grit Concentrator trays shall be molded thermoplastic with a minimum ¼ inch thick LDPE on the pans and sidewalls. Formed and welded stainless steel trays shall not be allowed.
3. The stack of trays shall securely fit into a stainless steel support frame. The support frame shall fit and secure to the bottom of the CONTRACTOR supplied concrete support structure.
4. The sump bottom with fluidizing ring shall be installed in the CONTRACTOR supplied concrete tank and incorporate a threaded connection to the water supply line.
5. No gap in the grit basin shall be less than 3 inches
6. All pipe flanges shall conform to ANSI B16.1 bolt patterns.

D. Valves and Accessories

1. The Grit Concentrator shall be provided with the following accessories:
   a) One (1) 1" bronze globe valve to regulate the system water flow rate to the grit collector.

b) One (1) 1" bronze ball valve for shut off
c) One (1) 1" brass solenoid valve for automation
d) One (1) 8-40 gpm acrylic flow meter

2. Unions or quick disconnects are to be incorporated into the piping on either side of the flow meter for ease of removal and cleaning. The quick disconnects or couplings are to be supplied and installed by the contractor.

2.3 GRIT CLASSIFICATION/CONCENTRATION UNIT

A. Design Data

1.	Number of Units:	1
2.	Size:	24" diameter
3.	Performance:	95% removal of all grit (specific gravity 2.65) ≥ 75 microns at design flow
4.	Influent Solids Concentration:	≤ 1.0 %
5.	Design Flow/Unit:	150 gpm @ 27" headloss
6.	Influent Connection:	3" flanged pipe
7.	Effluent Connection:	8" flanged pipe
8.	Underflow Connection:	6" flanged pipe
9.	Material of Construction:	304 SS
10.	Operation:	Continuous

B. Operation

1. The Grit Classification/Concentration unit shall be designed to handle screened raw wastewater.
2. The Grit Classification/Concentration unit shall be characterized by a dominant, strong free vortex which utilizes centrifugal and gravitational forces and secondary boundary layer velocities to effect the separation, collection and classification of grit from the unit's inflow.
3. Defining characteristics of the dominant free vortex / secondary boundary layer velocity type units are as follows:
   a. Dominating increasing tangential velocity profile toward the center of the unit.
   b. The ability to handle increasing flows with no loss of the specified grit removal efficiency and with increasing headloss requirements.
   c. No requirements for electrical or mechanical components, flow deflecting/guiding weirs or baffles, or compressed air lines within the unit to meet the specified performance.
   d. Continuous removal of grit.
4. The Grit Classification/Concentration unit shall be all-hydraulic with no moving parts within the unit.
5. Vortex grit units which do not have a dominant, strong free vortex / secondary boundary layer velocity and whose performance decreases with increasing flow shall not be allowed.
6. The grit underflow from the Grit Classification/Concentration unit shall be transported by gravity to the Grit Dewatering unit.

C. Construction

1. The Grit Classification/Concentration unit shall be fabricated from stainless steel. The vessel walls shall be 3/16 inch thick.
2. A coating of Belzona shall be applied to the inside bottom part of the Grit Classification/Concentration body to add a secondary layer of abrasion resistance.
3. The Grit Classification/Concentration unit shall be designed to withstand a maximum working pressure of 14.7 psig. The actual maximum pressure at the inlet shall be no more than 14.7 psig.
4. All flanges shall be rotatable and conform to ANSI B16.1 bolt patterns.
5. A minimum 12 inch diameter visual access shall be provided in the top of the Grit Classification/Concentration unit. All internal elements shall be removable from inside the unit.
6. The Grit Classification/Concentration unit shall be free standing on three legs and mounted above a Grit Dewatering unit. Clearance shall be provided between the bottom of the grit underflow pipe and the Grit Dewatering unit clarifier surface.

2.4 GRIT DEWATERING CONVEYOR

A. Design Data

1.	Number of Units:	1
2.	Maximum Design Flow Rate:	125 gpm
3.	Maximum Grit Load:	0.75 cyd/hr
4.	Clarifier Size:	60" Wide
5.	Clarifier Surface Area:	14.5 sq. ft
6.	Spiral Diameter:	12"
7.	Maximum Spiral Speed:	2 rpm
8.	Inlet Connection:	6" flanged pipe
9.	Overflow Connection:	6" flanged pipe
10.	Drain Connection:	3" threaded pipe
11.	Motor:	1.0 hp
12.	Material:	304 SS

B. Operation

1. The Grit Dewatering Conveyor unit shall be designed to capture and dewater concentrated grit slurry from the Grit Classification unit.
2. The Grit Dewatering Conveyor unit clarifier shall be designed based on a settling rate not to exceed 1 gpm/ft^2.

C. Construction

1. The Grit Dewatering Conveyor shall be provided with an integral clarifier which shall provide at least 3 inches of freeboard.
2. The conveying screw shall have 3/16-inch-thick flights mounted on a 3 1/2 diameter schedule 40 pipe.
3. The housing for the Grit Dewatering Conveyor auger shall be fitted under the clarifier. The housing for the Grit Dewatering Conveyor auger shall be stainless steel and shall be inclined at 25 degrees.
4. The clarifier and auger housing shall be fully covered. All covers and hardware shall be stainless steel.

5. The auger housing shall be provided with one (1) threaded drain.
6. The Grit Dewatering Conveyor unit support structure shall be as shown on the general arrangement drawing and anchored to a stable base.
7. All flanges shall be spinning flanges, a minimum of 1/2 inch thick, and drilled to match ANSI 150 lb. pipe flanges.
8. The Grit Dewatering Conveyor unit shall be supplied as standard with access to ease maintenance:
   a. Externally accessible bearing unit.
   b. Clarifier observation and maintenance hatches.
   c. Rodding/Flushing water access point opposite of the unit drain.

D. Drive Unit

1. The Grit Dewatering Conveyor shall be provided with a drive unit consisting of the motor and the helical gear reducer, mounted as a single integrated unit.
2. The motor shall be 3 phase, 460 VAC, 60 Hz, NEMA Design B, TENV enclosure.
3. The helical gear reducer shall have hardened alloy steel gears accurately cut to shape.
4. The drive speed shall be adjusted by a variable speed drive housed in the control enclosure. The auger speed shall be adjustable from 1-10 rpm.

E. Valves and Accessories

1. The Grit Dewatering Conveyor unit shall be supplied with One (1) 3" full port stainless steel ball valve located on the unit drain.

2.5 RECESSED IMPELLER GRIT PUMP

A. Design Data

1. The pumps shall be designed for continuous operation and will be operated continuously under normal service.
2. Grit pump shall be Trillium, WEMCO Model C

B. Operation Criteria

	Flow GPM	TDH FT	Max. Pump RPM	Solids Passage	Min. Suction Dia.	Min. Disch. Dia.	Motor HP (max)	Motor RPM
Design Condition	150	20	900	3.0"	3.0"	3.0"	7.5 HP	1800 RPM

C. Design

1. As these pumps will be used to pump abrasive grit and other solids, the pumps shall be specifically designed to both optimize wear resistance and maintain hydraulic performance as wear occurs.
2. The pump(s) shall be of a fully recessed, Slurry Type design, with the impeller mounted completely out of the flow path between the pump inlet and discharge connection, so that solids are not required to flow through the impeller. All flow path clearances within the

pump shall be equal to or greater than the discharge diameter, so that all solids which will pass through the discharge will pass through the pump.

3. The impeller shall be constructed of 650 Brinell Hi-Chrome Iron ASTM A532, Class III, Type A and specifically designed to maintain hydraulic pumping performance as wear occurs.
   a. The impeller shall be of cup design such that the deepest portion of the vane is not located at the vane tips and the tips are surrounded by a thick-sectioned rim of the following thickness:

Pump Size	Minimum Impeller Dia. Outside Rim	Minimum Rim Thickness at Wear Area	Minimum Vane Thickness at Base of Wear Area	Impeller Minimum Weight
3-inch	14-1/16 in.	1 in.	1-3/8 in.	55 lbs.

   b. The hydraulic design shall be such that the length of the impeller vane increases as wear occurs to the rim, allowing as-new or better pumping performance throughout the wear cycle of the impeller.
   c. The hydraulic design of the impeller shall preferentially direct flow to a sacrificial, independently replaceable suction piece. The suction piece shall be easily accessible and replaceable, without the need to disassemble any other component of the pump.
   d. Pump-out vanes on the rear shroud of the impeller are not acceptable.
   e. Impellers of a radial design that incorporate the impeller in a recessed portion of the volute or wearplate are not acceptable.

Pump Size	Casing Minimum Thickness	Suction Piece at Wear Area	Weight of Wearing Parts*
3-inch	9/16 in.	1 in.	360 lbs.

*Suction piece, impeller, casing, and wearplate.

4. The pump's head vs. capacity curve shall slope upward toward shutoff in one continuous curve with no points of inflection capable of causing hunting at any pump operational speed.
5. Pump(s) shall be equipped with slotted raised-face flanges to receive 125 lb. standard bolting. Special case slots shall be cast in to retain bolts and to fasten the case to the bearing housing and to the intake for easy case removal.

D. Materials Of Construction

1. The parts exposed to abrasive wear - case, removable suction piece, impeller, and wearplate shall be of Ni-Hard, ASTM A532 Class I Type A; material, and be a minimum of 650 Brinell hardness for maximum wear resistance. Brinell values below this are not acceptable.
2. Test bars shall be cast integrally with the case and suction piece and shall remain attached to the casting upon final delivery to the owner. Test bars shall be of sufficient thickness to represent the average thickness of the cast part. After receipt of final delivery, the owner may at any time prior to the final acceptance, remove the test bar and independently verify compliance to the material and hardness specification. Failure of the tested bars to meet the specified requirements shall be cause for rejection.

E. Bearing Housing

1. The bearing housing shall be of cast iron, ASTM A48CL-25A.
2. The shaft shall be of AISI Grade 1045 (or equal) steel, and shall be protected throughout the packing area by a removable, hardened 416 or 420 stainless steel shaft sleeve.
3. Bearings shall be oil bath lubricated. The oil reservoir shall be sealed at both ends to prevent entrance of foreign matter. The thrust bearings shall consist of three angular contact ball bearings for maximum protection from all thrust loads. The bearing housing will be equipped with a pressure venting device and oil fill and drain taps. A built-in sight glass shall be furnished to check proper oil level. The bearings shall be rated for a minimum B10 life of 100,000 hours, without credit for any rear pump-out vanes to balance hydraulic thrust.

F. Shaft Sealing

1. Mechanical Seal: A single cartridge mechanical seal requiring no external flushing shall be furnished in the pump.
   a. The seal shall utilize a rotational sealing ring with an o-ring or elastomeric cup mounted rotational ring, a stainless steel rotating body with an o-ring mounted stationary ring loaded by a non-fouling, conical spring encapsulated in Viton. Installation of the seal shall require no measurements or scribe marks on the shaft.
   b. The rotational sealing ring shall be made of tungsten carbide with a 6% cobalt binder, the surface of which shall be lapped to a flatness not to exceed three helium light bands.
   c. The stationary sealing ring shall be constructed of sintered silicon carbide. The surface shall be lapped to a flatness not to exceed three helium light bands. The stationary ring shall be o-ring mounted into the stainless steel stationary body. Stationary sealing rings of converted carbon or other surface-only treatments are not acceptable.
   d. The spring that loads the rotational sealing ring shall be cone-type, non-fouling design and shall run in the pumped product without fouling or hang-up. The spring metal material shall be SAE1075 Carbon Steel, ASTM A-684 heat-treated to a Rockwell C hardness of 42 to 46 and be totally encapsulated in Viton for protection from the pumped fluid. The product side of the spring shall have a minimum 1/4" thick Viton rubber covering for corrosion/abrasion protection. Seals which use single coil, multiple coil, bellows and rubber-in-shear designs are not acceptable.
   e. To minimize the number of points where the slurry must be sealed, the mechanical seal assembly shall have no more than four (4) o-rings: two (2) seal face o-rings, one (1) shaft sleeve o-ring, and one (1) retainer o-ring. O-rings are to be made of Viton. Seals using more than four (4) o-rings are not acceptable.
   f. The seal shall be fitted with an integral shaft sleeve. The shaft sleeve shall be made of CD4MCu ASTM A-743 duplex stainless steel or type 316 stainless steel. The rotating body of the seal shall be positively driven by no less than two (2) stainless steel drive keys.
   g. All metal components not encapsulated in Viton shall be constructed of abrasion-resistant CD4MCu ASTM A-743 duplex stainless steel or type 316 stainless steel. Surface finish shall be a maximum of 64 RMS.
   h. The seal shall be capable of running with up to ± 0.025" radial shaft deflection and ± 0.040" axial shaft deflection without damage or loss of performance.

i. A seal chamber of Hi-chrome iron, ASTM A-532, minimum 600 Brinell hardness, shall be provided to mount the seal and to provide a reservoir of adequate volume for the pumped product to contact and to lubricate the seal faces. The seal shall be installed into the seal chamber from the impeller side of the pump so that only the casing/suction piece and impeller need to be removed to gain complete access to the seal for inspection and/or maintenance.

j. Seals requiring a water or product flush may be furnished in lieu of the non-flushed seal, provided the contractor furnishes, at no extra charge, all of the external auxiliary equipment necessary for the flushing system, including, but not limited to:

1) Isolated water/flush supply system to the seal, including pump, reservoir, pressure reduction valve, solenoid valve, bypass piping and check valve, all furnished in a suitable enclosure, associated wiring, and modifications to the motor control center to actuate the solenoid valve.
2) A pressure gauge, flowmeter, shutoff and isolation valves, manual throttle valve, and strainer at the pump.
3) All tubing/piping shall be stainless steel.

G. Mounting: Belt Drive

1. The pump manufacturer shall provide a common pump and motor base, constructed of minimum 3/8 inch thick fabricated steel, suitably reinforced to support the full weight of the pump, motor, belt drive and guards.
2. The pump manufacturer shall furnish and install a separate, adjustable motor base. The motor base shall be provided with a threaded screw for adjustment so that the motor can be easily moved for V-belt tensioning and adjustment.
3. The pump manufacturer shall supply and install belts and sheaves to drive the pump at the speed necessary to meet the rated conditions.
4. The drive shall be of the stationary control variable speed TB Woods type JVS, type SVS, or equal, which allows a speed change by means of an adjustment to the motor sheave when the drive is not in operation.
5. An approved fiberglass or thermoplastic belt guard shall be provided to safely enclose the belt drive. If metal guards are furnished, they shall be of all 316 stainless steel construction with suitable lifting eyes and handles to aid in removal.

H. Motor

1. Motor shall be TEFC type, 7.5 HP, 3-Phase, 60 Hz. Cycle, 460Volt, 900 RPM, and shall be connected to the pump by the drive method specified. All motors shall be of nationally known manufacture and shall conform to NEMA standards and specifications.

2.6 CONTROLS AND INSTRUMENTATION

A. Control Panel

1. One (1) control panel shall be furnished, completely pre-wired and tested.
2. The control panel shall adhere to the following specifications:
   a. Enclosure Rating: NEMA 4X
   b. Material: 304SS
   c. Voltage: 480 Volt

d. Phase: 3 Phase
e. Frequency: 60 Hz
f. Logic: Programmable Relay

3. The Control panel shall contain all timers, VFDs, switches, indicator lights, and other components necessary to operate the following equipment:
   a. One (1) Grit Concentrator
   b. One (1) Grit Pump
   c. One (1) Grit Dewatering Conveyor
4. The control panel shall be supplied with applicable control relays and time delay relays with a minimum one extra normally closed and one extra normally opened contact is provided for each relay.
5. Where remote monitoring is required, the panel shall be provided with all dry contacts necessary.
6. The panel door layout shall include the following items:
   a. Front panel mounted combination main disconnect switch and circuit breaker
   b. Back lit, push-to-test Power On indicating light
   c. System three position HOA switch
   d. System Emergency Stop push button
   e. System Alarm Reset push button
   f. Grit Concentrator fluidizing valve OPEN light
   g. Grit Concentrator fluidizing water HOA switch
   h. Grit Pump running light
   i. Grit Pump three position HOA switch
   j. Grit Pump fail indicating light
   k. Grit Pump manual START push button
   l. Grit Pump manual STOP push button
   m. Grit Pump manual speed potentiometer
   n. Grit Dewatering Conveyor running light
   o. Grit Dewatering Conveyor fail indicating light
   p. Grit Dewatering Conveyor three position HOA switch
   q. Grit Dewatering Conveyor manual START push button
   r. Grit Dewatering Conveyor manual STOP push button
   s. Grit Dewatering Conveyor manual speed potentiometer
   t. Grit Dewatering Conveyor FAIL RESET push button

2.7 SEQUENCE OF OPERATION

1. The system shall be controlled to provide automatic or manual operation, manual starting and stopping and system shut down when a fault is detected.
2. Clarified plant water shall be supplied to the Grit Concentrating unit.
3. Grit Concentrator
   a. Grit shall be intermittently discharged from the sump via the Grit Pump. Prior to the Grit Pump operating, the fluidizing valve shall open for a predetermined period of time and remain open for a duration.
   b. If the time between grit discharge cycles exceeds a certain threshold, the fluidizing valve shall open for a period of time to ensure that the grit stays liquefied.
4. Grit Classification/Concentration unit
   a. Screened raw wastewater shall be pumped to the Grit Classification /Concentration unit intermittently.

b. An accumulating timer (AT) shall reset and begin timing out when a signal is received indicating flow of plant influent to the Grit Classification/Concentration unit. (The signal, provided by others, would be initiated by either the influent pump run signal, by the opening of the valves that provide flow to the Grit Classification/Concentration unit, or from a flow transmitter indicating flow to the Grit Classification/Concentration unit.) The AT regulates the length of time between GBC, (Grit Bowldown Cycles). When the AT times out it shall send a signal to initiate a GBC. The timing between, and duration of, the grit blowdown sequence is site specific; the AT should be adjustable between 5 min to 8 hr, normally set at 3 hrs. The panel shall be equipped with two timers, one for dry weather, and one for wet weather. For higher grit loads, the wet weather timer shall increase the frequency of the GBC as compared with the dry weather timer. The timer being used shall be selected by a local switch or by remote contact closure on terminals provided in the panel.

c. During the GBC grit pump will stop and the contents of the Grit Classification/Concentration unit will empty into the Grit Dewatering Escalator.

5. Grit Dewatering Conveyor unit

a. The Grit Dewatering Conveyor auger shall run on a pre-determined intermittent schedule as Grit slurry is transported to the unit to suit site conditions.

b. The auger speed shall be adjustable via the control panel.

c. After a System Shut Down the Grit Dewatering Conveyor shall continue to operate for a pre-determined amount of time to allow for the removal and dewatering of all grit accumulated in the clarifier. The off delay timer shall be adjustable from 0-60 minutes with a typical delay off time of 15 minutes.

2.8 UTILITY REQUIREMENTS

A. Water

1. The Grit Concentrator Unit shall require a minimum intermittent supply of 20 gpm clarified non-potable water at a minimum 50 psig.

B. Electrical

1. The system shall require one (1) 480 VAC, three phase electrical service connection to operate

2.9 MATERIALS AND FINISHES

A. Materials

1. All stainless steel used for the fabrication of the equipment shall conform to the following standards:

Plate and Sheet	ASTM A 167
	ASTM A 240
Bar	ASTM A 276
	ASTM A 479

Tube	ASTM A 312

B. Exterior Surface Finishes

1. All surfaces shall be free of sharp edges, weld spatter and residue. All welds shall be ground smooth.
2. All stainless steel weld surfaces shall be acid washed.
3. All non-submerged exterior surfaces shall be Glass Bead Blasted to a uniform finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

3.2 INSTALLATION

A. Install the grit removal equipment according to manufacturer's instructions.

3.3 START-UP, TRAINING AND MANUFACTURER'S SERVICES

A. A factory trained representative for the equipment specified herein shall be present at the jobsite and/or classroom designated by the Owner for a maximum of four (4) 8-hour man-days (two (2) visits) for installation inspection, plant startup, functional testing, and operator instructions; travel time excluded. A minimum of 30 days notice is required to schedule manufacturer's services.

3.4 FUNCTIONAL TESTING

A. Prior to plant startup, all equipment shall be inspected for proper alignment, operation, connection, and satisfactory operation by means of a functional test. It is the General Contractor's responsibility to duly notify the MANUFACTURER of any inabilities to perform functional testing prior to operator training.

3.5 MANUFACTURER'S CERTIFICATE(S)

A. Provide MANUFACTURER'S certificate of installation and commissioning following functional testing and startup.

B. Provide MANUFACTURER'S OEM Software Licensing Agreement following and final payment.

END OF SECTION 46 23 23

SECTION 46 33 41 - LIQUID CHEMICAL FEED SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Skid- Mounted Sodium Hypochlorite Feed Pumps
2. Control panels.

B. Related Requirements:

1. Section 26 05 03 - Equipment Wiring Connections: Execution and product requirements for connecting devices specified by this Section.
2. Sections 40 42 13 - Process Piping Insulation: Insulation requirements for piping and appurtenances.

1.2 REFERENCE STANDARDS

A. Instrument Society of America:

1. ISA 5.1 - Instrumentation Symbols and Identification.
2. ISA 20 - Specification Forms for Process Measurement and Control Instruments Primary Elements and Control Valves.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
B. Integrate instrumentation and control devices provided under other Sections.
C. Resolve signal, power, or functional incompatibilities among interfacing devices.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
B. Product Data: Submit manufacturer's information with each instrument data sheet.
C. Shop Drawings:

1. Symbology and Nomenclature: Comply with ISA 5.1.
2. Indicate interfaces between instruments, motor starters, control valves, variable-speed drives, flow meters, and chemical feeders.

D. Data Sheets:

1. Comply with ISA 20.
2. Submit following:

a. Manufacturer's model number or designation.
b. Component system or loop.
c. Installation location.
d. Input and output characteristics.
e. Scale, range and units.
f. Requirements for electric and plant water requirements.
g. Materials of component parts in contact with process chemicals.
h. Special requirements or features.

E. Manufacturer 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: Certify that equipment has been installed according to manufacturer instructions.
H. Qualifications Statements:

1. Submit qualifications for system integrator.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
B. Project Record Documents: Complete loop and schematic diagrams including field and panel wiring, piping and tubing runs, routing, mounting details, and point-to-point diagrams with cable, wire, tube, and termination numbers.

1.6 QUALITY ASSURANCE

A. Instruments Using Common Measurement Principle:

1. Furnish by single manufacturer.
2. Furnish same type, model, or class.

B. System Integrator: Company specializing in integrating chemical feed products specified in this Section with minimum three years' experience.

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 AMBIENT CONDITIONS

A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
B. Panels and Enclosures: Suitable for operation in locations as indicated on Drawings.
C. Temperature Range: 32 degrees F to 104 degrees F.
D. Relative Humidity: 20 to 90 percent, noncondensing.
E. Instrumentation in Hazardous Areas: Suitable for use in particular hazardous or classified location.

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 five-year manufacturer's warranty for liquid feed equipment systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The H21 Series peristaltic chemical feed pump shall be a heavy-duty modular design suitable for 24-hr/day operation. Flomotion Systems, Buffalo, NY or approved equal.
B. Pump

1. Process Conditions

Pump Model	H21KA8
Quantity	2
Tag Number	Specify
Fluid Being Metered	Sodium Hypo & Ammon Sulfate
Viscosity (cps)	Specify
Specific Gravity	Specify
Tubing Material	Floprene
Min – Max Capacity	0.004-48.5gph
Pump RPM Range	0.8-225
Min Flow Rate (GPH)	0.1
Max Flow Rate (GPH)	38.5
Fittings	1/2" MNPT, NSF61 PVC
Discharge Pressure (Max PSI)	30
Power Input	115/230Vac, 1ø, 60hz

2. Pumphead
   a. The ABS plastic pumphead shall have a spring-loaded roller assembly utilizing high performance 3/32" (2.4mm) thick wall extruded tubing specifically formulated for use in peristaltic pumps.
   b. The pumphead shall be capable of accepting a minimum of 6 different tubing diameters ranging from 1/16" (1.6mm) ID to 3/8" (9.6mm) ID.
   c. The stainless steel roller assembly shall have adjustable occlusion to optimize pump performance. The rollers shall be Nylatron MD. Rigid/fixed roller assembly designs shall not be acceptable.
   d. Pumphead design shall be capable of pressures up to 100-psi depending on tubing sizes with a suction lift to 30 ft. vertical water column and run dry without damage.
   e. One of the two spring loaded roller shall be fully engaged at all times to prevent backflow or siphoning.
   f. The tubing shall be in contact with the inside diameter of the pumphead through an angle of 180 degrees and be held securely on suction and discharge with Viton or Buna N tube seal grommets.
   g. The pumphead shall be a completely sealed design. Any fluid leakage due to a tubing rupture shall be completely contained within the pumphead.

3. Gearmotor
   a. The pumphead/adapter flange shall have a lip seal to prevent fluid leakage between pumphead and speed reducer.
   b. The output shaft and all mounting hardware shall be stainless steel.
   c. Gearmotor shall have corrosion resistant Dupont black powder coat finish.
   d. Gearmotor shall be horizontal configuration with integral junction box wiring.
   e. Gearmotor shall be 3/8HP, TEFC, Inverter duty, 230/460Vac, 3ø, 50/60 Hz.

4. Speed Controller
   a. Controller shall be pump mounted and housed in a NEMA 4X enclosure.
   b. Controller shall have an integral 8-button keypad and display.

c. Controller can be operated in manual or automatic mode via 4-20mA input. In automatic mode the speed range shall have the capability of being optimized to the input signal.
d. Controller shall have the capability to accept a contact closure from an optional tubing rupture detector. The capability of starting a back-up pump shall also be provided.
e. The controller shall have the following additional input and output functions:
   1) Start/Stop Input
   2) Local/Remote input
   3) 4-20mA speed reference output
   4) Fault output
   5) Remote status output
   6) Run output
f. Controller power input 115/230Vac, 1ø, 60Hz with 10' grounded power cord.

5. Tubing and Connectors
   a. Pump tubing shall be extruded from NSF61 Floprene or other suitable material based on chemical compatibility with a wall thickness of 2.4mm.
   b. Connectors shall be leak proof 4pc precision machined specifically designed for peristaltic pump tubing shall be provided. Inserts to be color coded for specific tubing sizes. The use of metal hose clamps will not be permitted

6. Rupture Detector
   a. Tubing Rupture Detector shall be provided to automatically shut down the pump and signal an alarm in the event of a rupture. A pumphead mounted sensor and wall mount controller shall be provided with the following features:
      1) Sensor shall have no moving parts
      2) LED signals alarm condition
      3) 8 amp @ 250Vac DPDT latching relay
      4) Single reset pushbutton
      5) Ability to start back up pump
      6) 115Vac power input.

7. Spare Parts
   a. Three-year supply of pump tubing or pumphead cartridge assemblies.

8. Additional Options/Accessories
   a. CPN2KS Sigmamotor 2000ml Graduated Calibration Cylinder.
   b. P2N499P Sigmamotor 1/2" PVC Pressure Relief Valves with PTFE/EPDM diaphragm. Two port design. Adjustable 5-150 psi range.
   c. FLN12PV Sigmamotor 12 Cu. In. PVC Pulsation Dampener w/ Viton bladder
   d. GIN060PTB Sigmamotor Diaphragm Protected Pressure Gauges, 0-60-psi with PVC isolator body and PTFE diaphragm.
   e. BN499P Sigmamotor 1/2" PVC Back Pressure/Anti-siphon valves with PTFE/EPDM diaphragm.
   f. PES211-H Prepackaged Extrusion Welded Polyethylene Duplex Peristaltic Pump Skid with common suction, common discharge, leak containment and fork lift cut-outs. Tapered floor with rear corner drain. 1/2" schedule 80 PVC piping with transparent true union reversable right side/left side "Y" strainer/flush, PVC ball valves and above accessories included. All pre-mounted, wired and wet tested.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pump skids per manufacturer's instructions
B. Mount skids where shown on Drawings
C. Fit and align connecting piping to eliminate all stresses

3.2 START-UP AND PERFORMANCE WARRANTY TESTS

A. Make equipment adjustments required to place system in proper operating condition.
B. Test each feed system for proper operation in the presence of the Owner. All testing costs are the Contractors.
C. Furnish all testing equipment, special instruments and devices required for performance testing.
D. Modify and/or replace defective equipment until it meets specified requirements. Re-test system to verify satisfactory operation.
E. Demonstrate the accuracy of each metering pump using job supplied calibration column.

3.3 FIELD QUALITY CONTROL

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
B. Calibration:

1. Calibrate each instrument at 40, 60 and 100 percent of its span using test instruments to simulate inputs.
2. Field-calibrate instruments that were not bench-calibrated.
3. Tags: Attach calibration and testing tag to each device, signed and dated by device manufacturer's representative after calibration has been completed.

C. After installation, inspect and test for proper operation.
D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 1 days, (8 hours) 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.

3.4 DEMONSTRATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
B. Demonstrate system startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner's personnel.

END OF SECTION 46 33 41

SECTION 46 43 21 - TRANS-FLO CLARIFIER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. One (1) Trans-Flo Clarifier suitable for installation in rectangular settling tank.

B. Related Requirements:

1. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electrical connections to equipment specified by this Section.
2. Section 46 05 13 - Common Motor Requirements for Water and Wastewater Equipment: Execution requirements for motors specified in this Section.
3. Section 46 05 53 - Identification for Water and Wastewater Equipment: Nameplates for equipment specified in this Section.

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 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 6034 - Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors.
4. AGMA 6113 - Standard for Industrial Enclosed Gear Drives (Metric Edition).

C. American Society of Mechanical Engineers:

1. ASME B17.1 - Keys and Keyseats.
2. ASME B17.2 - Woodruff Keys and Keyseats.
3. ASME B29.100 - Double-Pitch Roller Chains, Attachments, and Sprockets.

D. ASTM International:

1. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

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.

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 clarifiers and components.
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. Furnish one set of manufacturer's recommended spare parts.

C. Tools: Furnish special tools and other devices required for Owner to maintain and calibrate equipment.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

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 and inspect for damage.
C. Store materials according to manufacturer's instructions.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

A. Each clarifier shall include:

1. Approximately twelve (12) inlet orifice tubes and deflector plates
2. Inlet skirt battle and support angle
3. Non-metallic collector chain
4. Flights and wear shoes
5. Sprockets
6. Stub shafts
7. Headshaft
8. Wall bearings (headshaft only)
9. Return track with support brackets
10. Floor wear strips
11. Two (2) embedded sludge removal orifice plates
12. One (1) rack and pinion operated scum pipe
13. Effluent weirs and battles
14. One (1) collector drive unit complete with reducer, motor, overload device and appropriate guards
15. Associated attachment bolts and anchor bolts

2.2 DESIGN CRITERIA

A. Influent/Effluent hydraulics shall be designed to handle:

	MIN.	AVE.	MAX.	PEAK
Effluent Flow (MGD)	0.4	0.5	0.75	1.25
Return Flow (MGD)	0.15	0.5	0.75	0.75
Mixed Liquor Flow (MGD)	0.55	1.0	1.5	2.0

B. Maximum headloss for header 0.75 ft
C. Minimum flow velocity in header 0.50 fps
D. Minimum header orifice diameter 2.5-inch
E. Influent channel velocities 0.50 fps minimum
F. Basin to Influent Channel headloss 0.10-fl at average.
G. Selection of collector components shall be based upon design calculations incorporating the following criteria:
   1. Operation under wet tank conditions
   2. Friction factors - 0.20 to 0.30 (UHMW on UHMW)
      - 0.05 to 0.10 (UHMW on stainless steel-water lubricated)
   3. Bearing friction -0.05 per shaft assembly
   4. Shaft deflection - not to exceed 0.033" per foot of shaft length
      In no event shall the collector components be less than specified herein.

2.3 INFLUENT FEED CHANNEL ORIFICE TUBES AND SKIRT BAFFLE

A. The orifices shall be formed from steel tubes sized and furnished by the manufacturer for installation by the General Contractor. The length of orifices shall not be greater than the floor thickness. Spacing of the orifices shall be determined by USFilter, Envirex Products but shall not exceed 6 ft.
B. Orifice baffles shall be constructed of 3/16" thick steel plate. Baffles shall allow no restriction less than the diameter of the orifice, and no greater than one diameter plus one inch.
C. The influent skirt baffle shall be constructed of 0.90-inch thick #825E high impact polystyrene sheets extending 5 ft. beneath the water surface. The skirt baffle shall be fabricated in approximately 10' sections and shall be hung beneath the influent channel floor, supported from a support angle. The skirt shall provide a distributing zone for feed flow from the orifices. This zone shall be open at its lower end for introduction of the feed into the tank at a uniformly low velocity of not more than 5 FPM at maximum flow.
D. The side feed channel design shall be such as to insure hydraulic balance in the tank.

2.4 COLLECTOR CHAIN

A. Collector chain shall be NCS720S non-metallic type having 6-inch pitch links with an average weight of 1.3 lbs/ft. The chain shall have a catalog working load of 2,600 lbs and a minimum ultimate strength of 6,000 lbs. The chain shall be manufactured of unfilled acetal resin and molded with the barrel and side bars as an integral assembly. The chain shall be assembled with pins not less than 15/16" diameter, manufactured of reinforced nylon resin and designed to provide full dead load bearing capacity throughout the full length of the link side bar hubs. The pins shall have a T-head to engage retainer lugs molded integrally with one link side bar hub as a positive means to prevent pin rotation. The pins shall be locked in position by a retainer ring molded integrally with the opposite side bar hub and provide a positive locking contact around the full periphery of the pin. The pins shall be pressed into the link side bar hubs to exclude

abrasives using a tool supplied by the manufacturer. Pins having dual purpose retainer and anti-rotational lugs will not be acceptable.

B. The attachment links shall be of similar construction to the plain chain links, with the flight pusher plate extending the full depth of the flight and molded integrally with the link sidebars. The attachment mounting hole spacing shall conform to ANSI Standard B29.21M81 and shall accommodate four (4) 3/8" diameter type 316 stainless steel hex head attachment bolts. Bolts shall be fastened with brass "Nylock" hex locknuts and type 316 stainless steel cut washers. The attachment link shall be capable of twisting a minimum of 10 degrees across the face of the attachment without failure.

C. Collector chain shall be tested and manufactured per the minimum quality assurance program specified under the Collector Chain Testing Section of this specification.

D. Maximum water absorption shall be no greater than 0.6% after immersion for 48 hrs. at 73.4° F (23°C) in accordance with ASTM D-570. The flight section shall include a scraper lip on the leading edge of the flight to optimize cleaning of the tank floor. Polypropylene filler blocks shall be furnished to allow the flight to be securely bolted to the chain attachment. Flight spacing shall be approximately 10 ft. for longitudinal collectors (and 5 ft. for cross collectors). Flights shall be accurately drilled and notched at the factory and banded together for shipment.

2.5 FLIGHTS

A. Flights shall be 3" x 8" nominal size fiberglass construction, essentially rectangular in cross section. The member shall have a Moment of Inertia of not less than 2.01 in.4 about its minor axis. The flight shall be of pultruded isophthalic polyester composite construction with a minimum fiberglass content of 50% but no greater than 60%, to insure member strength and insure total encapsulation of the glass fibers to prevent wicking. The use of extenders in the resin is prohibited.

B. Maximum water absorption shall be no greater than 0.6% afler immersion for 48 hrs. at 73.4‘ F (23° C) in accordance with ASTM D-570. The flight section shall include a scraper lip on the leading edge of the flight to optimize cleaning of the tank floor. Polypropylene filler blocks shall be furnished to allow the flight to be securely bolted to the chain attachment. Flight spacing shall & approximately 10 ft.. Flights shall be accurately drilled and notched at the factory and banded together for shipment.

2.6 WEARING SHOES

A. Each flight shall be provided with ½" thick wearing shoes to run on floor wear strips and on formed structural tracks on the return run. The shoes shall be cast of UHMW-polyethylene. Wearing shoes running on the floor wear strips shall be located central to the chain attachment to avoid drilling additional holes that would weaken the flight. Where necessary, the return run wearing shoes shall include a guide lug to insure proper tracking of the flight with the return track. All wearing shoes shall be reversible providing two (2) usable wearing surface.

2.7 COLLECTOR CHAIN SPROCKETS

A. Sprockets for the collector chains shall be molded totally of polyurethane having a water absorption rate not to exceed 1.3% at saturation in accordance with ASTM D-570. Sprockets shall be of split construction and have the double life tooth profile compatible with non-metallic chain. Sprocket halves shall be assembled on the shafting with two (2) type 316 stainless steel full width clamping bands which exert compressive force around the full periphery of the hub, thereby clamping the sprocket to the shaft where required. The clamping bands shall include provisions to restrict lateral movement. Stub shaft sprockets shall rotate freely on bearing sleeves (bearing sleeves not used on stainless steel shafts) clamped to the static shaft. Head sprockets shall have chain saver rims. The headshaft sprockets shall have the keyway machined in to the hub in such a way as to restrict lateral movement of the key and to insure chain alignment. Wedge dogs of type 316 stainless steel shall be located along the split line near the periphery and so designed to draw the sprocket halves together in diametrical and lateral alignment.

B. Headshaft sprockets shall not be less than 22.23" pitch diameter and have 23 teeth. Cornershaft sprockets shall not be less than 16.61" pitch diameter and have 17 teeth. Driving sprockets shall be keyed firmly to the headshaft and shall be clamped to the shaft by stainless steel band clamps.

2.8 BEARINGS SLEEVES (Note: Bearing Sleeves are NOT USED for stainless steel stub shafts)

A. Stub shaft bearing sleeves shall be molded of UHMW-polyethylene per ASTM-D4020-81 with a minimum tensile strength of 5600 psi at 57 degrees Celsius (73 degrees Fahrenheit). The sleeves shall be of split construction and shall include a shoulder at each end to restrict lateral movement of the sprocket. The two (2) sleeve halves shall be secured to the stub shaft by two (2) type 316 stainless steel clamping bands, which exert compressive force around the full periphery of each shoulder. The shoulders shall include retainer rings to contain the clamping bands.

2.9 HEADSHAFT

A. Headshaft shall be solid cold-finished steel, straight and true, held in position with split UHMW- polyethylene set collars. The headshaft shall contain keyways with fitted keys and shall be sized to transmit the power required. Headshaft shall extend across the full width of the tank and turn in bearings mounted on the tank walls. Shaft and sprockets shall be shipped unassembled to prevent damage to sprockets during shipping and handling.

2.10 STUB SHAFTS

A. The longitudinal idler sprockets shall be mounted on stub shafts with bearing sleeves (Note: No bearing sleeves if stainless steels shafts are used). The wall bracket is to be a cast ductile iron tripod, attached to the wall with three (3) 3/4" dia. adhesive anchors. The stub shaft shall be a 3 1/2" dia. cold-finished steel. The shaft is to be fixed to the base by three (3) 1/2" dia. set screws.

2.11 BEARINGS

A. Headshaft bearings shall be of cast iron construction of the water lubricated, self-aligning type, having a babbitted sleeve. The housing shall be specially designed to prevent the accumulation of settled solids on its' surfaces. The bearings shall be bolted directly to the concrete wall in a manner that shall permit their easy alignment.

2.12 RETURN TRACKS

A. Return tracks shall be type 316 stainless steel formed shapes attached to stainless steel or non-metallic brackets mounted on the tank walls. Each bracket shall be designed to cantilever the return track approximately 9" off the tank wall. Support brackets shall be spaced approximately 10 ft. apart.

2.13 WEAR STRIPS

A. The door shall have two lines of removable wear strips of 3/8" thick UHMW-polyethylene material in 10 ft sections with each section having five (5) countersunk holes. All splices shall be mitered at 45 degrees to allow for smooth passage of the wear shoes in the direction of flight travel. Wear strips are to be attached to the tank floor with 1/4" dia. type 316 stainless steel flat head self tapping screws used along with 1/4" vinyl anchors. Anchors shall be set in predrilled holes.

2.14 DRIVE UNITS

A. One drive unit shall be provided for each collector mechanism
B. The motor shall be rated at 0.5 hp, totally enclosed, ball bearing, constant speed, of ample power for starting and continuously operating the mechanism under normal operating conditions without overloading. The motor shall conform to NEMA standards and be suitable for operation on 460 volts, 3 phase, 60 Hertz.
C. The drive unit speed reducer shall be of the helical gear type, fully housed, running in oil, with anti-friction bearings throughout. The drive units shall be assembled by the Manufacturer and shipped as a complete assembly to ensure proper assembly of all components.
D. The motor shall be directly connected to the speed reducer and mounted as a common unit. V-belt drives will not be acceptable. Provide a 120 v space heater in the motor.

2.15 DRIVE CHAIN

A. Collector drive chains shall be No. NH78 non-metallic, having 2.609" pitch links with an average weight of 1.4 lbs. per ft.. The chain shall have a maximum catalog working load of not less than 1,750 lbs., based upon strength and fatigue considerations. The chain links shall be manufactured of acetal resin and connected with 7/16" diameter stainless steel pins. The pins shall be constructed to prevent rotation and shall be held in place without the use of pins or

cotters. Chains made of glass reinforced resins that require an abrasion resisting bushing to insulate the pin from the link barrel shall not be acceptable.

2.16 DRIVEN SPROCKET

A. The driven sprocket shall consist of a polymeric toothed rim bolted to a split polymeric dished body. The rim and body shall be molded of high performance polyurethane having a water absorption rate not to exceed 1.3% at saturation in accordance with ASTM D-.570. The body shall be molded concentric and perpendicular to the bore with the rim mounting holes accurately located to insure concentricity of the sprocket assembly. The body halves shall be assembled on the headshaft with two

B. (2) clamping bands to exert compressive force around the full periphery of the hub, thereby clamping the sprocket assembly to the shaft. Wedge dogs shall be located along the split line near the periphery and so designed to draw the sprocket halves together in diametrical and lateral alignment. The body shall have a machined keyway designed to restrict the lateral movement of the key.

C. The rim shall be molded in four (4) segments and each segment shall be bolted to the body with four (4) 5/8" diameter bolts. The sprocket rim shall be not less than 33.25" pitch diameter and have 40 teeth. All sprocket hardware shall be type 316 stainless steel.

D. The drive sprocket shall consist of a polymeric plate section bolted to a cast éon driving hub. The sprocket plate section shall be molded of polyurethane as described under the collector chain sprocket section. The sprocket shall be not less than 9.26" pitch diameter and have 11 teeth.

E. The drive sprocket shall be provided with a shear pin device to provide for protection of the drive equipment in the event of excessive loading. Aluminum shear pins shall be provided to transmit torque from the driving hub to the sprocket shear plate with a polymeric gasket located between the shear faces to prevent seizing.

2.17 OVERLOAD ALARM TRIP

A. The driver sprocket hub shall also be provided with a trip lug that, upon torque overload, shall contact the actuator arm of the double throw limit switch which, in turn, shall shut off the motor and energize the alarm circuit. The limit switch shall have a (weatherproof) (explosionproof) enclosure and shall be provided with a steel support bracket for positioning adjacent to the overload device. The audible alarm and silencing switch shall be furnished by the Electrical Contractor.

2.18 DRIVE CHAIN TIGHTENER

A. The drive chain arrangement shall include a chain tightener to take up excessive slack in the drive chain. The tightener assembly shall include a stainless steel slide base and mounting bracket with a self-centering and self-lubricated molded polyurethane idler sprocket.

2.19 CHAIN GUARD

A. The drive chain and sprockets located above the operating platform shall be covered with a removable metal guard of No.14 gauge type 304 stainless steel.

2.20 SLUDGE REMOVAL HEADERS

A. Manufacturer shall furnish embedded sludge removal header plates as shown on the Contract Drawings. Removal headers shall be formed in the concrete floor slab and shall & provided with 1/4-inch steel removable orifice plates. Orifice plates shall include a series of inlet orifices sized and spaced for a uniform withdrawal of settled sludge over the width of the tank.

2.21 SCUM REMOVAL MECHANISM

A. Each skimmer pipe shall span one (1) tank width. Each mechanism shall be independently operated and shall be capable of 75 degree rotation in either direction.

B. The pipe shall be 12-inch diameter with nominal 1/4-inch wall thickness. A 60 degree wide slotted opening shall be cut symmetrical about the vertical axis to provide a weir over which scum can flow into the pipe when rotated. Edges of the slot shall be parallel to the longitudinal axis of the pipe. Full periphery bands shall be left in the pipe at intervals not exceeding 2.5 ft. to act as stiffeners.

C. The revolving pipe shall be supported at each end in such a manner that a slight misalignment shall not interfere with the smooth operation of the pipe. The pipe shall be supported by and revolve in a rolled steel collar which shall be welded to an adjustable steel plate. The open end support shall have segments welded to the internal periphery of the collar to provide ample bearing surface for the pipe without crushing the seal. Plywood fillers shall be furnished with the open end supports to provide a watertight connection to the tank walls without grouting.

D. A suitable watertight seal shall be provided for the open end of the pipe. This seal shall be so constructed that it shall remain effective even with a slight misalignment of the pipe and collar. The seal shall not be affected by grease, mild acids, or alkalies. The seal shall be readily renewable without removing the pipe from the supporting brackets and shall not bind or impede the smooth action of the revolving pipe.

E. The skimmer pipe shall be manually operated by means of a handwheel with handle and rack and pinion assembly. The handwheel shall be fitted to a structural steel floor stand of welded construction having a non-rising stem. The stem shall be brass and threaded, having four (4) Acme threads and shall turn inside a standard pipe lifting stem, which raises and lowers the sliding rack assembly. The rack assembly shall consist of two (2) angles fastened together by two (2) connecting pins and welded to a plate, which is welded to the lifting stem. The rack assembly shall move in a cast iron guide bracket to assure positive contact of the connecting pins with a steel pinion segment welded to the skimmer pipe. The pinion segment shall rotate on the rack connecting pins so as to permit an easy and accurate means of adjusting the skimmer pipe through a 75 degree angle in either direction, for a total of 150 degree.

2.22 EFFLUENT WEIRS AND SCUM BAFFLES

A. The effluent weirs and scum baffles shall be per Miscellaneous Metals Specification.

2.23 GENERAL ITEMS

A. All anchor bolts shall be Type 304 stainless steel of ample size and strength for the purpose intended. All anchor bolts are to be set by the General Contractor in accordance with the Manufacturer's instructions. A radius screed for finishing of grout for the curved end ofthe tank shall be furnished by the Equipment Manufacturer.

2.24 PAINT

A. Equipment shall be shop primed as noted under the Painting Section.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

3.2 INSTALLATION

A. Install clarifier equipment 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. Dry Startup: Run equipment without liquid in basins and inspect for:

1. Alignment of sprockets, chain, flights, and wearing surfaces.
2. Binding and excessive heat buildup in drive units.

C. Wet Startup: Run equipment with wastewater in basins and verify proper operation.
D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than two trips of two days each 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 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 module functions and adjust as necessary.

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 43 21

SECTION 46 51 13 - FLOATING MECHANICAL AERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Floating mechanical aerators.
B. Related Requirements:

1. Section 09 96 00 - High Performance Coatings: Surface preparation and coating requirements.

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:

1. Submit manufacturer's product information for system materials and component equipment.
2. Submit electrical characteristics and connection requirements.
3. Submit installation requirements and other details.

C. Shop Drawings:

1. Indicate size and configuration of aerator assembly, mountings, weights, and accessory connections.
2. Indicate system materials and component equipment.

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. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
G. Source Quality-Control Submittals: Provide certified wet & dry testing of the complete unit at the manufacturer's facility.

1. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

H. Manufacturer Reports:

1. Certify that equipment has been installed according to manufacturer's instructions.
2. Indicate activities on Site, adverse findings, and recommendations.

1.4 COORDINATION

A. Coordinate Work of this Section with Work of other Sections.

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 aerators and components.

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 materials according to manufacturer's 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'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 shall furnish a warranty extending twelve (12) months after substantial completion date of the project.

PART 2 - PRODUCTS

2.1 FLOATING MECHANICAL AERATORS (SA2110, SA2120)

A. Manufacturers:

1. Aqua-Aerobic® (Model FSS Endura® Series Aqua-Jet® Aerator)
2. Evoqua® (Aqua-Lator® Surface Aerator)
3. Or Approved Equal

B. Performance and Design Criteria:

1. Motor size: 15 hp

C. Diffusion Head

1. Material: 304 SS
2. The design of the diffusion head shall be such that the liquid spray shall discharge at an angle of 90 degrees to the motor shaft over a 360 pattern in the horizontal plane and shall be a monolithic casting.
3. The diffusion head casting shall act as a base for the aerator motor and alignment of the motor to this base shall be controlled by machined index fittings that engage the P-base of the motor. Diffusion head designs that employ studs and spacers or shoulder bolts are not allowed.
4. The diffusion head shall have load bearing flange-to-flange connections.
5. The diffusion head shall contain an anti-deflection journal insert to limit the radial deflection of the motor shaft. This anti-deflection journal insert shall be located in the lower extremity of the diffusion head approximately one-half the distance between the motor base and the lower end of the shaft. The journal insert shall be machined from Delrin or molded from moly-filled urethane and shall be a minimum of 0.060 inch diameter or larger through the bore than the diameter of the motor shaft. There shall be a fluid deflector located on the motor shaft immediately below the anti-deflection journal, which shall cover completely the anti-deflection journal insert and the lower portion of the diffusion head. This fluid deflector shall be molded from black neoprene or Delrin and shall be press fit onto the motor shaft.

D. Float:

1. Material: Fiberglass-reinforced polyester (FRP) skin, resistant to ultraviolet exposure.
2. The aerator shall have sufficient reserve buoyancy to ensure stability and to provide support flotation required during aerator servicing.
3. Fill:

    a. Material: Closed-cell polyurethane foam with minimum density of 2.0 lbs/ft^3.
    b. Injection applied.

4. Float shall be completely sealed to prevent the foam from being in contact with the external environment.
5. Float shall have three (3) mooring points, spaced at 120-degree locations around the outer circumference. All mooring connections shall be stainless steel.

E. Propeller:

1. Two-blade, left handed, self-cleaning, marine type
2. Material: 316 or 15/5 SS
3. Dynamically- and hydraulically-balanced.
4. Self-cleaning
5. Propeller shall be keyed to mate to the keyed shaft for ease of maintenance and assembly. The propeller shall be secured to the shaft by a locking nut.

F. Volute

1. Material: 304 stainless steel
2. Minimum diameter: 14 inches
3. The volute shall have a minimum of 3/16-inch wall thickness and a minimum of four full-length stainless steel gussets shall be welded on 90° spacing around the circumference of the volute between the top and bottom flanges.
4. Volute shall be round and true so that propeller blade tip clearance is uniform within the volute as it rotates.

G. Intake Cone

1. Material: 304 stainless steel
2. The intake cone shall be fabricated having a gradually expanding opening outward to the intake end. The length and inlet diameter shall be sufficient to provide uniform inlet hydraulics so that no increase in vibration is caused due to its shape or size.
3. The intake cone shall be designed so that the suction lift from the aerator propeller is vertical from the liquid depth below the aerator
4. Anti-vortex cross vanes: 304 stainless steel

H. Balancing

1. The entire rotating assembly including the motor rotor, shaft, shaft accessories, and impeller shall be dynamically balanced within 2.0 mils peak-to-peak horizontal displacement measured at the upper and lower motor bearing. Measurements shall be taken at a frequency equivalent to the motor RPM. Measurements shall be taken with the motor in a vertical, shaft down position with the entire power section mounted on resilient pads.

I. Electrical Service Cable

1. Electrical service cable shall be provided and shall be a continuous length (non-spliced). The cable shall have three power conductors and a ground conductor.
2. Conductors shall be flexible type annealed copper stranded. Each conductor, including the ground conductor, shall be insulated. Cables containing an uninsulated ground conductor will not be acceptable.
3. The insulated conductors shall be assembled together with a non-hygroscopic filler material.
4. Outer jacket shall be high quality CPE, PVC, TPE or equal, and shall be rated at a conductor operating temperature of not less than 90°C.
5. The cable shall be rated for hard usage outdoor service and shall be resistant to oil, sunlight, ozone, grease, acids, water, abrasion and impact.
6. The electrical service cable shall be factory assembled to the motor conduit box with cord grip and strain relief grip. The cord grip shall include a Neoprene bushing providing a liquid tight seal. The strain relief grip shall be a 304 stainless steel wire mesh strain relief grip for the electrical cable at the motor to prevent the cable from pulling out of the conduit box.
7. Spiral Wrap Electrical Cable Protection: A polyethylene expandable spiral wrap abrasion protection sleeve shall be provided for wrapping around the electrical cable at the unit. The spiral wrap shall be weather resistant for a temperature range from -40 °F to 122 °F, and protect the electrical cable from rubbing on the edge of the float.

J. Operation:

1. Electrical Characteristics:

   a. 460 V, 3 phase, 60 Hz.

2. Motor:

   a. Type: Totally enclosed, fan cooled (TEFC).
   b. Motor windings shall be nonhygroscopic, and insulation shall equal or exceed NEMA Class "F".
   c. Base: Vertical
   d. Shaft: 17-4 PH stainless steel
   e. Bearings shall be regreasable and be of the radial and axial thrust type.
   f. Hardware, Condensate Drains, and Grease Fittings shall be Cadmium-plated.

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 facilities are ready to receive floating mechanical aerators.

3.2 INSTALLATION

A. Install 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. Wet Startup: Run equipment with wastewater and verify proper alignment and operation.
C. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than one day (8 hrs) on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in maintenance of equipment.
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 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 51 13

SECTION 46 51 15 – VERTICEL AERATION SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Description of Work:

1. Provide all labor, material and equipment to furnish and install one (1) VertiCel® Aeration System as specified herein
2. (b) This specification covers the general requirements for the design, fabrication and installation of one (1) fine bubble aeration basin divided into one (1) cell

B. Work and Components Included (But Not Limited To)

1. The Equipment Manufacturer shall furnish the items listed below:
   a. Stainless steel drop legs
   b. PVC manifolds and air distributors
   c. PVC diffuser holders, subplates and retainer rings
   d. Stainless steel supports and anchors
   e. Bolts, nuts and gaskets for aeration system flange connections
   f. Liquid purge systems
   g. Membrane disc diffusers with integral O-ring gaskets
2. Like items of equipment specified herein shall be the end products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts and manufacturer's service

C. Work Not Included
1. The following items are specified under other sections of these specifications:
   a. Concrete and Grout – Section 03 60 00
   b. Metal Fabrication – Section 05 50 00
   c. Paint – Section 09 96 00
   d. Electrical – Division 26

1.2 ACCEPTABLE MANUFACTURERS:

A. The Contractor shall use one of the following Engineer approved manufacturers:
1. Evoqua Water Technologies LLC, of Waukesha, WI
2. Or pre-qualified equal which meet or exceed the following requirements

B. Experience
1. The equipment Manufacturer shall have at least ten (10) successful installations of the specified type equipment at different locations in the United States
2. The Engineer may require evidence, in the form of operating records, from these installations to substantiate any claims concerning the ability of the equipment to perform as required

C. Pre-qualification or equal consideration
   1. Manufacturer not already pre-qualified and approved by Engineer meet the following criteria along with the submittal requirements specified in Section 1.03
   2. Manufacturer not already pre-qualified and approved by Engineer shall submit to Engineer an installation list, including facility contact information, demonstrating compliance with 1.02 (B) of this Specification no later than fifteen (15) days prior to the published bid opening date
   3. Manufacturer not already pre-qualified and approved by Engineer shall submit to Engineer written correspondence no later than (15) days prior to the published bid opening date, indicating intent to comply with an extended warranty valid for five (5) years from the start-up of equipment and the performance bond as described herein equal to 100% of the equipment price
      a. Performance Bond
         1) Manufacturer shall furnish a performance bond in an amount equal to 100% of the purchase price to be paid to the Manufacturer for the equipment specified herein. The performance bond furnished by the Manufacturer shall name the Installation Contractor with whom the manufacturer enters an agreement for the purchase of the equipment as an obligee and identify the Owner as a dual obligee. The obligees named in the bond are required to return original copies of the bond to the Manufacturer's surety company upon completion of the Manufacturer's obligations under the equipment purchase agreement executed between the Manufacturer and Installation Contractor. If the original copies of the bond are unavailable for any reason, the obligees will complete a release letter addressed to the manufacturer's surety company stating that the manufacturer's obligations under the above referenced purchase agreement have been satisfied and the surety company is released of any further obligations under the performance bond
         2) The performance bond shall be issued on the Manufacturer's standard form and shall be executed by a surety named in the current list of "Companies Holding Certificates of Authority as Acceptable Reinsuring Companies" as published in Circular 570 by the Financial Management Service, Surety Bond Branch, US Department of the Treasury. Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act."
         3) Manufacturer not already pre-qualified and approved by Engineer shall submit to Contractor a Performance Bond within fifteen (15) days of the executed agreement between Manufacturer and Contractor. The Performance Bond must adhere to the requirements stated in 1.02 (C) (2) (a) of this Specification
         4) Manufacturer not already pre-qualified and approved by Engineer shall submit manufacturing certificate to Engineer no later than (15) days prior to the published bid opening date that indicates discs are fabricated in the United States. Manufacturer shall also provide sample of discs to Engineer or Contractor to verify the disc specification stated in 2.02 (C) (3)
         5) Manufacturer not already pre-qualified and approved by Engineer shall submit disc aerator oxygen performance test data stated in Section 1.03, A, (4) to Engineer no later than (15) days prior to the published bid opening date that shows the proposed disc aeration equipment meets or exceeds the stated requirements
            a) If test data from an existing facility cannot be provided to meet Section 1.03 (4), of this specification, a field test shall be performed

by the Equipment Manufacturer in accordance with the Section 3.01 of this specification

6) Manufacturer not already pre-qualified and approved by Engineer shall submit diffuser test data stated in Section 1.03 (5,6,7,8,9,10,11) to Engineer no later than (15) days prior to the published bid opening date that shows that the proposed diffuser aeration equipment meets or exceeds the stated requirements
   a) If test data from an existing facility cannot be provided to meet any requirement of Section 1.03 (5,6,7,8,9,10,11) of this specification, a field test shall be performed by the Equipment Manufacturer on the installed equipment to verify the specified oxygen transfer efficiency. The field test shall be performed in accordance with ASCE's July, 1984 publication, Measurement of Oxygen Transfer in Clean Water

1.3 SUBMITTALS

A. Operating instructions, manuals and shop drawings shall be submitted in accordance with Section 013300.
B. Shop drawings shall be submitted to the Engineer for approval. Shop drawings shall include dimensional layouts, materials, details of appurtenances, anchoring, and installation and operation instructions. Fabrication and installation shall be in accordance with approved drawings
C. SOTE calculations to verify the clean water oxygen transfer efficiency of the fine bubble diffusers at both design and maximum airflow
D. Headloss Calculations for the fine bubble aeration system shall start from the top of the drop leg and continue to the furthest diffuser. Calculations shall include the total headloss across the membrane, balancing orifice, piping system and static head at both design and maximum airflow
E. Certified calculations, stamped by a registered professional engineer, shall be submitted with shop drawings to verify pipe supports shall be designed to provide a pipe flexural stress less than 750 psi at the maximum operating diffuser air rate
F. Data shall be submitted to show the types of chemicals the fine bubble diffuser membrane is resistant to
G. Six (6) copies of the manufacturer's operation, installation and maintenance manual shall be submitted for approval prior to shipment of the equipment
H. Definitions:
   1. SCFM: Standard cubic feet per minute is understood to be air at 68° F, 14.7 PSIA and 36% relative humidity flowing at a rate of 1 cubic foot per minute
   2. SOTR: Standard oxygen transfer rate is understood to be the rate of oxygen transferred to tap water (pounds of oxygen per hour) at standard conditions of 20° C, 0.0 mg/l residual dissolved oxygen concentration, and a barometric pressure of 760 mm Hg (dry air)

3. SOTE: Standard oxygen transfer efficiency is understood to be the percentage of oxygen transferred under standard conditions of 20°C, 0.0 mg/l residual dissolved oxygen concentration, and a barometric pressure of 760 mm Hg (dry air)
4. SWD: Side water depth is understood to be the overall dimension from the high point of the basin floor to the water surface

1.4 EQUIPEMENT MANUFACTURER'S SERVICE REPRESENTATIVE

A. Manufacturer's Field Service for Equipment Installation.
1. The Manufacturer's field service technician shall check the installation of the equipment, assist in the start-up, and provide training on the maintenance of the equipment. A minimum of one (1) trip and a total of two (2) days at site shall be provided

1.5 SYSTEM DESIGN AND PERFORMANCE

A. Tank Design
1. Rectangular Tank
a. Number of Tanks: 1
b. Dimensions/Pass: Length 43 ft. – Width 23 ft. – SWD 21 ft.

B. Design aeration system to transfer not less than the following pounds of standard condition oxygen per day per tank in clean water at the specified submergence, air rate and pressure

	Average	Peak
Std. O_2 Transfer Rate (SOTR) (Total-lbs-O_2/day/tank)	1,500	3,000
Volumetric Air Rate (SCFM Total/Tank)	160	344
Oper. Press. At top of Drop Leg (psig)	9.32	9.73
Diffuser Submergence (ft.)	20.2	20.2
Total Diffusers	190	

C. Design air distributors with centerline spacing not to exceed 4 feet to maximize oxygen transfer efficiency and mixing efficiency and to minimize solids deposition between air distributors.

PART 2 - PRODUCTS

2.1 GENERAL

A. There shall be provided, as shown on the plans, one (1) complete VertiCel® aeration wastewater treatment systems

B. Each VertiCel® system shall consist of two (2) VLR basins operating in series, followed by one (1) diffused aeration basin. In this project, two (2) VLR basins are existing.

C. Raw wastewater, after entering the system, shall pass progressively through the VLR basins and diffused aeration basin then to the final clarifiers. Wastewater may be introduced into any one, or split between both VLR basins, depending on the operating conditions. Recycled sludge shall be returned to first basin under normal operating conditions. The flow from one aeration basin to another shall be by displacement of the mixed liquor circulating in each basin through slide gate and/or submerged ports interconnecting each adjacent aeration basin. The displaced flow shall be equal to the volume of raw waste and recycled sludge introduced into the aeration system

D. The effluent from each basin shall be controlled by means of a submerged slide gate and/or adjustable overflow weir. The effluent controls shall be designed to allow a liquid level variation of approximately 6" in each VLR basin with variations in the flow of wastewater and recycled sludge. Flow controls shall be arranged so that any basin in the system may be taken out of service and the remaining basin(s) still operated. All piping, valves, slide and stop gates, operators, and weirs shall be provided by the Contractor

E. The design and layout shown on the drawings are based on the Manufacturer listed in Section 1.02.A.1. If equipment other than that of the Manufacturer shown is submitted to the Engineer for consideration as an equal, it shall be the responsibility of the Bidder wishing to make the substitution to submit with the request a revised drawing of the mechanical equipment and basin layouts acceptable to the Engineer. This revised drawing shall show the proposed location of the substitute unit, and area required for withdrawal space of replacement or serviceable components. This drawing shall also show clearances of adjacent equipment and service area required by that equipment

F. Changes in architectural, structural, electrical, mechanical and plumbing requirements for the substitution shall be the responsibility of the Bidder wishing to make the substitution. This shall include the cost of redesign by affected designers. Any additional cost incurred by affected subcontractors shall be the responsibility of the Bidder and not the Owner

2.2 EQUIPMENT

A. Stainless Steel – Pipe, Fittings and Supports

1. 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
2. Fabricate non-welded parts and flanges from sheets, plates or bars of 304 stainless steel conforming to ASTM A240 or ASTM A276
3. Welds & Welding Procedure
   a. 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
   b. Provide full penetration butt welds to the interior surface with gas shielding of interior and exterior of joint
   c. Continuously weld both sides of face rings and flanges to eliminate potential for crevice corrosion
4. Corrosion Protection and Finishing - Clean all welded stainless steel surfaces and welds after fabrication by using the following procedure:

a. Pre-clean all outside weld areas to remove weld splatter with stainless steel brushes and/or deburring and finish grinding wheels
b. Finish and clean all interior and exterior welds and piping 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
c. Corrosion protection techniques not utilizing full immersion methods are unacceptable and will be cause for rejection of the equipment

B. Natural Rubber – Furnish all fixed and expansion joint O-ring gaskets of natural rubber/SBR with a Shore A durometer of 45 ± 5

C. Polyvinyl Chloride (PVC) – Pipe and Fittings
1. Produce all PVC pipe and fittings from PVC compound with a minimum tensile strength of 7000 psi
2. Provide lower drop pipe, manifold and air distributors as follows:

Diameter	Wall Thickness	ASTM
4-Inch	SDR 33.5	D3915, 3034
6-inch & larger	Schedule 40	D1784, 1785, 2466

3. Design air distributors and manifolds to withstand 125° F mean wall temperature
4. Add two parts by weight of titanium dioxide per 100 parts of resin to PVC compounds for air distributors, joints and PVC diffuser assembly components to minimize ultraviolet light degradation
5. Factory solvent weld all PVC joints and diffuser holders. Field solvent welding is NOT permitted

D. EPDM – Membrane Diffusers and Gaskets
1. Manufacture circular membrane diffuser discs with integral O-ring of EPDM synthetic rubber compound with precision die formed slits. Thermoplastic materials (i.e. plasticized PVC or polyurethane) are not acceptable
2. Add carbon black to the material for resistance to ultraviolet light
3. Design diffuser as one piece injection molded part with a minimum thickness of 0.080 inches for 9-inch diameter unit
4. Limit the maximum tensile strength of the diffuser to 10 psi when operating at 2.4 SCFM/sq. ft. of material. Furnish proportionately thicker material for larger diameter disc diffusers to limit the maximum tensile stress and to resist stretching
5. Produce diffusers free of tears, voids, bubbles, creases or other structural defects
6. Furnish diffuser material to meet the following:

Item	Value/Units	ASTM
Base Polymer	EPDM	D573
UV Resistance	Carbon Black	
Specific Gravity	1.25 or less	
Durometer – Minimum	58% ± 5%	D2240
Modulus of Elasticity	500 psi	D412
Ozone Resistance (72 hrs: 40°C pphm)	No cracks @ 2X magnification	D1171 Test A
Tensile Strength	1200 psi	D412
Elongation - % - Retained 70 hrs @ 100°C	75% Max	D573

- minimum at break	350%	D412

7. Quality Control – Test diffuser using primary sampling criteria outlined in Military Standard 105E
8. MEMBRANE LONGEVITY - Longevity of the proposed membrane diffusers shall have been demonstrated in at least three full-scale municipal installations operating continuously for a minimum of three years. Test reports, prepared by an independent testing agency, shall confirm membrane longevity through compliance with the following maximum allowed percent (+/-) change in each membrane property. Tests conducted in-house by the Supplier shall not be acceptable

Data for a minimum of three diffusers from each installation shall be provided.

Property	Maximum Percent Change
Durometer	5.0%
Weight	5.0%
Permanent Set	0.5%

2.3 FINE BUBBLE AERATION SYSTEM COMPONENTS

A. Drop Legs – Provide a stainless steel drop leg from the air main connection to the drop leg connection on the manifold
   1. Provide a stainless steel Van Stone style flange with a 150-pound drill pattern for the top connection
   2. Provide a stainless steel band clamp coupling with gasket for the lower dropleg to manifold connection

B. Manifolds - Provide PVC manifolds for connection to the air distribution headers
   1. Fabricate manifolds with 4-inch diameter fixed threaded union or flanged joints for connection to the air distributors
   2. Design manifold, distributor connections and supports to resist thrust generated by expansion/contraction of the air distributors over a temperature range of 125° F
   3. Support manifold with a minimum of two supports
   4. Connect manifolds with fixed threaded union or flanged joints to prevent rotation or blow apart

C. Air Distributors and Diffuser Holders – Provide 4-inch diameter air distributors perpendicular to the air manifold
   1. Fabricate distributors with single diffuser holders solvent welded to the crown of the air distributor for complete air seal and strength
   2. Provide minimum solvent weld area of 15 square inches
   3. Design distributors and holders to resist a dead load of 200 lbs applied vertically to the outer edge of the diffuser holder
   4. Provide 4-inch diameter threaded removable end caps complete with gasket, threaded coupling and end plate for clean out at the end of each distributor

D. Air Distributor and Manifold Connection Joints

1. Join air distributor sections with positive locking fixed threaded union or flange type joints for all submerged header joints to prevent blow apart and rotation
2. Bell and spigot, slip on or expansion type joints are not acceptable for submerged joints
3. Design threaded union joints that prevent rotation by directly locking spigot section connected to one end of the distribution header, and a threaded socket section connected to the mating distribution header. "O" ring gasket and a threaded screw on retainer ring to provide complete seal. Factory solvent weld all joints. Joints that rely on friction alone or use the "O" ring to prevent rotation shall not be acceptable
4. Design flange joints with an angle face ring, follower flange with a 125-pound drill pattern and stainless steel hardware

E. Supports – Provide each section of manifold and air distributor with a minimum of two (2) supports
1. Limit maximum support spacing to 8 feet
2. 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
3. Design supports to be adjustable without removing the air distributor from the support
4. Design supports to allow for complete removal from the tank to facilitate installation of additional headers and in-tank maintenance
5. Manifold Support – 6-inch diameter and larger
   a. Design supports to include hold down guide straps, support structure and anchor bolts
   b. Design guide straps with a 2-inch minimum width to eliminate point load on manifold and minimize binding
   c. Design support for 2-inches plus or minus vertical adjustment for leveling of manifold
   d. Attach supports to tank floor with two stainless steel anchor bolts
6. Air Distributor and Manifold Supports – 4-inch diameter
   a. Provide guide and fixed type supports to allow expansion/contraction
   b. Design supports with hold down straps, support structure and anchor bolt
   c. Design support for 1 1/2-inch (plus or minus) vertical adjustment for leveling air distributor to plus or minus 1/4-inch
   d. Guide support
      1) Guide straps to 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
      2) Design strap with 1/8-inch clearance around distributor so strap is self-limiting and cannot be over tightened
   e. Fixed Supports
      1) Fixed straps to have 1 1/2-inch wide top and bottom contoured bearing surface with punched burrs to positively grip the air distributor when tightened
      2) Design strap to be self-limiting to prevent stressing the distributor if the clamp is over tightened
   f. Attach supports to tank floor with one stainless steel anchor bolt

F. Diffuser Assemblies – Furnish diffuser assemblies including diffuser, diffuser gasket, holder, retaining ring and air flow control orifice
1. Membrane Diffuser
   a. Incorporate an integral check valve into the membrane diffuser

b. Design and test diffusers for a dynamic wet pressure (DWP) of 12 inches ± 20% water column @ 1.0 SCFM/diffuser and 2 inches submergence
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 is defined as the perforated horizontal projected area of the diffuser
d. Quality Control – Test diffuser using primary sampling criteria outlined in Military Standard 105E

2. Diffuser Holders, Support Plate and Retainer Rings
   a. Design holder with air flow control orifice and plenum chamber below the diffuser. Holder to provide peripheral support for the diffuser
   b. Diffuser Support Plate – Provide a PVC support plate to form an air plenum under the diffuser and support for the membrane when the air is off
   c. Design retainer ring to seal the diffuser and O-ring in the holder to prevent air leakage around gasket
   d. Design retainer ring threads with minimum cross section of 1/8 inch and allow for one complete turn to engage threads

G. Anchor Bolts
   1. Design anchor bolts for embedment in 4000 psi concrete with a pullout safety factor of 4
   2. Provide a mechanical stainless steel expansion type anchor bolt system

H. Liquid Purge System - Provide a liquid purge system to drain the entire submerged aeration piping system for each aeration grid including airlift purge eductor line and control valve

I. Instruments
   1. Manufacture shall supply one (1) ORP probes and mounting kit. The probe handrail mounting kit shall be constructed of aluminum (as shown in general arrangement drawings). One analytical transmitter shall be supplied. The transmitter shall have a 4-20 mA output for transmission of the signal to the PLC

PART 3 - EXECUTION

3.1 INSTALLATION

A. The Contractor shall install the VertiCel® Aeration System as shown on the drawings.
B. Equipment shall be installed in accordance with GENERAL MECHANICAL REQUIREMENTS, and in accordance with the Manufacturer's recommendations to provide a complete installation.

3.2 ELECTRICAL CONNECTIONS AND WIRING

A. Wiring and conduits for electrical power, control and instrumentation shall be provided by the Electrical Contractor under DIVISION 16 - ELECTRICAL.

END OF SECTION 46 51 15

SECTION 46 51 23 – FIXED HEADER COARSE-BUBBLE AERATION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes all materials and equipment for the fixed header aeration systems in the aerobic digester tanks.

1.2 REFERENCE STANDARDS

A. American Society of Civil Engineers:

1. ASCE 2 - Measurement of Oxygen Transfer in Clean Water.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer's information for system materials and component equipment.

C. Shop Drawings:

1. Indicate system materials and component equipment.
2. Indicate connections and other installation details.

D. Manufacturer's Certificate: Certify that products 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: Certify that equipment has been installed according to manufacturer instructions.

I. 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 submittals.

B. Project Record Documents: Record actual locations and final orientation of equipment.

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. Deliver materials in manufacturer's packaging; include application instructions.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store diffusers 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 coarse bubble diffusers.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Xylem Sanitaire – Brown Deer, Wisconsin

B. Approved equal

1. Experience in design, manufacture, supply, and commissioning of coarse bubble fixed header aeration equipment of the type specified is required for this project. Submit references for a minimum of five installations of similar size and design as specified, having been in successful operation for a period of not less than five years.

2.2 SYSTEM DESIGN AND PERFORMANCE

A. Tank Configuration:
1. Number of Tanks: 2
2. Dimensions: 39' x 20"
3. Side Water Depth: 20'

B. Diffuser Design Requirements:
1. Volumetric Air Rate (SCFM/tank): 533
2. Available Operating pressure at drop leg (psig): 10.5
3. Diffuser submergence (ft): 19

2.3 MATERIALS, FABRICATION and FINISHING

A. Stainless Steel

1. Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel with a 2D finish conforming to ASTM A240.

2. Fabricate non-welded parts and pieces from sheets, plates or bars of 304 stainless steel conforming to ASTM A240 or ASTM A276.

3. Provide drop legs, manifolds and headers of the diameter shown on the drawings with dimensional tolerances conforming to ASTM A554 and fabrication procedures in accordance to ASTM A774 & A778.

4. Furnish air distribution headers with the following minimum nominal wall thicknesses.

a. For gusset-reinforced diffuser connectors and header systems as specified in Section 2.3E.

Header Diameter (Inches)	**Wall Thickness (Inches)**
4 Thru 18	0.109

b. For diffuser connectors and headers that are not gusset reinforced as specified in Section 2.03E, the minimum allowable header wall thickness is 0.25 inches to minimize potential for connector failure.

5. Furnish diffuser connector from cast 316L Stainless Steel.

6. Furnish all flanges from stainless steel per paragraph 2.02 A2.

7. Furnish all nuts, bolts and washers including anchor bolts in 18-8 series stainless steel.

8. Furnish 304L stainless steel diffusers conforming to the material as listed in paragraph 2.02 A 1,2, and 3 with a cast 304L Schedule 80 threaded inlet nozzle.

9. Welds & Welding Procedure

   a. Weld in the factory with ER 316L filler wire using MIG, TIG or plasma-arc welding inert gas processes. Provide a cross section equal to or greater than the parent metal.
   b. Provide full penetration butt welds to the interior surface with gas shielding to interior and exterior of joint.
   c. Provide smooth, even distribution interior weld beads with an interior projection not exceeding 1/16 inch beyond the I.D. of the air header or fittings.
   d. Continuously weld both sides of face rings and flanges to eliminate potential for crevice corrosion.
   e. Field welding is NOT permitted.

10. Corrosion Protection and Finishing
    Clean all welded stainless steel surfaces and welds after fabrication by using the following procedure:

    a. Pre-clean all outside weld areas to remove weld splatter with the use of stainless steel brushes and/or deburring and finish grinding wheels.
    b. Finish clean all interior and exterior welds and piping by full immersion pickling and rinse with water to remove all carbon deposits, oxide film and contaminants to regenerate a uniform, corrosion resistant chromium oxide film.

       1) Completely immerse all stainless steel assemblies and components in an acid solution as described in Section 6.2.11 of ASTM A380. Use nitric-hydrofluoric acid solution as defined in Table A.2.1 of Annex A2 of ASTM A380.
       2) Provide a final thorough rinse using ordinary industrial or potable water and dry in conformance per Section 8.3 of ASTM A380.

    c. Corrosion protection techniques not utilizing full immersion methods are unacceptable and will be cause for rejection of the equipment.
    d. Engineer/Owner at their option may choose to observe the equipment cleaning procedure by notifying the manufacturer of their intent to visit thirty (30) day prior to the date. Cost of the travel and expenses are by the owner.

B. Neoprene – furnish all gaskets of fiber reinforced neoprene – 45 to 50 durometer (Shore A).

2.4 FIXED AERATION HEADERS, MANIFOLD AND DROPLEGS

A. Provide a drop leg from the air main connection or air control valve to the aeration system as shown on the drawings.

   1. Provide a Van Stone style flange design with a 150 pound drill pattern for the top connection.

   2. Provide a band clamp coupling with gasket for the lower dropleg to header connection for ease of installation and alignment.

B. Fabricate manifold and air distribution headers in sections up to 41feet in length.

1. Provide eccentric reducers for changes in diameter for constant invert elevation.

2. Provide 8 inch diameter and smaller headers with removable end caps and 10 inch diameter and larger headers with welded end caps.

C. Join sections of manifold or air distribution headers with flanged joints or expansion joints. Design individual header sections for rotation independent of adjacent sections for alignment purposes during installation.

1. Provide flanged joints consisting of face rings, rotating ring flanges, bolts and gaskets.

2. Provide expansion joints consisting of a welded flanged expansion barrel, "O" ring gasket, "O" ring locking flange and hardware to accommodate + 2 inch of movement.

D. Furnish expansion/contraction system for all headers designed for temperature range of 125° F consisting of simple and fixed supports and expansion joints.

1. Lengths of header can extend up to 80 feet from restraining point without an expansion joint.

2. Limit maximum distance between restraining points on a continuous length of header to 120 feet maximum.

3. Provide an expansion joint on continuous lengths of header between two restraining points.

4. Provide simple supports to restrain header from buoyant uplift forces in compliance with Section 2.04.

5. Provide fixed supports in compliance with Section 2.04.
   a. Limit movement to prevent expansion joint blow apart and transmit expansion forces from the header to the fixed support stand.
      1) Provide a mechanical link to connect the header and fixed support stand.
      2) Reinforce the header at the attachment point of the mechanical link.

E. Duplex Diffuser Connectors

1. Factory weld to the invert centerline of the air header.

2. Design diffuser connectors for two diffusers.

3. Furnish PVC plugs for all unused diffuser connectors.

4. Provide connectors of length appropriate to the header diameter and positioned so that air exiting the diffusers clears the header.

5. Design header and diffuser connectors as follows:
   a. Reinforce the connector header weld joint by providing gussets continuously welded between the vertical side wall of the header and the connector ends to limit long term flexure failure. Minimum gusset thickness is 0.125 inch.

b. Weld connector to the header with a full penetration butt weld to minimize potential for crevice corrosion between header and connector. Use of fillet welds at the connection between the diffuser connector and header is NOT permitted.
c. Resist a vertical dead load applied to the threaded end of the connector that results in a bending moment of 1000 inch-lbs without exceeding 24,000 psi design stress in any part of the header wall or connector.
d. Header wall thickness for unreinforced connectors must comply with Section 2.2, A.4.b.

2.5 SUPPORTS AND ANCHOR BOLTS

1. Provide each section of air header with a minimum of two supports with the maximum spacing between supports not to exceed 17 ft. 6 inch.

2. Limit header or manifold cantilever to no more than 4 ft.

3. Provide header supports with a vertically adjustable header hold down locking mechanism mounted on a stainless steel support structure.

2.6 AIR DIFFUSERS

1. Provide diffusers fabricated of stainless steel material – refer to Section 2.02 Materials, Fabrication and Finishing.

2. Design diffuser for operating range of 8 to 40 SCFM.

3. Design diffusers with cast schedule 80 – 3/4 inch NPT threaded nozzle and acetyl orifice insert if required, an inverted air reservoir, air exit ports and a full length deflector.

   a. Design diffusers to provide full wide band aeration with a minimum air release perimeter of 48 inches per diffuser. Release air uniformly along a minimum two foot band beyond each side of the header.
   b. Locate exit ports discharging air into liquid on horizontal planes at two levels.

4. Diffuser Deflector

   a. Provide deflector below each diffuser for its full length and width.
   b. Design deflector to direct the liquid being aerated along the diffuser reservoir walls so that the air exits through the ports and is sheared into small bubbles and distributed into the liquid.

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.

3.3 INSTALLATION/START UP SERVICES

A. Provide services of a factory representative for 1 day(s) to verify the proper installation of the equipment.

B. Provide services of a factory representative for 1 day(s) to instruct owner's personnel on operation and maintenance.

3.4 WARRANTY

A. Warrant all parts to be free from defects in materials and workmanship for a period of one year after substantial completion or 18 months after delivery, whichever occurs first.

B. Furnish replacement parts to the Owner for any items found to be defective within the one year warranty period.

3.5 SOURCE QUALITY CONTROL

A. Section 01 40 00 – Quality Requirements for testing, inspections, and analysis.

B. Provide shop inspection and testing of completed assembly.

C. Certificate of Compliance:

1. 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.

3.6 FIELD QUALITY CONTROL

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

B. Testing:

1. Test for proper operation.
2. Energize system equipment and test operation under supervision of manufacturer's representative and in presence of Engineer.

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.

3.7 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.

END OF SECTION 46 51 22

SECTION 46 61 23 - DISC CLOTH TERTIARY FILTRATION

PART 1 - GENERAL

1.1 SUMMARY

A. Scope of Work:

1. Modification of Two (2) existing Disc cloth filters. Add additional 4 Discs in each existing Disc cloth filter, add necessary backwash nozzles for the new discs, replace the backwash pump and a new motor starter to accommodate the larger backwash pump in the existing control panel.

B. Related Requirements:

1. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electrical connections to equipment specified by this Section.

1.2 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with Work of other Sections.

1.3 SCHEDULING

A. Section 01 31 00 – Project Management and Coordination: Requirements for scheduling.

1.4 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.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Tools: Furnish special tools and other devices required for Owner to maintain equipment.

1.6 QUALITY ASSURANCE

A. Applicable Standards:

1. ASTM -American Society for Testing and Materials
2. AISI -American Iron and Steel Institute
3. AGMA -American Gear Manufacturer's Association
4. NEMA- National Electrical Manufacturer's Association
5. NEC -National Electric Code

B. To assure unity of responsibility, the additional 4 Discs in each existing Disc cloth filter, the necessary backwash nozzles for the new discs, the replacement of the backwash pump and a new motor starter to accomodate the larger backwash pump in the existing control panel shall be furnished and or coordinated 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. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store and protect materials according to manufacturer instructions.

1.8 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 date the goods are put into service, 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

1. Veolia Water Technologies, Inc (Kruger)

2.2 PERFORMANCE REQUIREMENTS:

Design Average Flow per unit, MGD	1.0
Peak Hour Flow per unit, MGD	2.0
Maximum Influent TSS, mg/L	20 mg/L
Effluent TSS, mg/L	<5
Filter Opening, µ	10
Filter Cloth Material	Polyester (woven)
Number of Filter Elements (Existing)	4 Disc / 2×64 panels
Number of Filter Elements (Additional added)	4 Disc / 2×64 panels
Filter Disc Diameter, m	2.1
Total Filter Area, ft^2	194×2
Filter Submergence, %	60
Filter Rotational Speed, RPM	2.8
Material of Construction (Disc)	AISI 304 stainless
Drive Motor (Existing)	1.5 hp, 460v, 3 phase
Drive Motor Service Factor	1.3
Drive Assembly (Existing)	Helical wormgear with riveted chain and sprocket
Number of Backwash Nozzles (per Disc)	12
Backwash Pressure, psi	110
Backwash Flowrate, GPM	60
Backwash Pump	7.5 hp, 460v, 3 phase

2.3 Filter System General Design Information:

A. The automatic backwash filter system shall be suitable for filtering domestic wastewater after secondary treatment and clarification. Each filter shall be designed to operate on a continuous basis and shall be designed to operate while receiving varying flows.

B. The proposed disc filtration system shall not exceed a hydraulic loading rate of 5.96 gpm/sf at peak flow.

2.4 MATERIALS AND EQUIPMENT

A. All fabricated metal shall be minimum grade AISI 304 stainless steel unless otherwise stated in this specification. Filter panels shall be polyester filter cloth mounted on AISI 304 stainless steel frames with integrated rubber seals. Filter disc segments shall be 304 stainless steel.

B. The valves, equipment, materials of construction and controls specified under this section supersede valves, equipment, materials of construction and controls specified elsewhere in the contract documents. Purchased components such as gear reducers, pumps, motors, valves, and actuators shall be provided as per filter manufacturer's standard designs and with standard recommended manufacturer's paint.

2.5 DISC ASSEMBLY

A. The filter shall be composed of modular and removable discs. Each disc shall consist of disc segments that can be easily mounted or dismounted as required. The segments of one disc will be bolted to each other, and the completed disc assembly will be secured to the center drum with stainless steel F clips and hardware.

B. Filter panels (filter media) shall be mounted on the sides of the disc segments. The filter panels shall consist of stainless steel frames with PET monofilament filter fabric attached to the frames. Each panel shall be equipped with a gasket that is fitted to and provided integral to the media frame to provide a watertight seal between the filter panels and disc segments. The panels will be held in place by a locking frame and one bolt per panel for easy exchange.

C. Nominal media pore size shall not exceed 10 microns.

2.6 BACKWASH CLEANING SYSTEM

A. The Discfilter shall be equipped with a single oscillating back-washing system with non-motorized moving spray headers for efficient cleaning of the filter cloth and for reduction of the consumption of backwash water. All panels shall receive 110 psi pressure backwash spray.

B. The backwash system shall be comprised of stainless steel backwash spray headers installed between the discs. The spray headers shall oscillate in an upward and downward motion during drum rotation. The spray header oscillation shall be operated by a cam system that is connected to the drum drive. Each header shall have flat pattern spray nozzles for each disc side. The spray nozzles shall consist of nozzle tips, mounting cap for quick removal, nozzle body and seals. The replacement of spray nozzles must be possible from outside the filter tank. A swivel joint shall allow the spray header manifold to rotate out for nozzle access without disassembly of the manifold or headers.

C. Each filter shall have one externally mounted low-pressure Grundfos centrifugal pump for the backwash system. The backwash pump shall be of the vertical multi-stage design with the motor mounted directly to the top of the pump. The motor shall be supplied by Grundfos integral with the pump. The motor shall be standard efficiency rated for 460V, 3 phase, 60 HZ operation. Filtered water shall be discharged from the pump to the backwash header piping constructed of stainless steel.

2.7 CONTROL PANEL MODIFICATION

A. The existing motor starter located in the Disc Filter Control Panel to manage the start/stop of the Backwash Pump motor will be replaced with a new motor starter as per this specification. The motor starter will be sized appropriately to match the requirements of the Backwash Pump

motor. The motor starter will be an IEC starter rated between 0.1 and 50 Amps @ 460VAC 3 phase, with rotary handle operator, visible trip indication, protection by overload, short circuit, undervoltage and shunt. The motor starter will be equipped with auxiliary contacts for monitoring and control. The IEC motor starter shall be Square D TeSys or approved equal.

2.8 DISCFILTER SPARE PARTS

A. The following spare parts will be supplied: 5 Backwash Spray Nozzles, 2 Filter Panels. Parts inventory shall be based in the United States.

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor shall install the disc filter system per the Equipment Manufacturer's directions and the drawings. The Contractor will provide all required supports and anchoring required to install the disc filter unit. The plumbing and electrical connections shall be provided as detailed on the drawings and specifications. The Equipment Manufacturer will provide adequate crating and protection of the disc filter panel screen for shipment to the project site. Installation instructions will be provided that specifically outline installation of this drum screen. Lifting instructions will be provided to assist the Contractor in placing the unit into the concrete scree n sump.

3.2 FIELD SERVICES

A. The Equipment Manufacturer shall furnish the services of a factory-trained representative based in the United States and employed by the manufacturer, for a minimum of two (2) working days and one (1) trip. This trip shall consist of inspection and check-out (dry/wet/electrical) and for start-up.. The Contractor will provide to the Equipment Manufacturer a minimum prior notice of three (3) weeks in order to schedule these services.

END OF SECTION 46 61 23

SECTION 46 73 22 – DECANTER ASSEMBLY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install two (2) decant lines for drawing off fluid from two (2) sludge digester tanks at any point between the maximum tank water level and the invert of the draw-off pipe as specified herein and shown in the Drawings
B. The decant line shall be provided complete with all accessories, anchor bolts and other appurtenances as specified and as may be required for a complete and operating installation

1.2 REFERENCES

A. American Gear Manufacturers Association (AGMA)
B. National Electrical Manufacturers Association (NEMA)
C. American Federation of Bearing Manufacturers Association (AFBMA)
D. American Society for Testing and Materials (ASTM)
E. American Welding Society (AWS)
F. Steel Structures Painting Council, American National Standards Institute (SSPC)
G. Underwriters Laboratory (UL)

1.3 SUBMITTALS

A. Shop Drawing Submittals shall be submitted in accordance with Section 013300, and contain the following minimum content:

1. Shop Drawings and erection drawings showing details of construction, dimensions, anchor bolt locations, and field connections
2. Descriptive literature, bulletins, and catalogs of the equipment, including details of the hand winch and any lubrication points
3. Installation, operation, and maintenance procedures
4. Total weight of the equipment

1.4 OPERATION AND MAINTENANCE MANUALS

A. Submit operations and maintenance manuals for the equipment in compliance with Section 013300. Manuals shall include:
   1. Contact name, address, and telephone number of the equipment manufacturer's Service Department and Parts Department
   2. Descriptive literature, including illustrations, covering the operational features of the equipment, specific for the particular installation, with all inapplicable information omitted or marked out
   3. Operation and maintenance information
   4. Complete maintenance parts list
   5. Complete connection, interconnecting and assembly diagrams
   6. Approved Shop Drawings

1.5 QUALITY ASSURANCE

A. The materials covered by these specifications are intended to be standard equipment of proven reliability and as manufactured by a reputable manufacturer having experience in the production of fluid decanting equipment. The equipment furnished shall be designed and constructed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Contract Drawings and operated per the manufacturer's recommendations

B. The design is based on a model as produced by Vulcan Industries, Inc. of Missouri Valley, Iowa. Acceptable manufacturers include Jim Myers & Sons, Waste-Tech, Inc., and Online Engineering. Substitute, alternate, and "or-equal" manufacturers are not acceptable

1.6 DESIGN REQUIREMENTS

Number of Units:	Two (2)
Maximum Water Surface Elev:	528.16
Decanter Intake Elev:	528.25
Invert Elev. Of Draw-off Pipe (Swivel Joint):	519.00
Decant Pipe Size:	6-inch

1.7 STORAGE AND HANDLING OF EQUIPMENT

A. The CONTRACTOR shall store and temporarily support equipment prior to installation in strict accordance with the Manufacturer's recommendations and instructions. Protect all exposed surfaces. The CONTRACTOR shall be responsible for work, equipment and materials until inspected, tested and finally accepted.

B. Protect the equipment from being contaminated by dust, dirt, vibration and moisture.

PART 2 - PRODUCTS

2.1 GENERAL

A. The decant line furnished shall be capable of decanting fluid from a storage tank at any point between the maximum fluid level and the invert of the draw-off pipe. The decant line shall be installed as shown on the Contract Drawings

2.2 DECANT TUBE

A. The decant tube(s) shall be fabricated of a minimum 12-gauge, 304 stainless steel. The unit shall be of single swivel joint design and shall be of proper length as shown on the Contract Drawings
B. The decant tube shall have a flanged elbow that shall be bolted to the contractor supplied draw-off piping. Contractor shall coordinate actual laying lengths with installation of piping
C. A swivel joint shall be furnished to allow the decant tube to travel between the high water level and the invert of the draw-off pipe as shown on the Contract Drawings. Swivel joint shall have replaceable seal gaskets
D. The decant tube shall be weighted with a properly sized weld-on weight to prevent flotation of the pipe

2.3 WINCH

A. A 1000-pound capacity, 304 stainless steel spur gear hand operated ratchet winch shall be furnished for each decant assembly. Winches shall have a suitable length of 3/16-inch diameter stainless steel cable and a hook with safety latch to attach the cable to the decant tube

2.4 FASTENERS

A. All fasteners and anchor bolts shall be 304 stainless steel unless otherwise indicated in this specification. Anchor bolts shall be provided for mounting the hand winch. All threaded fasteners shall be coated with a nickel based anti-seize thread lubricant prior to assembly

2.5 PROTECTIVE COATINGS

A. Stainless steel and plastic components shall not be painted. The stainless steel structural components and enclosure panels shall be passivated after fabrication to remove embedded iron, surface rust and weld burn. All other surfaces shall be blast cleaned to an SSPC-SP6 finish, removing all dirt, rust, scale and foreign materials
B. Cleaned surfaces shall be shop primed with one (1) coat of Tnemec 69-1212 primer, or equal, to attain a minimum dry film thickness of 2.5 mils

PART 3 - EXECUTION

3.1 WARRANTY

A. The equipment supplier shall warrant that its equipment shall be free from defects in material and workmanship; and that it will replace or repair, F.O.B. its factory, any part or parts returned to it which examination shall show to have failed under normal use and service by the user within one (1) year from date of Substantial Completion on the project

3.2 START-UP

A. Manufacturer shall provide the services of manufacturer's technician to checkout the equipment with ½ day and certify the installation before the start-up

END OF SECTION 46 73 22

Appendix A

Geotechnical Report

CAREY STATION WATER REUSE FACILITY

GREENSBORO, GREENE COUNTY, GEORGIA

May 6, 2024

REPORT OF GEOTECHNICAL EXPLORATION

Prepared By

Goodwyn Mills Cawood LLC
801 Broad St # 900
Augusta, GA 30901
T (706) 303-3272
www.gmcnetwork.com

GMC PROJECT NUMBER: GAUG230004

GMC

Goodwyn Mills Cawood

801 Broad Street
Suite 900
Augusta, GA 30901

T (706) 251-9099
F (770) 955-1064

www.gmcnetwork.com

May 9, 2024

Mr. Graham Sizemore
GMC
801 Broad St # 900
Augusta, GA 30901

RE: REPORT OF GEOTECHNICAL EXPLORATION
CAREY STATION WATER REUSE FACILITY
GREENSBORO, GEORGIA
GMC PROJECT NO. GAUG230004

Dear Mr. Sizemore,

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, PE
Executive Vice President
Licensed Georgia PE046948

Michael J. McNeill, PE
Vice President
Licensed Georgia PE045033

GMC

TABLE OF CONTENTS

Page

1.0 EXECUTIVE SUMMARY 1

2.0 PROJECT INFORMATION AND SCOPE OF WORK 2

2.1 PROJECT INFORMATION 2
2.2 SCOPE OF WORK 2

3.0 FIELD EXPLORATION AND LABORATORY TESTING 2

3.1 EXISTING SITE CONDITIONS 2
3.2 SITE GEOLOGY 2
3.3 FIELD EXPLORATION 3
3.4 SUBSURFACE CONDITIONS 3
3.5 GROUNDWATER INFORMATION 4
3.6 LABORATORY ANALYSES 4

4.0 RECOMMENDATIONS 5

4.1 GENERAL 5
4.2 SITE PREPARATION 5
4.3 EXCAVATION CONSIDERATIONS 6
4.4 TIME OF YEAR SITE PREPARATION CONSIDERATIONS 6
4.5 FILL PLACEMENT 7

5.0 FOUNDATIONS 8

5.1 SHALLOW FOUNDATIONS 8
5.2 FLOOR (MAT) SLABS 8
5.3 SEISMIC SITE CLASSIFICATION 9
5.4 BELOW GRADE WALLS 9
5.5 BACKFILLING OF UTILITY TRENCHES 11
5.6 SLOPES 11
5.7 SUBGRADE RESTORATION 11
5.8 DRAINAGE CONSIDERATIONS 12

6.0 REPORT LIMITATIONS 12

APPENDIX:

Figure 1 – Site Location Plan
Figure 2 – USGS Site Map
Figure 3 – Boring Location Plan
Soil Classification Chart
Subsurface Diagrams
Boring Records
Laboratory Results
Field and Laboratory Procedures

GMC

1.0 EXECUTIVE SUMMARY

This summary report presents the results of our geotechnical investigation performed for the proposed Carey Station Water Reuse Facility improvements. The proposed project is located at 4610 Carey Station Road in Greensboro, Greene County, Georgia. Our geotechnical scope of work for this project included conducting geotechnical fieldwork, associated engineering analysis, and providing a geotechnical engineering report. The project is early in the design phase, and therefore there are no detailed structural information at the time of this report. Preliminary site grading plans were provided.

This report provides recommendations for site preparation, foundations, and other geotechnical related conditions that might affect the proposed construction. The following geotechnical considerations were identified during our investigation:

- The subsurface conditions were explored by drilling a total of ten (10) soil test borings across the site to the planned depth of 25 to 45 feet below existing grade.
- The surficial soils consisted of 1 to 4 inches of organic laden material (OLM). The subsurface conditions encountered generally consisted of medium to hard sandy to clayey SILT (ML). Standard Penetration Test (SPT) N-values ranged in these materials from 2 to 60 blows per foot (bpf). Partially Weathered Rock (PWR) was encountered at a depth of 28.5 feet below existing grade and in boring B-7 and 18.5 feet below existing grade in boring B-9.
- Laboratory testing included grain size, Atterberg limits, and permeability.
- Groundwater was not encountered in the borings at the time of drilling.
- Based on the limited laboratory testing performed, most of the on-site material can be reused as compacted fill. Silty soils are very moisture sensitive and require the moisture content to be at or near the optimum moisture content to achieve the required compaction. This may require moisture conditioning (wetting/drying) of the material, depending on the time of year site construction is occurring.
- Seismic Site Class is "D" based on N-values from the borings.
- Conventional shallow foundations may be utilized with a net allowable bearing capacity of 2,000 psf. If mat foundations are utilized, a modulus of subgrade reaction of 125 pci may be utilized. A sliding coefficient of 0.30 may be used for soil and concrete.

The recommendations presented herein have been developed based on the subsurface conditions encountered during field investigation and our understanding of the proposed construction. Should changes in the project criteria occur, a review must be carried out by GMC to determine if modifications to our recommendations will be required.

2.0 PROJECT INFORMATION AND SCOPE OF WORK

2.1 Project Information

A geotechnical exploration has been conducted for the proposed Carey Station Water Reuse Facility improvements. The proposed project is located at 4610 Carey Station Road in Greensboro, Greene County, Georgia.

The proposed facility will include a 1.5 MG reject pond, EQ basin, sludge aerobic digester, clarifier, headworks, and influent pump station. At the time this report was prepared, we had not been provided with structural information for the proposed structures.

2.2 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.
- Information regarding groundwater conditions.
- General recommendations for site preparation, excavation considerations, preparation of existing soils for proposed construction activities, construction of compacted fills, foundation recommendations, and pavement recommendations.

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.

3.0 FIELD EXPLORATION AND LABORATORY TESTING

3.1 Existing Site Conditions

At the time of our exploration, the site topography consisted of a hilly terrain. The existing elevation of the lowest boring is 490 feet and the highest boring is 516 feet. The facility is currently comprised of an existing 0.5 MGD vertical loop reactor facility, a 1.5 MG reject pond, and a 1.5 MG reuse pond. The proposed construction areas consisted of woodlands surrounding the existing facility and grassed areas adjacent to existing structures at the facility.

3.2 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.

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.

3.3 Field Exploration

The site subsurface conditions were explored by drilling a total of ten (10) soil test borings across the site to depths of 25 to 45 feet below existing grade. 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 using a 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). Shelby Tube samples were collected in selected borings. All samples were identified according to project number, boring number and depth, and were placed in polyethylene plastic wrapping to protect against moisture loss.

3.4 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, grain size, and Atterberg limits performed on selected soil samples, are contained in the Appendix.

The following table summarizes the borings drilled:

Structure	Boring	Proposed Bearing Elevation (feet)	Approximate Ground Surface Elevation (feet)	Auger Refusal Depth (feet below existing grade)	Groundwater Depth/Approximate Elevation (feet)
Reject Pond	B-6 to B-9	486	490 to 500	N/A	Not encountered
EQ Basin	B-1, B-2	492	510 to 513	N/A	Not encountered
Headworks/Pump Station	B-3	507 / 493	514	N/A	Not encountered
Clarifier	B-4	506	510	N/A	Not encountered
Sludge Aerobic Digester	B-5	505	504	N/A	Not encountered
Chemical Storage Tank & Chemical Pump Room	B-10	499	507	N/A	Not Encountered

Surficial Materials

The surficial soils consisted of 1 to 4 inches of organic laden material (OLM).

Residual Soils

The subsurface conditions encountered generally consisted of medium to hard sandy to clayey SILT (ML, ML-CL). Standard Penetration Test (SPT) N-values ranged in these materials from 2 to 60 blows per foot (bpf).

Partially Weathered Rock

Partially Weathered Rock (PWR) was encountered at a depth of 28.5 feet below existing grade and in boring B-7 and 18.5 feet below existing grade in boring B-9.

3.5 Groundwater Information

Groundwater was not encountered in the borings at the time of drilling. 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.

3.6 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, permeability testing, and clay content. The

laboratory-testing program was conducted in general accordance with applicable ASTM standards and the results are summarized in the Appendix. The following table summarizes the laboratory testing:

Structure	Boring	Sample Elevation (feet)	USCS Classification	Atterberg Limits	Permeability (cm/sec)	Fines Content (%)
EQ Basin	B-1	492-494	ML	LL=38, PL=27, PI=11	4.07×10^{-7}	61.8
Reject Pond	B-7	477-479	SM	LL=32, PL=27, PI=5	8.73×10^{-7}	44.8

4.0 RECOMMENDATIONS

4.1 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:

- All structures will bear in native sandy and clayey silt (ML, ML-CL); therefore, no rock removal is anticipated.
- Shelby tube samples were obtained at the proposed EQ basin and reject pond bottom elevations and were tested for permeability, clay content, and plasticity. The results of these tests, included in the Section 3.6 Laboratory Analyses and in the Appendix, are representative for the bottom of the proposed ponds.

4.2 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. 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.

4.3 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.

4.4 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.

4.5 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 of 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 ML and ML-CL should be suitable for use as compacted fill. Any zones of debris or highly organic material should be segregated and not utilized as structural fill. 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.

5.0 FOUNDATIONS

5.1 Shallow Foundations

If the site preparation recommendations in Section 4 are followed, the proposed structures can be supported on shallow foundations. The foundations should:

- Structures may be sized using a net allowable soil bearing pressure of 2,000 pounds per square foot (psf). If mat foundations are utilized, a modulus of subgrade reaction of 125 pci may be utilized. A sliding coefficient of 0.30 may be used for soil and concrete.
- Total settlements of foundations due to loads 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 existing soils 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.

5.2 Floor (Mat) 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 (and mat foundations) be supported on a minimum of 4 inches of crushed aggregate or sand compacted to at least 98% 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.

5.3 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 0.224g and a mapped 1.0 second spectral response acceleration (S_1) of approximately 0.085g.

Using this information, Site Class D and Risk Category IV, the site coefficients F_a and F_v have been determined to be 1.6 and 2.4, respectively. The design spectral response accelerations S_{DS} and S_{D1} were 0.239g and 0.136g, respectively.

5.4 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.

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 4.5 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 Φ	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 0.30 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.

5.5 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 4-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.

5.6 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.

5.7 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.

GMC

5.8 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.

6.0 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 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.

GMC

APPENDIX

Figure 1 – Site Location Plan

Figure 2 – USGS Site Map

Figure 3 – Boring Location Plan

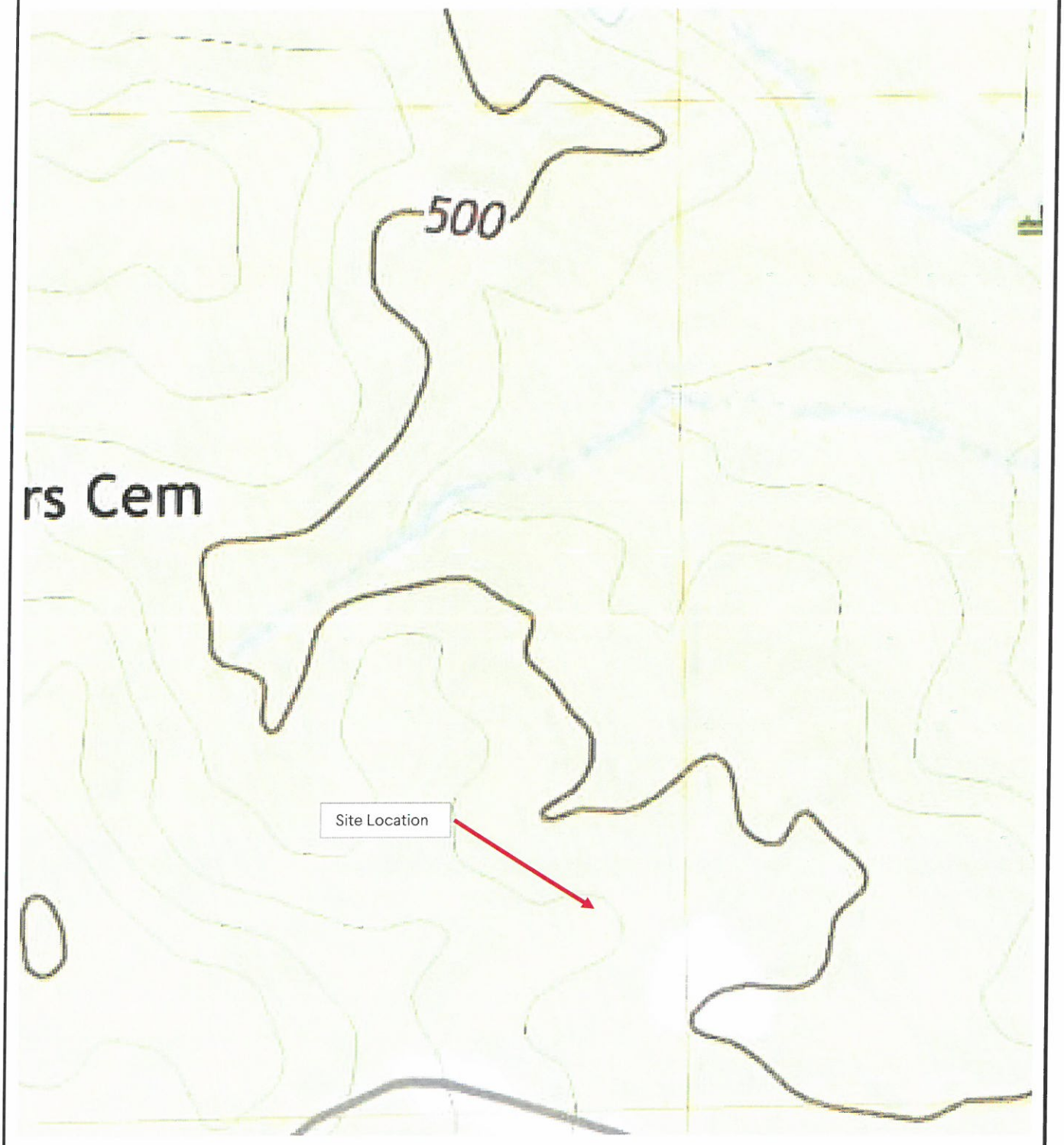
Soil Classification Chart

Subsurface Diagrams

Boring Records

Laboratory Results

Field and Laboratory Procedures



Carey Station WRF
Greensboro, GA

USGS Topo Map 2020
Site Location Plan

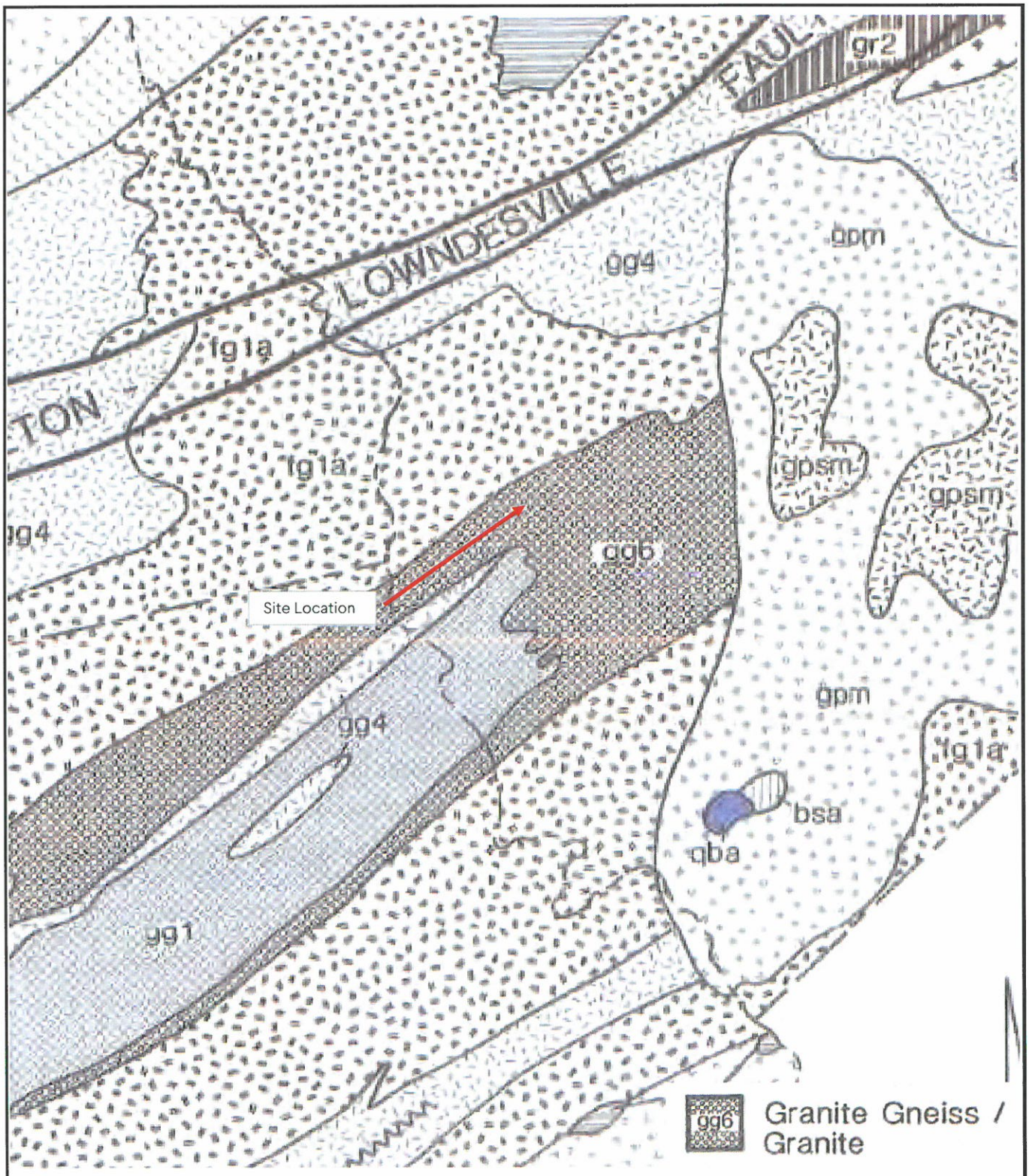
Figure 1

GMC# GAUG230004
4/2/2024
Drawn By: SWN

801 Broad St # 900
Augusta, GA 30901

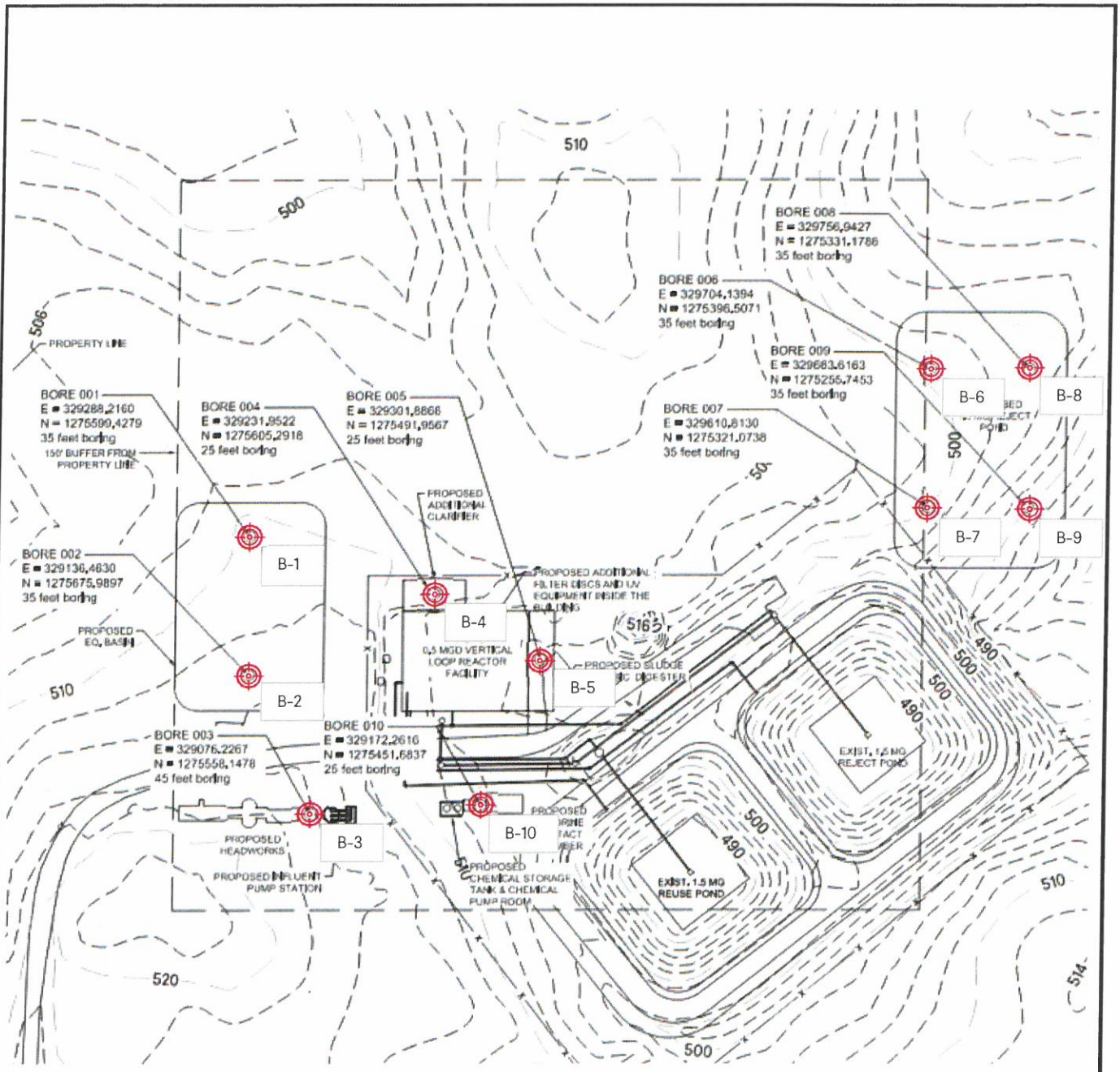
Tel: (706) 303-3272
www.gmcnetwork.com

GMC



Carey Station WRF Greensboro, GA	**Figure 2** GMC# GAUG230004 4/2/2024	801 Broad St # 900 Augusta, GA 30901 Tel: (706) 303-3272
USGS Site Map	Drawn By: SWN	www.gmcnetwork.com

GMC



Carey Station WRF
Greensboro, GA

Boring Location Plan

Figure 3

GMC# GAUG230004
4/2/2024
Drawn By: SWN

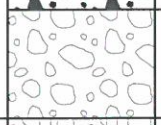
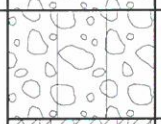
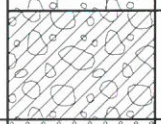
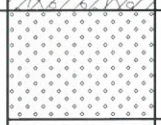
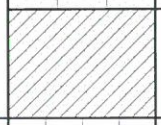
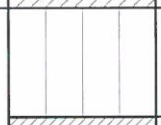
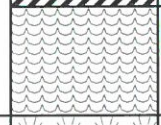
801 Broad St # 900
Augusta, GA 30901

Tel: (706) 303-3272
www.gmcnetwork.com

GMC

GMC

SOIL CLASSIFICATION CHART

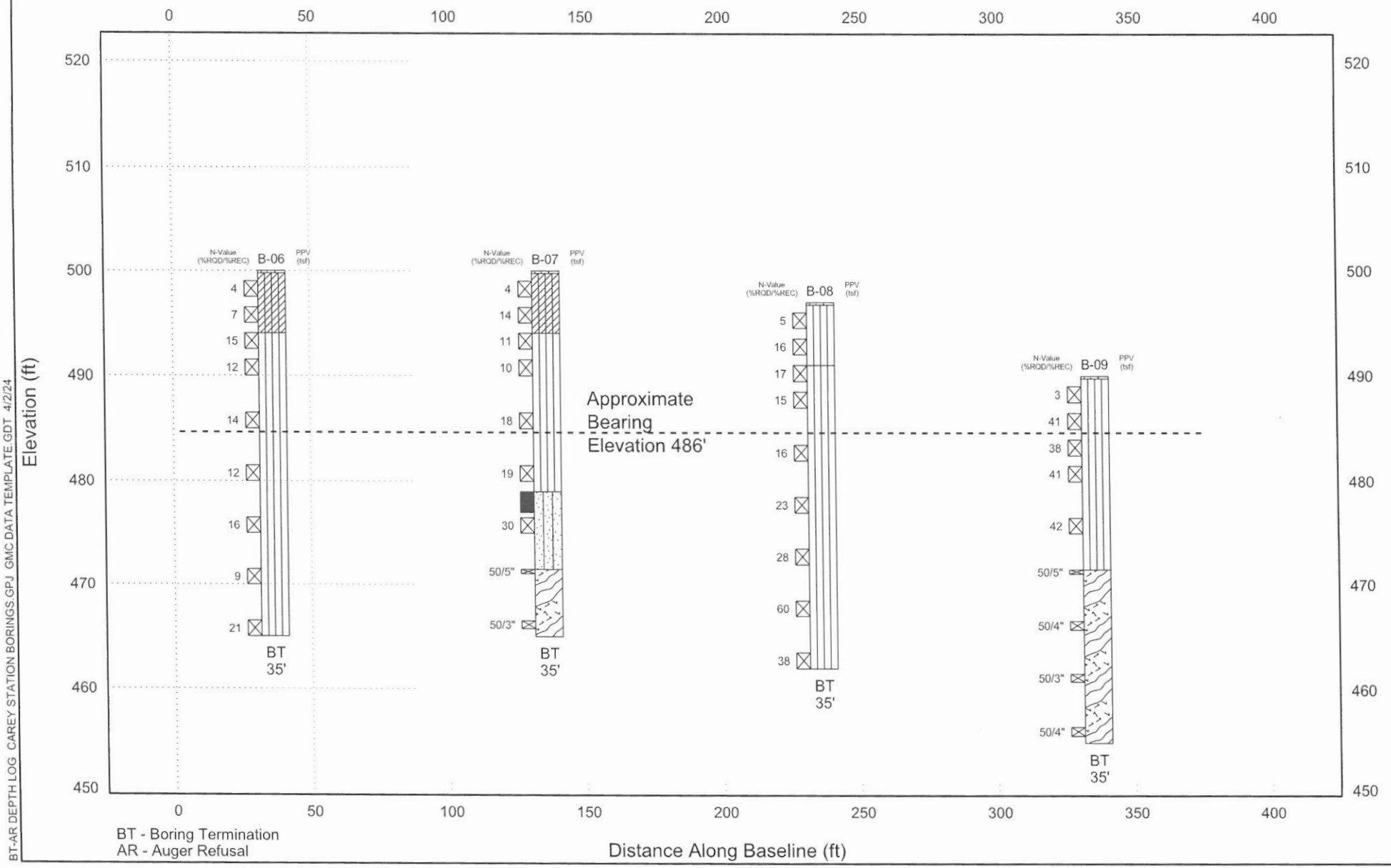
MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND 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
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY 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
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	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
	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				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

SUBSURFACE DIAGRAM A

TOPSOIL | ML-CL | ML | SM | GNEISS

CLIENT Piedmont Water Company
PROJECT NAME Carey Station Water Reuse Facility
PROJECT NUMBER GAUG230004
PROJECT LOCATION Greensboro, Georgia

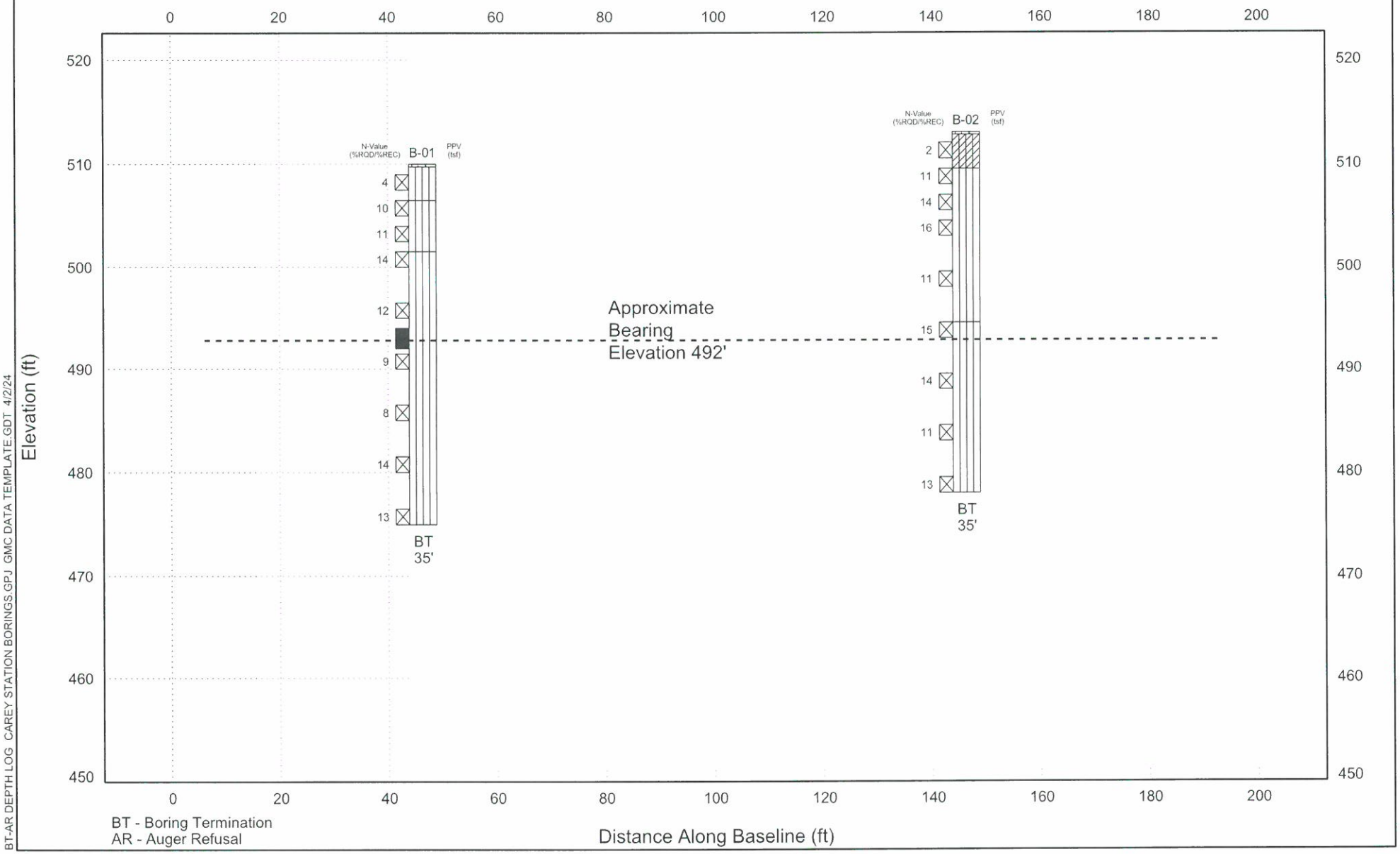


BT-AR DEPTH LOG CAREY STATION BORINGS.GPJ GMC DATA TEMPLATE.GDT 4/2/24

SUBSURFACE DIAGRAM B

TOPSOIL | ML | ML-CL

CLIENT Piedmont Water Company
PROJECT NAME Carey Station Water Reuse Facility
PROJECT NUMBER GAUG230004
PROJECT LOCATION Greensboro, Georgia



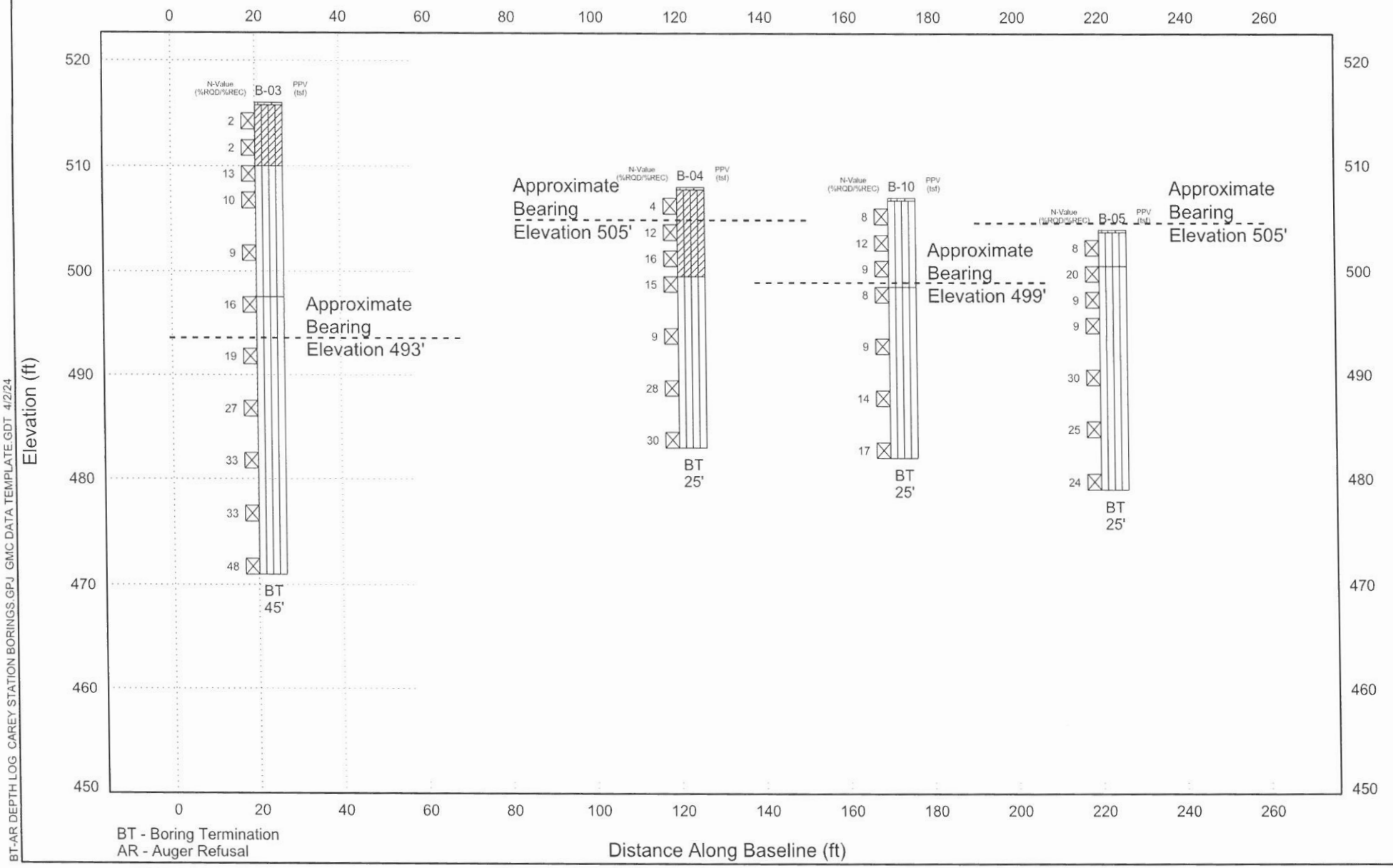
BT - Boring Termination
AR - Auger Refusal

BT-AR DEPTH LOG CAREY STATION BORINGS.GPJ GMC DATA TEMPLATE.GDT 4/2/24

SUBSURFACE DIAGRAM C

TOPSOIL | ML-CL | ML

CLIENT Piedmont Water Company
PROJECT NAME Carey Station Water Reuse Facility
PROJECT NUMBER GAUG230004
PROJECT LOCATION Greensboro, Georgia



BT - Boring Termination
AR - Auger Refusal

BT-AR DEPTH LOG CAREY STATION BORINGS.GPJ GMC DATA TEMPLATE.GDT 4/2/24

BORING NUMBER B-01

GMC

CLIENT Piedmont Water Company
PROJECT NAME Carey Station Water Reuse Facility
PROJECT NUMBER GAUG230004
PROJECT LOCATION Greensboro, Georgia
DATE STARTED 2/20/24 **COMPLETED** 2/20/24
GROUND ELEVATION 510 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Premier Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 550 ATV, Auto-Hammer, HSA w/ SPT
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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
510	0		Organic Laden Material (OLM) - 3 inches										
			SILT (ML), brown, medium to very stiff	SS		1-2-2 (4)							
			, light brown and gray	SS		3-5-5 (10)							
				SS		6-5-6 (11)							
500	10		, brown and light brown	SS		6-7-7 (14)							
				SS		5-6-6 (12)							
				ST						38	27	11	62
490	20			SS		4-5-4 (9)							
				SS		3-4-4 (8)							
480	30			SS		6-7-7 (14)							
				SS		7-6-7 (13)							
470	40		Boring was terminated at 35.0 feet.										
460	50												

BORING NUMBER B-02

GMC

CLIENT Piedmont Water Company
PROJECT NAME Carey Station Water Reuse Facility
PROJECT NUMBER GAUG230004
PROJECT LOCATION Greensboro, Georgia
DATE STARTED 2/20/24 **COMPLETED** 2/20/24
GROUND ELEVATION 513 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Premier Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 550 ATV, Auto-Hammer, HSA w/ SPT
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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		Organic Laden Material (OLM)- 3 inches										
510			SILTY CLAY (ML-CL), red, very soft	SS		1-1-1 (2)							
			SANDY SILT (ML), light brown, medium to stiff	SS		6-5-6 (11)							
				SS		6-7-7 (14)							
	10			SS		7-9-7 (16)							
500				SS		6-5-6 (11)							
	20		, light brown and gray	SS		6-7-8 (15)							
490				SS		8-7-7 (14)							
	30			SS		6-5-6 (11)							
480				SS		7-6-7 (13)							
			Boring was terminated at 35.0 feet.										
	40												
470													
	50												

BORING NUMBER B-03

GMC

CLIENT Piedmont Water Company
PROJECT NAME Carey Station Water Reuse Facility
PROJECT NUMBER GAUG230004
PROJECT LOCATION Greensboro, Georgia
DATE STARTED 2/20/24 **COMPLETED** 2/20/24
GROUND ELEVATION 516 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Premier Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 550 ATV, Auto-Hammer, HSA w/ SPT
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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		Organic Laden Material (OLM)- 3 inches										
			SILTY CLAY (ML-CL), red, very soft	SS		1-1-1 (2)							
				SS		1-1-1 (2)							
510			SANDY SILT (ML), brown, medium to hard	SS		4-6-7 (13)							
	10			SS		4-5-5 (10)							
				SS		4-4-5 (9)							
500													
	20		, light brown and gray	SS		5-7-9 (16)							
				SS		7-9-10 (19)							
490													
	30			SS		8-12-15 (27)							
				SS		5-14-19 (33)							
480													
	40			SS		13-18-15 (33)							
				SS		13-20-28 (48)							
470			Boring was terminated at 45.0 feet.										
	50												

BORING NUMBER B-04

GMC

CLIENT Piedmont Water Company
PROJECT NAME Carey Station Water Reuse Facility
PROJECT NUMBER GAUG230004
PROJECT LOCATION Greensboro, Georgia
DATE STARTED 2/20/24 **COMPLETED** 2/20/24
GROUND ELEVATION 508 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Premier Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 550 ATV, Auto-Hammer, HSA w/ SPT
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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		Organic Laden Material (OLM)- 2 inches										
500			SILTY CLAY (ML-CL), red, medium to stiff	SS		3-2-2 (4)							
				SS		3-5-7 (12)							
				SS		5-7-9 (16)							
	10		SANDY SILT (ML), brown, medium to hard	SS		7-7-8 (15)							
				SS		5-4-5 (9)							
490				SS		12-14-14 (28)							
	20			SS		10-15-15 (30)							
			Boring was terminated at 25.0 feet.										
480													
	30												
470													
	40												
460													
	50												

BORING NUMBER B-05

GMC

CLIENT Piedmont Water Company
PROJECT NAME Carey Station Water Reuse Facility
PROJECT NUMBER GAUG230004
PROJECT LOCATION Greensboro, Georgia
DATE STARTED 2/20/24 **COMPLETED** 2/20/24
GROUND ELEVATION 504 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Premier Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 550 ATV, Auto-Hammer, HSA w/ SPT
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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		Organic Laden Material (OLM)- 1 inch										
			SANDY SILT (ML), red, medium to hard	SS		6-4-4 (8)							
500			, brown and light brown	SS		6-9-11 (20)							
				SS		4-4-5 (9)							
	10			SS		4-5-4 (9)							
490				SS		11-15-15 (30)							
	20			SS		8-10-15 (25)							
480				SS		9-11-13 (24)							
			Boring was terminated at 25.0 feet.										
	30												
470													
	40												
460													
	50												

BORING NUMBER B-06

GMC

CLIENT Piedmont Water Company
PROJECT NAME Carey Station Water Reuse Facility
PROJECT NUMBER GAUG230004
PROJECT LOCATION Greensboro, Georgia
DATE STARTED 2/20/24 **COMPLETED** 2/20/24
GROUND ELEVATION 500 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Premier Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 550 ATV, Auto-Hammer, HSA w/ SPT
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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
500	0		Organic Laden Material (OLM)- 3 inches										
			SILTY CLAY (ML-CL), red, medium to stiff	SS		2-2-2 (4)							
				SS		3-3-4 (7)							
			SANDY SILT (ML), light brown, stiff to very stiff	SS		7-7-8 (15)							
490	10			SS		6-6-6 (12)							
				SS		5-6-8 (14)							
480	20			SS		5-6-6 (12)							
				SS		7-7-9 (16)							
470	30			SS		5-4-5 (9)							
				SS		8-9-12 (21)							
			Boring was terminated at 35.0 feet.										
460	40												
450	50												

BORING NUMBER B-07

GMC

CLIENT Piedmont Water Company
PROJECT NAME Carey Station Water Reuse Facility
PROJECT NUMBER GAUG230004
PROJECT LOCATION Greensboro, Georgia
DATE STARTED 2/20/24 **COMPLETED** 2/20/24
GROUND ELEVATION 500 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Premier Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 550 ATV, Auto-Hammer, HSA w/ SPT
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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
500	0		Organic Laden Material (OLM)- 4 inches										
			SILTY CLAY (ML-CL), red, medium to stiff	SS		2-2-2 (4)							
				SS		6-7-7 (14)							
			SANDY SILT (ML), light brown, stiff to very stiff	SS		5-6-5 (11)							
490	10			SS		5-5-5 (10)							
				SS		7-8-10 (18)							
480	20			SS		7-9-10 (19)							
			SILTY SAND (SM), gray, medium	ST						32	27	5	45
				SS		10-13-17 (30)							
470	30		PARTIALLY WEATHERED ROCK - Sampled as POORLY GRADED SAND with SILT (SP-SM), gray, very dense	SS		50/5"							
				SS		10-50/3"							
			Boring was terminated at 35.0 feet.										
460	40												
450	50												

BORING NUMBER B-08

GMC

CLIENT Piedmont Water Company
PROJECT NAME Carey Station Water Reuse Facility
PROJECT NUMBER GAUG230004
PROJECT LOCATION Greensboro, Georgia
DATE STARTED 2/20/24 **COMPLETED** 2/20/24
GROUND ELEVATION 497 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Premier Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 550 ATV, Auto-Hammer, HSA w/ SPT
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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		Organic Laden Material (OLM)- 3 inches										
			SANDY SILT (ML), brown, medium to very stiff	SS		3-3-2 (5)							
				SS		10-9-7 (16)							
490			, light brown, stiff to hard	SS		8-10-7 (17)							
	10			SS		7-7-8 (15)							
				SS		6-7-9 (16)							
480				SS		8-10-13 (23)							
	20			SS		10-13-15 (28)							
470				SS		14-28-32 (60)							
	30			SS		14-17-21 (38)							
			Boring was terminated at 35.0 feet.										
460													
	40												
450													
	50												

BORING NUMBER B-09

GMC

CLIENT Piedmont Water Company
PROJECT NAME Carey Station Water Reuse Facility
PROJECT NUMBER GAUG230004
PROJECT LOCATION Greensboro, Georgia
DATE STARTED 2/20/24 **COMPLETED** 2/20/24
GROUND ELEVATION 490 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Premier Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 550 ATV, Auto-Hammer, HSA w/ SPT
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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
490	0		Organic Laden Material (OLM)- 4 inches										
			SANDY SILT (ML), light brown, soft to hard	SS		1-1-2 (3)							
				SS		12-23-18 (41)							
				SS		14-19-19 (38)							
480	10			SS		13-19-22 (41)							
				SS		10-19-23 (42)							
470	20		PARTIALLY WEATHERED ROCK - Sampled as POORLY GRADED SAND with SILT (SP-SM), light brown, very dense	SS		50/5"							
				SS		27-50/4"							
460	30			SS		25-50/3"							
				SS		30-50/4"							
450	40		Boring was terminated at 35.0 feet.										
440	50												

BORING NUMBER B-10

GMC

CLIENT Piedmont Water Company
PROJECT NAME Carey Station Water Reuse Facility
PROJECT NUMBER GAUG230004
PROJECT LOCATION Greensboro, Georgia
DATE STARTED 2/20/24 **COMPLETED** 2/20/24
GROUND ELEVATION 507 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Premier Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 550 ATV, Auto-Hammer, HSA w/ SPT
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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		Organic Laden Material (OLM)- 2 inches										
			SANDY SILT (ML), brown, medium to very stiff	SS		3-4-4 (8)							
				SS		6-6-6 (12)							
500				SS		3-4-5 (9)							
	10		, light brown	SS		4-4-4 (8)							
				SS		4-5-4 (9)							
490													
	20			SS		6-7-7 (14)							
				SS		9-8-9 (17)							
480			Boring was terminated at 25.0 feet.										
	30												
470													
	40												
460													
	50												

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Goodwin Mills- Laboratory Testing							
Date:	3/28/2024	Panel Number : P-1						
Project No. :	EN231257	Permometer Data						
Boring No.:	B-001	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Sample:	N/A	a_a =	0.767120	cm^2		Pipet **Rp**	**18.2**	cm^3
Depth (ft):	16.0-18.0	M_1 =	0.030180	C = 0.0004653		Annulus **Ra**	0.9	cm^3
Other Location:	Tube	M_2 =	1.040953	T = 0.0602682				

Material Description : Sandy Silt

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			634.51	g	Tare No.:	TTYL	Tare No.:	X
Tare or ring Wt. :			0.0	g	Wet Wt.+tare:	113.61	Wet Wt.+tare:	303.66
Wet Wt: of Sample :			634.51	g	Dry Wt.+tare:	103.84	Dry Wt.+tare:	251.29
Diameter :	2.81	in	7.14	cm^2	Tare Wt:	52.51	Tare Wt:	0.00
Length :	3.06	in	7.77	cm	Dry Wt.:	51.33	Dry Wt.:	251.29
Area:	6.20	in^2	40.01	cm^2	Water Wt.:	9.77	Water Wt.:	52.37
Volume :	18.98	in^3	310.97	cm^3	% moist.:	**19.0**	% moist.:	**20.8**
Unit Wt.(wet):	**127.32**	pcf	**2.04**	$g/cm^{\wedge 3}$				
Unit Wt.(dry):	**106.96**	pcf	**1.71**	$g/cm^{\wedge 3}$				

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = _____ OMC = _____
% of max = _____ +/- OMC = _____
Calculated % saturation: 97.71 Void ratio (e) = **0.58** Porosity (n)= **0.37**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 17.3 cm Hydraulic Gradient = 28.00

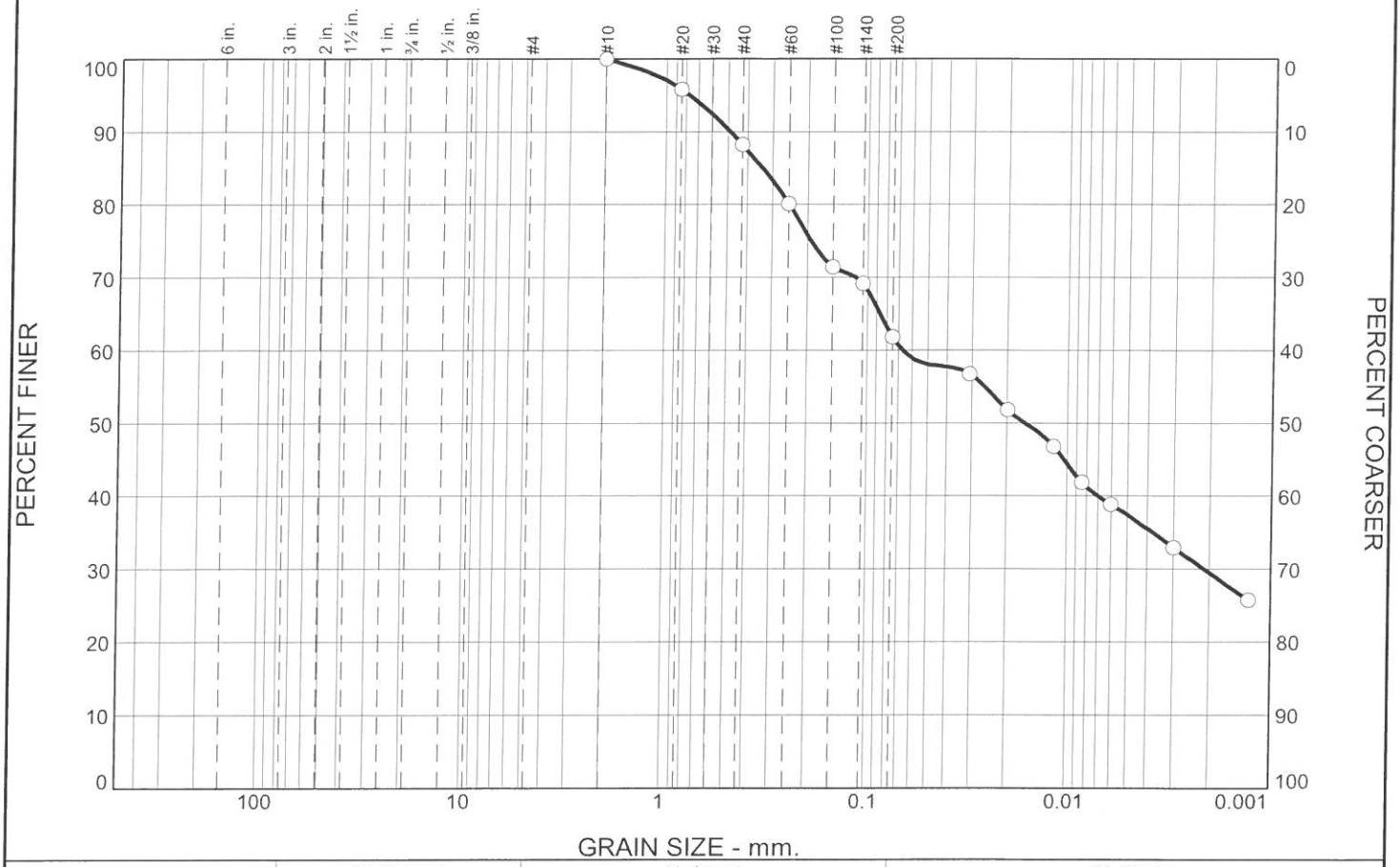
Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
3/4/2024	120	16.3	1.892485	21	0.977	4.59E-07	1.30E-03	
3/4/2024	240	15	3.192485	21	0.977	4.05E-07	1.15E-03	
3/4/2024	360	14	4.192485	21	0.977	3.68E-07	1.04E-03	
3/4/2024	480	12.5	5.692485	21	0.977	3.98E-07	1.13E-03	

SUMMARY

k_a =	**4.07E-07**	**cm/sec**		Acceptance criteria =	50 %
ki			Vm		
k1 =	4.59E-07	cm/sec	12.6 %	Vm =	$\frac{\lvert ka-ki \rvert}{ka} \times 100$
k2 =	4.05E-07	cm/sec	0.6 %		
k3 =	3.68E-07	cm/sec	9.7 %		
k4 =	3.98E-07	cm/sec	2.3 %		

Hydraulic conductivity	k =	**4.07E-07**	cm/sec	**1.15E-03** ft/day
Void Ratio	e =	**0.58**		
Porosity	n =	**0.37**		
Bulk Density	γ =	**2.04**	g/cm^3	**127.3** pcf
Water Content	W =	**0.33**	cm^3/cm^3	(at 20 deg C)
Intrinsic Permeability	k_{int} =	**4.17E-12**	cm^2	(at 20 deg C)

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	11.8	26.4	24.4	37.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	95.8		
#40	88.2		
#60	80.1		
#100	71.5		
#140	69.1		
#200	61.8		
0.0310 mm.	56.8		
0.0200 mm.	51.8		
0.0117 mm.	46.8		
0.0084 mm.	41.9		
0.0060 mm.	38.9		
0.0030 mm.	33.0		
0.0013 mm.	25.8		

* (no specification provided)

Soil Description

sandy silt

Atterberg Limits

PL= 27 LL= 38 PI= 11

Coefficients

D_{90}= 0.4902 D_{85}= 0.3365 D_{60}= 0.0669
D_{50}= 0.0163 D_{30}= 0.0021 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-6(6)

Remarks

F.M.=0.55

Source of Sample: Goodwyn Mills Testing **Depth:** 16.0-18.0 ft
Sample Number: B-001 **Date:** 3/28/24

Terracon Consultants, Inc.

Client: Goodwyn Mills Cawood
Project: Goodwyn Mills-Laboratory Testing

Project No: EN231257

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Goodwin Mills- Laboratory Testing							
Date:	3/28/2024	Panel Number : P-1						
Project No. :	EN231257	Permometer Data						
Boring No.:	B-007	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Sample:	N/A	a_a =	0.767120	cm^2		Pipet **Rp**	**10.4**	cm^3
Depth (ft):	21.0-23.0	M_1 =	0.030180	C = 0.0002343		Annulus **Ra**	1.2	cm^3
Other Location:	Tube	M_2 =	1.040953	T = 0.1131416				
Material Description :	Silty Sand							

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			351.30	g	Tare No.:	CH4	Tare No.:	X
Tare or ring Wt. :			0.0	g	Wet Wt.+tare:	268.45	Wet Wt.+tare:	199.87
Wet Wt: of Sample :			351.30	g	Dry Wt.+tare:	248.89	Dry Wt.+tare:	169.99
Diameter :	2.89	in	7.34	cm^2	Tare Wt:	52.70	Tare Wt:	0.00
Length :	1.63	in	4.14	cm	Dry Wt.:	196.19	Dry Wt.:	169.99
Area:	6.56	in^2	42.32	cm^2	Water Wt.:	19.56	Water Wt.:	29.88
Volume :	10.69	in^3	175.22	cm^3	% moist.:	**10.0**	% moist.:	**17.6**
Unit Wt.(wet):	**125.11**	pcf	**2.00**	$g/cm^{\wedge 3}$				
Unit Wt.(dry):	**113.77**	pcf	**1.82**	$g/cm^{\wedge 3}$				

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = _____ OMC = _____
% of max = _____ +/- OMC = _____
Calculated % saturation: 98.54 Void ratio (e) = **0.48** Porosity (n)= **0.33**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 9.2 cm Hydraulic Gradient = 28.00

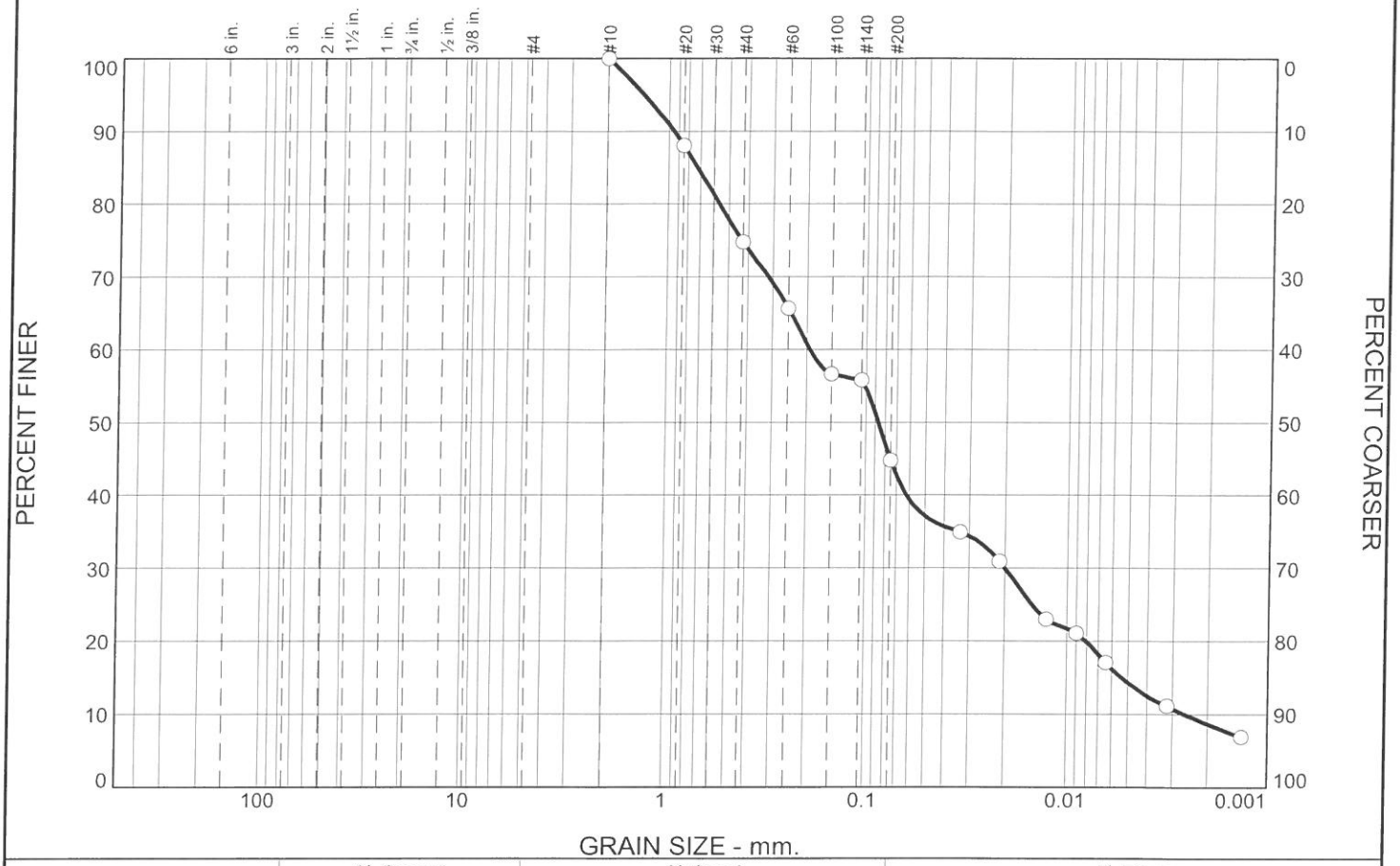
Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
3/4/2024	30	9.3	1.138481	21	0.977	1.05E-06	2.98E-03	
3/4/2024	60	8.8	1.638481	21	0.977	7.82E-07	2.22E-03	
3/4/2024	90	8	2.438481	21	0.977	8.21E-07	2.33E-03	
3/4/2024	120	7.3	3.138481	21	0.977	8.37E-07	2.37E-03	

SUMMARY

ka =	**8.73E-07**	**cm/sec**		Acceptance criteria =	50 %
ki			Vm		
k1 =	1.05E-06	cm/sec	20.5 %	Vm =	$\frac{\lvert ka-ki \rvert}{ka} \times 100$
k2 =	7.82E-07	cm/sec	10.4 %		
k3 =	8.21E-07	cm/sec	6.0 %		
k4 =	8.37E-07	cm/sec	4.2 %		

Hydraulic conductivity	k =	**8.73E-07**	cm/sec	**2.47E-03**	ft/day
Void Ratio	e =	**0.48**			
Porosity	n =	**0.33**			
Bulk Density	γ =	**2.00**	g/cm^3	**125.1**	pcf
Water Content	W =	**0.18**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**8.94E-12**	cm^2	(at 20 deg C)	

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	25.2	30.0	30.5	14.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	88.1		
#40	74.8		
#60	65.7		
#100	56.6		
#140	55.8		
#200	44.8		
0.0334 mm.	35.0		
0.0214 mm.	31.0		
0.0127 mm.	23.0		
0.0090 mm.	21.1		
0.0064 mm.	17.0		
0.0032 mm.	11.1		
0.0014 mm.	6.9		

* (no specification provided)

Soil Description

silty sand

Atterberg Limits

PL= 27 LL= 32 PI= 5

Coefficients

D_{90}= 0.9513 D_{85}= 0.7209 D_{60}= 0.1932
D_{50}= 0.0868 D_{30}= 0.0201 D_{15}= 0.0054
D_{10}= 0.0026 C_u= 73.85 C_c= 0.80

Classification

USCS= SM AASHTO= A-4(0)

Remarks

F.M.=1.00

Source of Sample: Goodwyn Mills Testing **Depth:** 21.0-23.0 ft
Sample Number: B-007 **Date:** 3/28/24

Terracon Consultants, Inc.

Client: Goodwyn Mills Cawood
Project: Goodwyn Mills-Laboratory Testing

Project No: EN231257

GMC

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 augers 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 cemeted 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

GMC

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	
Very Loose	≤ 4 bpf
Loose	5 - 10 bpf
Medium	11 – 30 bpf
Dense	31 - 50 bpf
Very Dense	> 50 bpf
(bpf = blows per foot, ASTM D 1586)	

Consistency of Cohesive Soils	
Very Soft	≤ 2 bpf
Soft	3 - 4 bpf
Medium	5 - 8 bpf
Stiff	9 - 15 bpf
Very Stiff	16 - 30 bpf
Hard	> 30 bpf

Relative Hardness of Rock
Very Soft Rock disintegrates or easily compresses to touch; can be hard to very hard soil.
Soft Rock may be broken with fingers.
Moderately Soft Rock may be scratched with a nail, corners and edges may be broken with fingers.
Moderately Hard Rock a light blow of hammer is required to break samples.
Hard Rock a hard blow of hammer is required to break sample.

Particle Size Identification	
Boulders	Larger than 12"
Cobbles	3" - 12"
Gravel	
Coarse	3/4" - 3"
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

RECOVERY = $\frac{\text{Total Length of Core}}{\text{Length of Core Run}} \times 100\ \%$

Description	Core Recovery %
Incompetent	Less than 40
Competent	40 - 70
Fairly Continuous	71 - 90
Continuous	91 - 100

Relative Quality of Rocks

RQD = $\frac{\text{Total core, counting only pieces > 4" long}}{\text{Length of Core Run}} \times 100\ \%$

Description	RQD %
Very Poor	0 - 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

GMC

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 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 commonly performed: 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.

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.

A specimen may be washed through only the No. 200 sieve, if the full range of particle sizes is not required. The percentage of material passing the No. 200 sieve is reported.

The distribution of materials finer than the No. 200 sieve is determined by use of a hydrometer. The particle sizes and distribution are computed from the time rate of settlement of the different size particles while suspended in water. These tests are performed in accordance with ASTM D-421, D-422 and D-1140.

PERMEABILITY TEST

The permeability test is used to measure the ease with which water will flow through soils, such as seepage through liners or under dams, the squeezing out of water from the soil by the application of load and drainage of subgrades, dams and backfills.

GMC

The permeability test is conducted on undisturbed or remolded samples. Samples are trimmed to 1.4 or 2.85 inches in diameter and are variable heights. The samples are molded or trimmed and placed in a ring and placed between porous plates. Water is forced to flow through the sample and the rate of flow is determined.

Two methods of permeability are used, depending on the grain size of soils.

Constant head method is used for granular soil per ASTM D-2434.

Falling head method is used for fine grained soil per ASTM D-5084.

GMC

ADDENDUM NO.1

PROJECT: **Carey Station Urban Water Reuse Facility 0.5 MGD to 1.0 MGD Expansion**
For Piedmont Water Company
GMC PROJECT NO. CAUG230002

---

1. Revisions

1.1 46 51 15 1.5.B - Total quantity of diffusers should be changed to 190
1.2 Add Specification 320519 - Geosynthetics for Exterior Improvements, see Appendix B
1.3 Add Specification 081113 - Hollow Metal Doors and Frames, See Appendix C
1.4 Add Specification 087100 - Door Hardware, See Appendix D
1.5 Add Specification 074113 - Standing-Seam Metal Roof Panels, see Appendix E
1.6 Add Specification 095113 – Acoustical Panel Ceilings, see Appendix F
1.7 Replace Specification 466123 Tertiary Filtration entirely, See Appendix G
1.8 Replace Specification 00 41 13 - Bid Form, See Appendix H
1.9 See Or-Equal List in Appendix I

2. Questions

2.1 **Please provide additional design information for the aluminum grating walkways shown on Drawing D-301. There is a proposed aluminum grating walkway that joins an existing walkway. What is the design of the existing walkway?**
Answer: See attached PDF files for the existing walkway design (Appendix A). Proposed aluminum grating walkway shall match the existing in Sections B and A on Sheets S4 and S5, respectively. Additional sheets shown for clarity on section location.

2.2 **For the new reject and equalization ponds the drawings indicate a liner is to be installed. Please provide a specification on the liner and if any geotextile will be required under the liner. The drawings also contradict with specification section 312000 paragraph 3.16 which calls for a bentonite liner. Please clarify which is correct and provide additional details.**
Answer: Liner shall use specification 320519 - Geosynthetics for Exterior Improvements in Appendix B. Delete specification section 312000 paragraph 3.16 which calls for a bentonite liner. Geotextiles may be used to compensate for irregular subgrades.

2.3 **Will Piedmont Water Company provide electricity on the job site?**
Answer: The contractor shall have the power company set up a temporary meter for their electrical needs/usage.

GMC

2.4 **SECTION 13 31 00 – FIBERGLASS REINFORCED BUILDING ENCLOSURE**
2.2 SYSTEM DESCRIPTION.
Provide one-piece molded construction FRP shelter of the following type: 1. Size: 12'-0" W x 16'-0" D x 7'-11" H. I see an 8x8 FRP Building shown on the plans (pages D-801 and D-802) for a Pump Bldg. Can you tell me where the building in the above specifications is located and or named?

Answer: FRP Building shall be 8'-0" W x 8'-0" D x 7'-6" H.

2.5 **Please provide information on the door/frame material and the door hardware required. The schedule on plan sheet A-814 does not provide any information and there are no division 8 specifications.**
Answer: See Specification 081113 - Hollow Metal Doors and Frames Appendix C and Speciation 087100 - Door Hardware in Appendix D.

2.6 **Please provide specifications for the standing seam metal roof system required.**
Answer: See Specification 074113 - Standing-Seam Metal Roof Panels in Appendix E

2.7 **Please clarify the finish ceiling requirements in the electrical building. Detail A on plan sheet A-811 shows gypsum board ceiling over metal framing, but detail A on plan sheet A-813 shows a suspended acoustical tile ceiling. If an acoustical ceiling is required, please provide specifications.**
Answer: Use acoustical ceiling, see specification 095113 – Acoustical Panel Ceilings in Appendix F

2.8 **Plan sheet A-814 has signage notes, but there is no other reference to signage in the plans or the specs. Please clarify if there is any signage required.**
Answer: No signages.

2.9 **Question from VLR manufacturer – "The existing VLR tanks have diffusers in them, are they to be re-used? Some oxygen delivery capacity was assumed from the diffusers for the VLR tanks."**
Answer: These diffusers are not to be reused. All aeration capacity shall be provided by the existing surface aerators and new fine bubble diffusers in the fine bubble tank.

2.10 **Question from VLR manufacturer – "46 51 15 2.3.I - One (1) ORP probe is to be provided with mounting kit. Drawing I-301 shows the ORP probe placed in the fine bubble tank. It was intended to place the ORP probe in one of the VLR tanks and move a DO probe from the VLR tanks to the fine bubble aeration tank. Are**

there existing DO instruments within the VLR tanks, and are there existing controls for the VLR?"
Answer: Contractor shall locate the ORP probe in the 2nd VLR tank. There are no existing DO instruments within the VLR tanks. VLR manufacturer shall add one (1) DO probe in the scope of supply including mounting kit for the fine bubble tank.

2.11 **The existing asphalt driveway is in bad shape and will likely not be salvageable after construction. Please consider adding replacement of the asphalt road in the scope of work.**
Answer: Yes, add the replacement the existing asphalt road in the scope of work – use detail 1 on C-613.

2.12 **Can the bid date be extended until Feb 26, 2025.**
Answer: No, the bid date will not be extended until Feb 26,2025.

3. Acknowledgement

3.1 Receipt of Addendum No. 1 shall be acknowledged via e-mail to liang.wang@gmcnetwork.com and confirm that the addendum has been received.

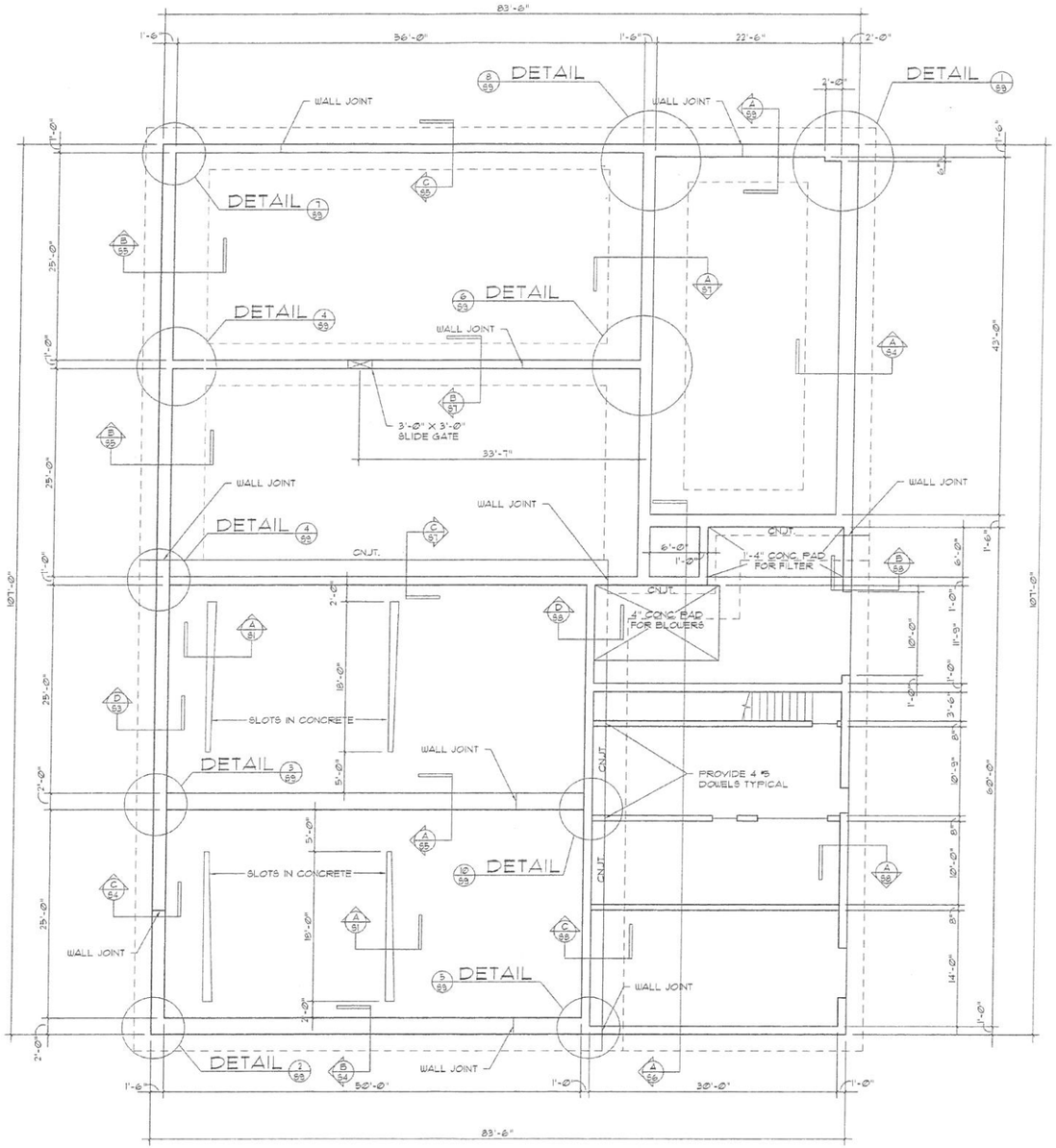
4. Conclusion

4.1 This is the end of Addendum Number 1, dated February 14, 2025

Liang Wang

Liang Wang, PE

Appendix A



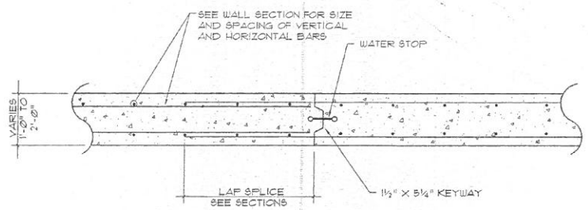
FOUNDATION PLAN
SCALE: 1/8" = 1'-0"

GENERAL NOTES:

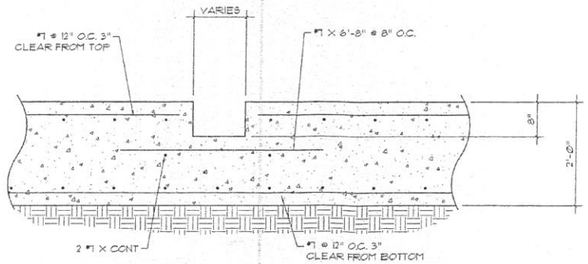
1. COORDINATE THESE DRAWINGS WITH THE EXISTING CONDITIONS. PROCESS & EQUIPMENT SHOP DRAWINGS. CONTRACTOR TO VERIFY ALL DIMENSIONS BEFORE WORK IS STARTED FOUNDATION IS DESIGNED USING A SOIL BEARING CAPACITY OF 2000 PSF. IF THE EXISTING CONDITIONS VARY FROM WHAT IS SHOWN, OR IF THE SOIL BEARING CAPACITY IS QUESTIONABLE, THE ENGINEER IS TO BE NOTIFIED IMMEDIATELY.
2. REMOVE ALL TOPSOIL, ROOT SYSTEM OR OTHER DELETERIOUS MATERIAL UNDER PROPOSED COLUMN AND WALL FOOTINGS AND REPLACE WITH SUITABLE COMPACTED FILL OR CRUSHED STONE. ENGINEERS DECISION ON QUESTIONABLE MATERIAL SHALL BE FINAL.
3. ALL BUILDING AREAS SHALL BE COMPACTED TO 95% OF MAXIMUM DRY DENSITY AT OPTIMUM MOISTURE CONTENT AS DETERMINED IN ACCORDANCE WITH ASTM D698, CURRENT EDITION.
4. ALL FOOTINGS TO BE CENTERED UNDER THE COLUMNS OR WALLS THEY SUPPORT, UNLESS NOTED OTHERWISE ON THE DRAWING.
5. WHERE A DETAIL IS SHOWN FOR ONE CONDITION, IT SHALL ALSO APPLY FOR ALL LIKE OR SIMILAR CONDITIONS, UNLESS NOTED OTHERWISE.
6. EXTEND ALL FOOTING REINFORCEMENT TO FAR SIDE OF FOOTING, TYPICALLY ALLOWING 3 INCHES OF COVER.
7. ALL CONCRETE SHALL HAVE A MINIMUM 28 -DAY COMPRESSIVE STRENGTH OF 4000 PSI AND SHALL CONTAIN FIBERMESH AT THE RATE OF 1.5 POUNDS PER CUBIC YARD.
8. CONCRETE REINFORCING STEEL SHALL COMPLY WITH THE REQUIREMENTS OF ASTM A615, GRADE 60 AND FREE OF ANY FORM RELEASE AGENTS. ALL ANCHOR BOLTS SHALL BE SIZE AND STRENGTH SPECIFIED. WELDED WIRE MESH SHALL BE IN ACCORDANCE WITH ASTM A-185.
9. ALL STRUCTURAL STEEL SHALL COMPLY WITH THE REQUIREMENTS OF ASTM 992 GRADE 50. CONNECTIONS SHALL BE AS SHOWN ON THE CONTRACT DRAWINGS UNLESS APPROVED BY THE STRUCTURAL ENGINEER PRIOR TO FABRICATION. CONNECTION BOLTS SHALL BE ASTM A325 UNLESS NOTED OTHERWISE. ALL WELDING TO BE PERFORMED BY A CERTIFIED WELDER AND ADHERING TO AWS D1.1 FOR WELDING OF STRUCTURAL SHAPES.
10. ALL STEEL DECK SHALL BE FABRICATED AND INSTALLED IN ACCORDANCE WITH ALL THE REQUIREMENTS OF THE STEEL DECK INSTITUTE.
11. ALL STRUCTURAL STEEL AND COLD FORMED SECTION SHALL BE FABRICATED AND ERECTED IN STRICT ACCORDANCE TO THE MANUAL OF STEEL CONSTRUCTION BY THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION AND TO THE METAL BUILDING MANUFACTURER ASSOCIATION CODE OF STANDARD PRACTICES.
12. ALL ROOF OPEN WEB STEEL JOIST TO MANUFACTURED AND ERECTED IN ACCORDANCE WITH THE STEEL JOIST INSTITUTE MANUALS AND RECOMMENDATIONS USING Fy = 50 KSI.
13. PROVIDE SOUTHERN SPECIES PLYWOOD RATED FOR INDICATED SPANS AND LOADS BY AMERICAN PLYWOOD ASSOCIATION. INSTALL IN ACCORDANCE WITH ALL RECOMMENDATIONS BY THE AMERICAN PLYWOOD ASSOCIATION INCLUDING SIZE AND SPACING OF FASTENERS.
14. ALL CONCRETE BLOCK SHALL BE GRADE A HOLLOW LOAD-BREARING UNITS CONFORMING TO ASTM C90. ALL MORTAR SHALL BE TYPE S ATTAINING A STRENGTH OF 1800 PSI WITHIN 28 DAYS.
15. ROOF TRUSS DESIGN LOADS SHALL BE AS FOLLOWS:

	ROOF
TOP CHORD LIVE LOAD	20 PSF
TOP CHORD DEAD LOAD	10 PSF
BOTTOM CHORD LIVE LOAD	0 PSF
BOTTOM CHORD DEAD LOAD	10 PSF
TOP CHORD WIND UPLIFT LOAD	IN ACCORDANCE W/ THE SHAPE FACTORS DENOTED IN THE STANDARD BUILDING CODE

16. TRUSSES SHALL BE DESIGNED AND FABRICATED BY THE TRUSS MANUFACTURER. DESIGN SHALL CARRY THE SEAL OF AN ENGINEER REGISTERED IN THE STATE OF GEORGIA. CONFIGURATION AND SIZE OF WEB MEMBERS SHALL BE DETERMINED BY THE TRUSS MANUFACTURER. SHOP DRAWINGS AND CALCULATIONS FOR TRUSSES SHALL BE SUBMITTED FOR APPROVAL BEFORE FABRICATION. TRUSS SHOP DRAWINGS SHALL BE AVAILABLE AT THE SITE.
17. MAXIMUM LIVE LOAD DEFLECTION FOR ROOF TRUSSES = L/240.
18. LOADS ABOVE SHALL BE UTILIZED IN THE DESIGN OF GIRDER TRUSSES.
19. BOTTOM AND TOP CHORDS OF ALL ROOF TRUSSES SHALL BE BRACED BY 1"X 4"X 8' AT 10 FEET ON CENTER. ALL ADDITIONAL PERMANENT BRACING AS REQUIRED BY STRUCTURAL DESIGN OF THE TRUSSES AND FOR STABILITY OF THE TRUSSES AND FOR STABILITY OF THE TRUSSES SHALL BE INDICATED ON THE SHOP DRAWINGS. BRACING SHALL BE CONTINUOUS X - TYPE WITH HORIZONTAL STRUTS TOP AND BOTTOM. BETWEEN LESS THAN 4 TRUSSES, SPACED AT 20 FEET MAXIMUM. BRACING SHALL BE ATTACHED TO EACH TRUSS.
20. THE CONTRACTOR SHALL PROVIDE ADEQUATE TEMPORARY BRACING FOR THE TRUSSES DURING ERECTION.
21. TRUSS DESIGN SHALL ACCOUNT FOR LOAD IMPOSED UPON TRUSSES BY WEIGHT OF MECHANICAL UNITS. SEE MECHANICAL PLANS FOR UNIT LOCATION. VERIFY WEIGHT OF UNIT W/ EQUIP. SELECTED.



TYP. FLOOR OR WALL JOINT CNJT.
SCALE: 3/4" = 1'-0"



SECTION (A/S1)
SCALE: 3/4" = 1'-0"

GEORGIA REGISTERED No. 12083 PROFESSIONAL ENGINEER JOHNNIE ERWIN KORNEGAY

KEI
Kornegay Engineering Inc.
Structural Consultant
363 Pierce Avenue
Macon, GA 31204
(912) 745-6161
FAX 745-4744
Project No: 02185

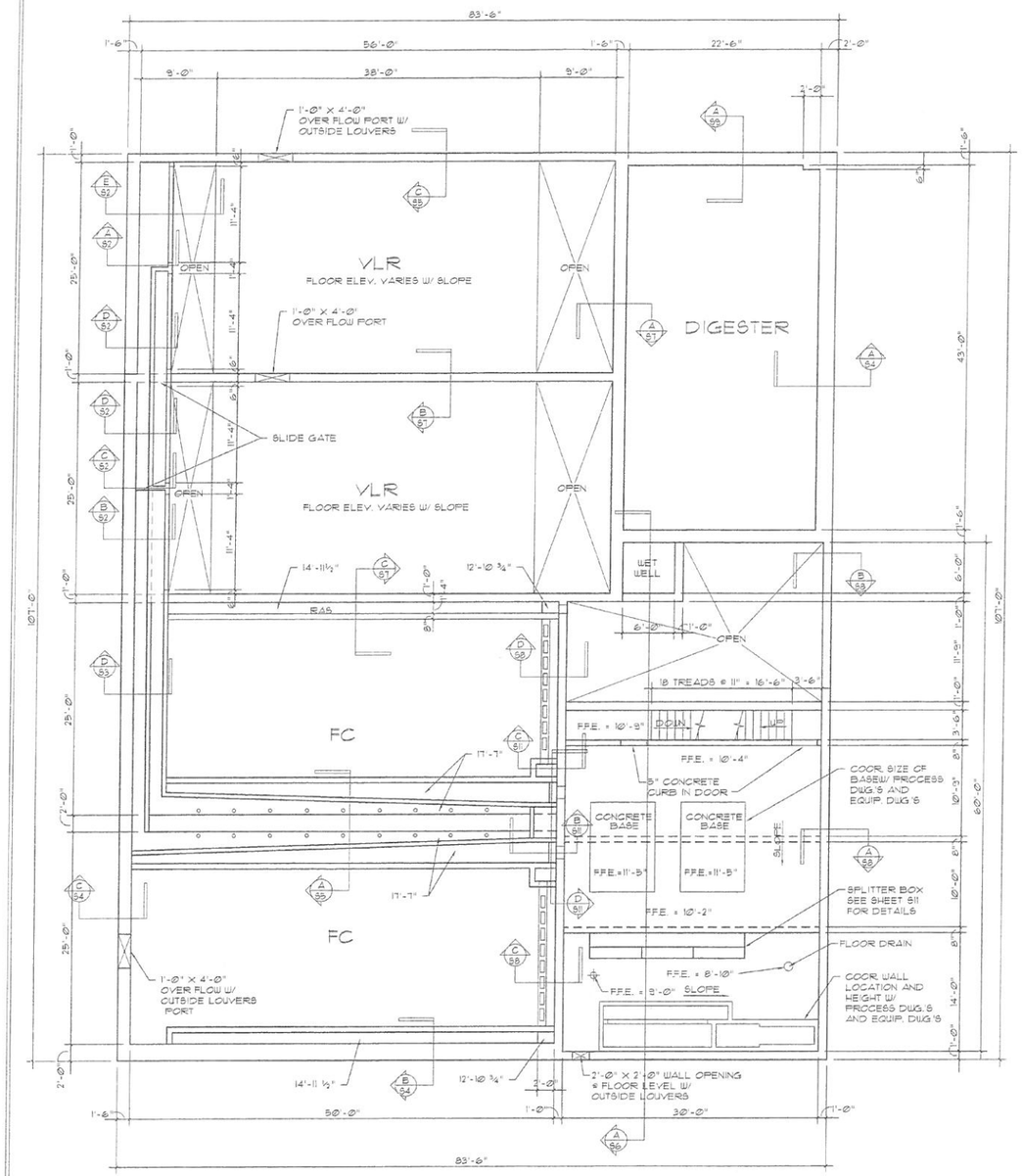
H. S. FELDMAN, Inc.
Water and Wastewater Facilities
Design/Build, Operations and Maintenance
341 Monroe Highway PHONE: 770-868-0863
Winder, Georgia 30680 FAX: 770-868-0953

QUALIFLUENT
WASTEWATER TREATMENT FACILITY

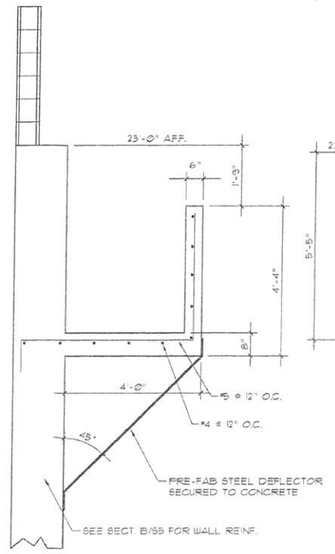
NO.	DATE	REVISION
1	2/11/03	GENERAL REVISIONS

PIEDMINT WATER FACILITY
CAREY STATION URBAN WATER REUSE FACILITY
FOUNDATION PLAN

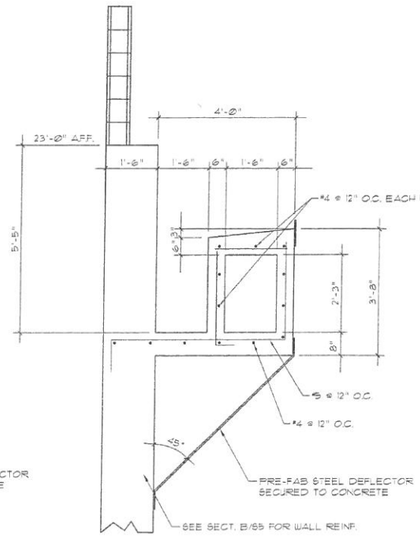
DATE	PROJ. NO.	SCALE/SHOWN	DWG. NO.
12/30/02	C5901		S1
REVISION DATE: 02/11/03		CAD FILE: 02-105	



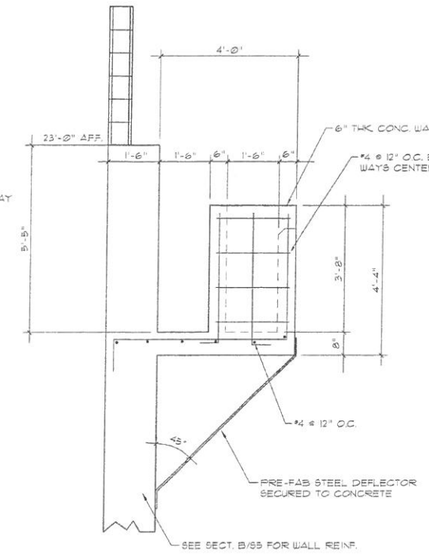
INTERMEDIATE SLAB PLAN
SCALE: 1/8" = 1'-Ø"



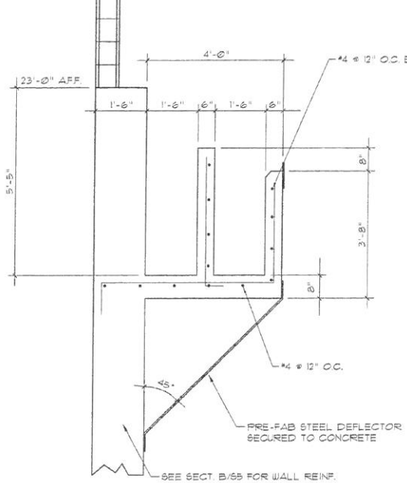
SECTION (A/S2)
SCALE: ½" = 1'-Ø"



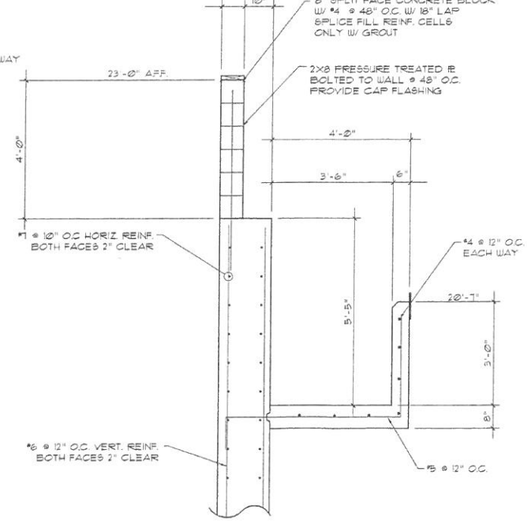
SECTION (B/S2)
SCALE: ½" = 1'-Ø"



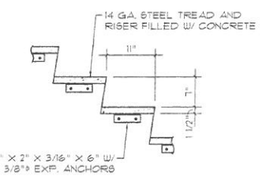
SECTION (C/S2)
SCALE: ½" = 1'-Ø"



SECTION (D/S2)
SCALE: ½" = 1'-Ø"



SECTION (E/S2)
SCALE: ½" = 1'-Ø"



TYP. STAIR DETAIL
SCALE: ¾" = 1'-Ø"

H. S. FELDMAN, Inc.
Water and Wastewater Facilities
Design/Build, Operations and Maintenance
341 Monroe Highway — PHONE: 770-868-0863
Winder, Georgia 30680 FAX: 770-868-0953

QUALIFLUENT
WASTEWATER TREATMENT FACILITY

NO.	DATE	REVISION
1	2/11/03	GENERAL REVISIONS

PIEDMONT WATER FACILITY
CAREY STATION URBAN WATER REUSE FACILITY
INTERMEDIATE SLAB PLAN

DATE	PROJ. NO.	SCALE:	DWG. NO.
12/30/02	C3001	SHOWN	S2

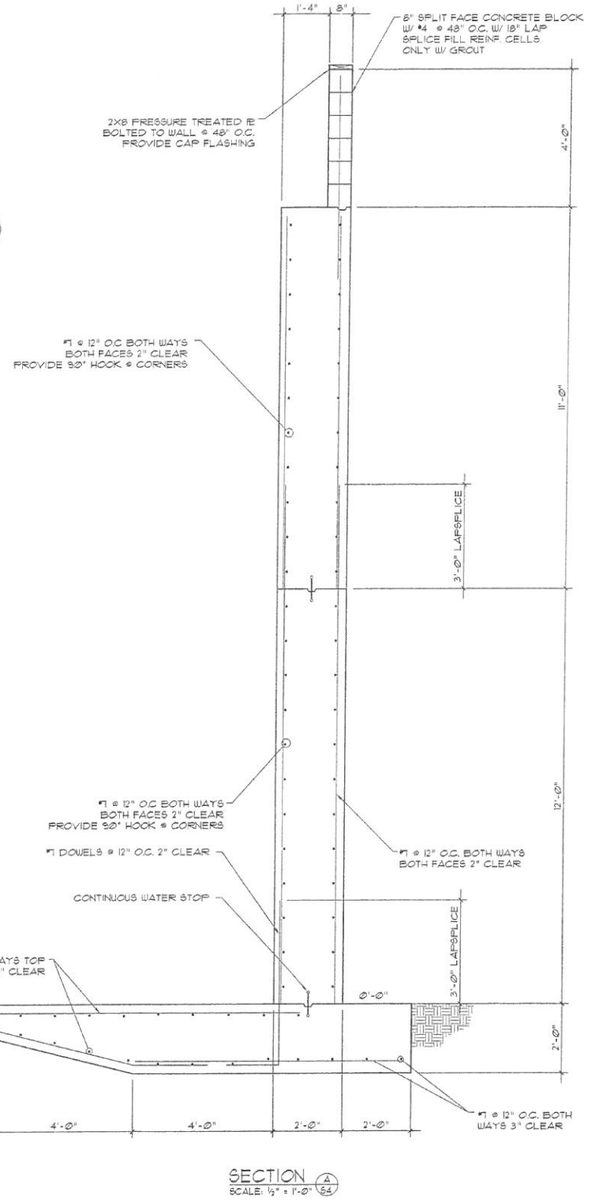
REVISION DATE: 02/11/03 — CAD FILE: 02-185

KEI
Kornegay Engineering Inc.
Structural Consultant
363 Pierce Avenue
Macon, GA 31204
(912) 745-6161
FAX 745-4744
Project No: 02185

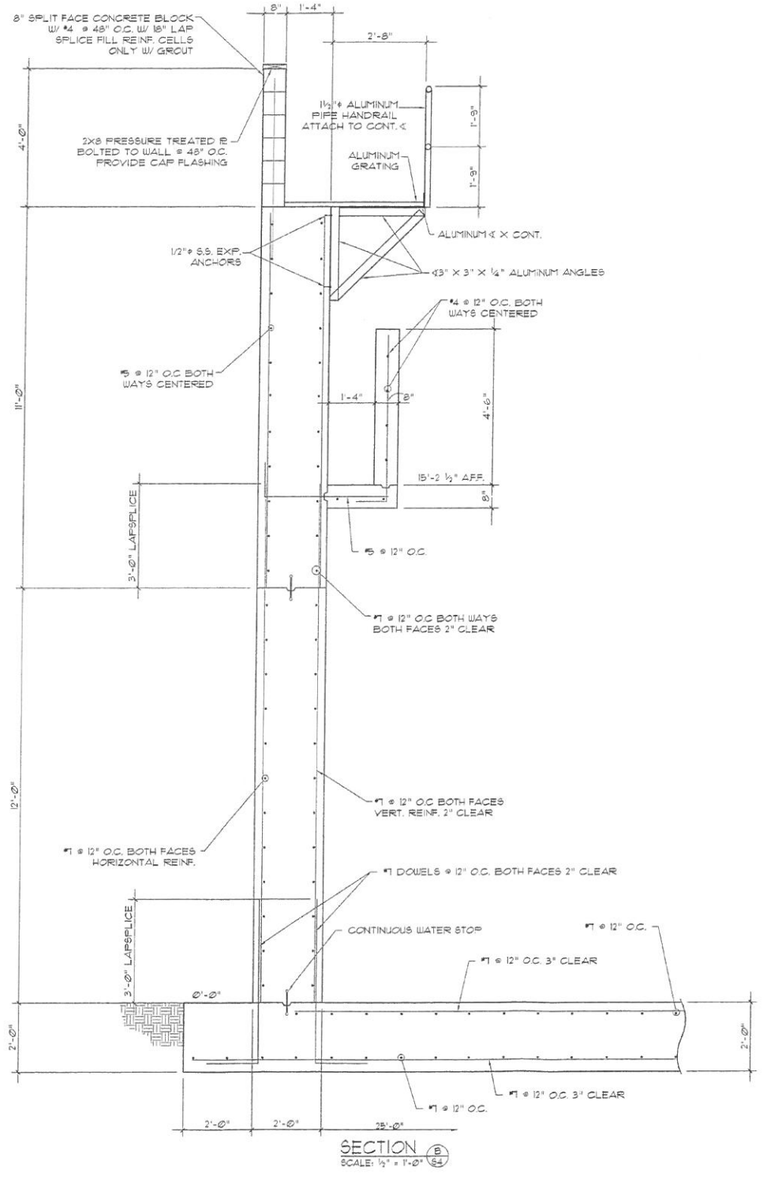
REGISTERED PROFESSIONAL ENGINEER No. 17363 GEORGIA DAN KORNEGAY

KEI
Kornegay Engineering Inc.
Structural Consultant
363 Pierce Avenue
Macon, GA 31204
(912) 745-6161
FAX 745-4744
Project No: 02185

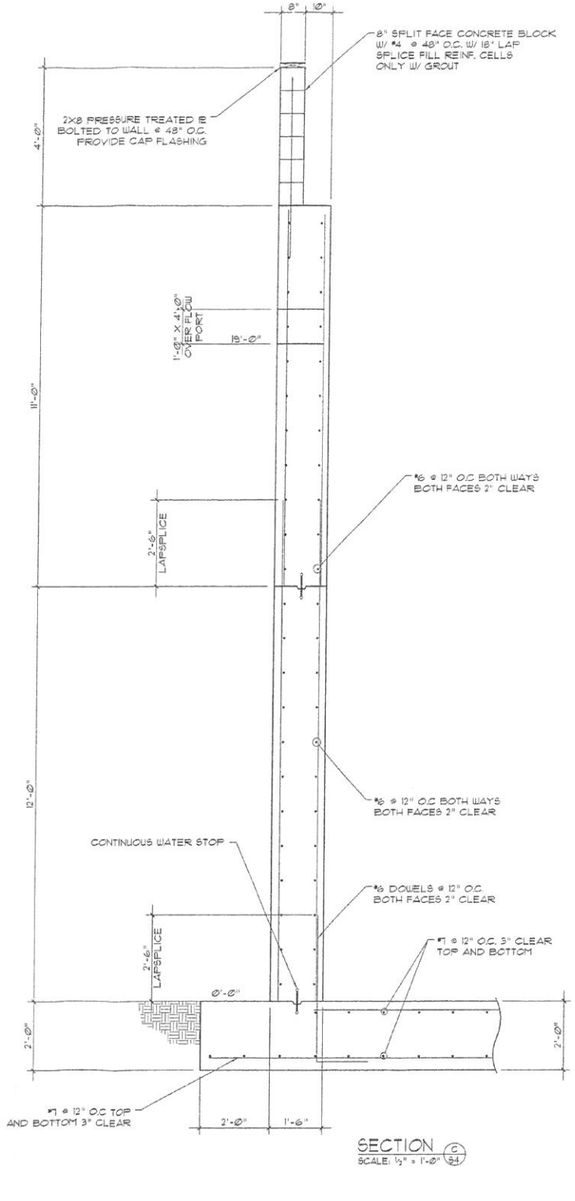
GEORGIA REGISTERED No 11263 PROFESSIONAL ENGINEER JOHN A. DAN KORNEGAY



SECTION A
SCALE: ½" = 1'-Ø" S4



SECTION B
SCALE: ½" = 1'-Ø" S4



SECTION C
SCALE: ½" = 1'-Ø" S4

H. S. FELDMAN, Inc.
Water and Wastewater Facilities
Design/Build, Operations and Maintenance
341 Monroe Highway
Winder, Georgia 30680
PHONE: 770-868-0863
FAX: 770-868-0953

QUALIFLUENT
WASTEWATER TREATMENT FACILITY

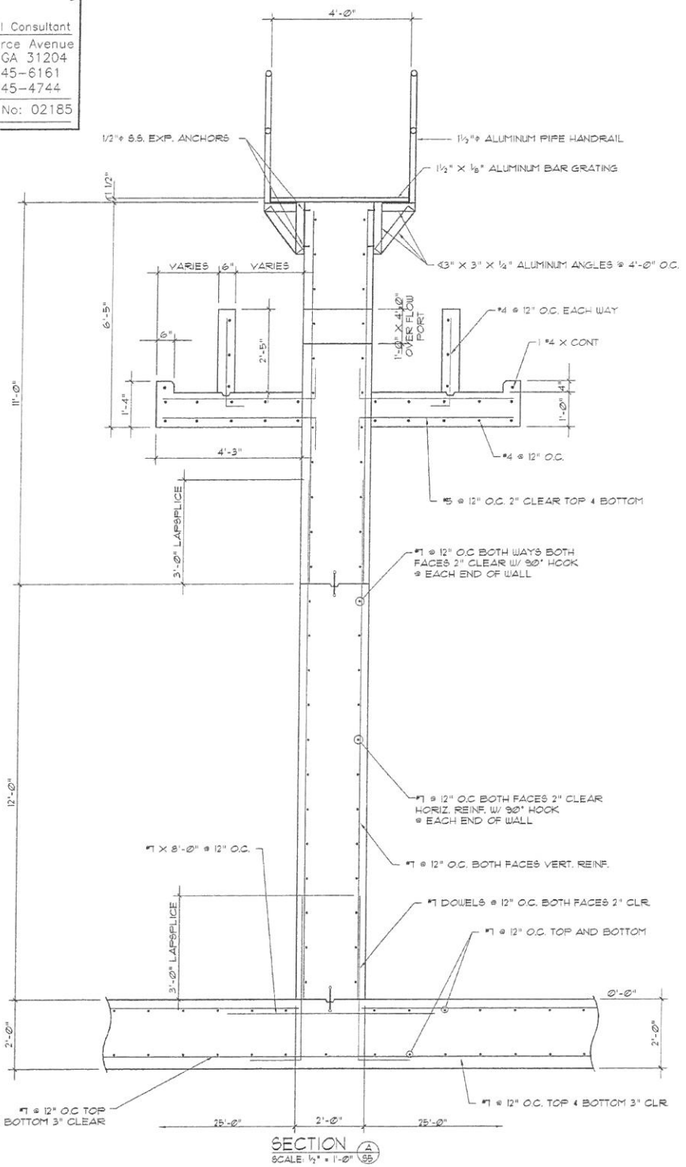
NO.	DATE	REVISION
1	2/11/03	GENERAL REVISIONS

PIEDMINT WATER FACILITY
CAREY STATION URBAN WATER REUSE FACILITY
SECTIONS

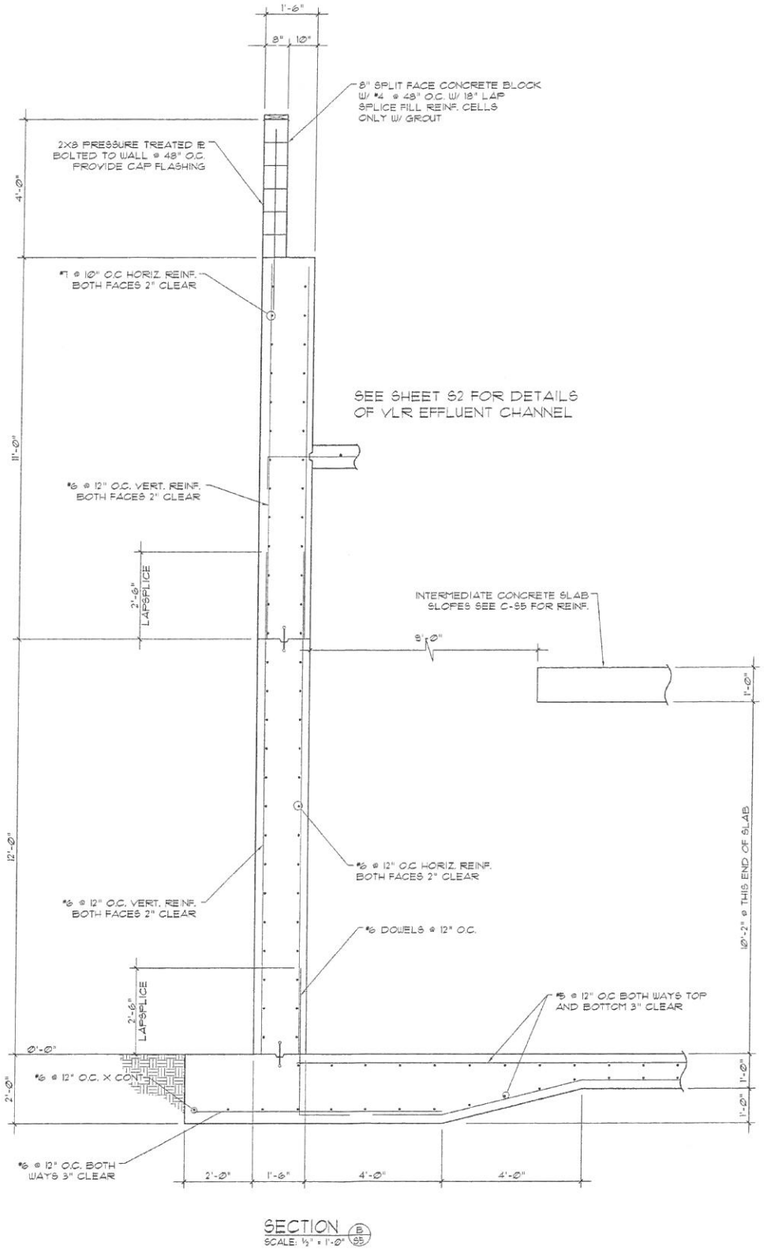
DATE	PROJ. NO	SCALE	DWG. NO
10/30/02	C9001	SHOWN	S4
REVISION DATE: 02/11/03		CAD FILE: 02-185	

KEI
Kornegay Engineering Inc.
Structural Consultant
363 Pierce Avenue
Macon, GA 31204
(912) 745-6161
FAX 745-4744
Project No: 02185

GEORGIA REGISTERED No. 11253 PROFESSIONAL ENGINEER HARRY DEAN KORNEGAY

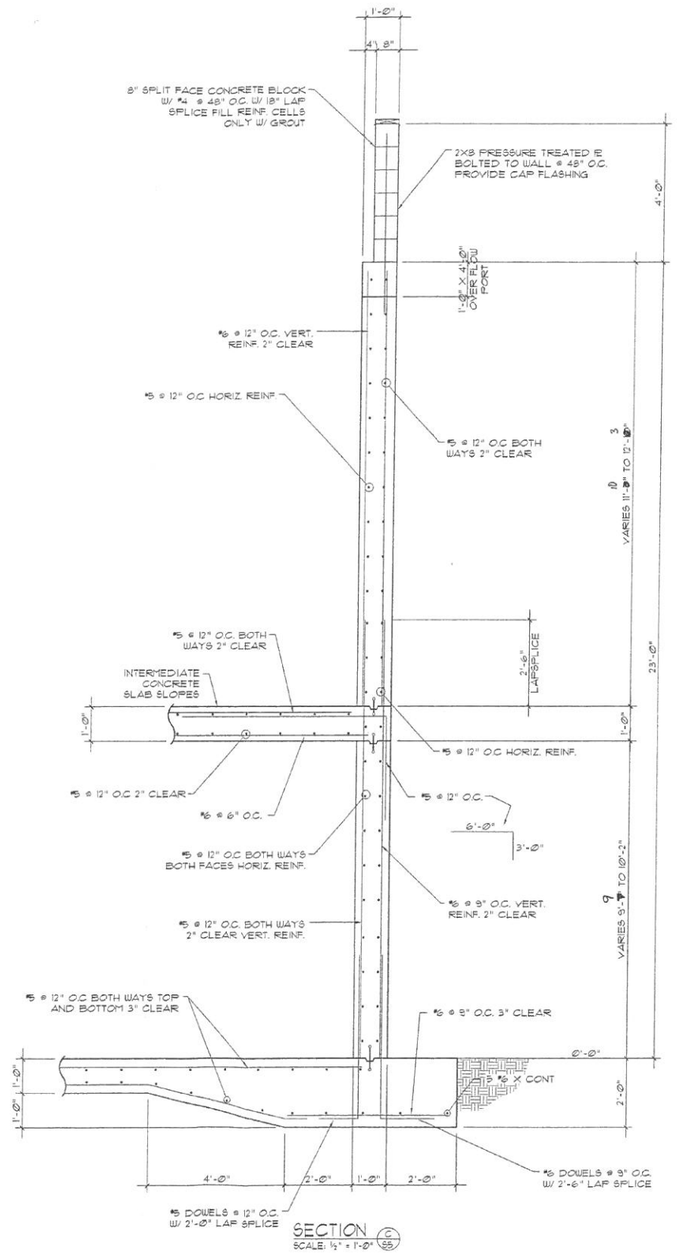


SECTION (A/S5)
SCALE: ½" = 1'-Ø"



SEE SHEET S2 FOR DETAILS OF VLR EFFLUENT CHANNEL

SECTION (B/S5)
SCALE: ½" = 1'-Ø"



SECTION (C/S5)
SCALE: ½" = 1'-Ø"

H. S. FELDMAN, Inc.
Water and Wastewater Facilities
Design/Build, Operations and Maintenance
341 Monroe Highway
Winder, Georgia 30680
PHONE: 770-868-0863
FAX: 770-868-0953

QUALIFLUENT
WASTEWATER TREATMENT FACILITY

NO.	DATE	REVISION
1	2/11/03	GENERAL REVISIONS

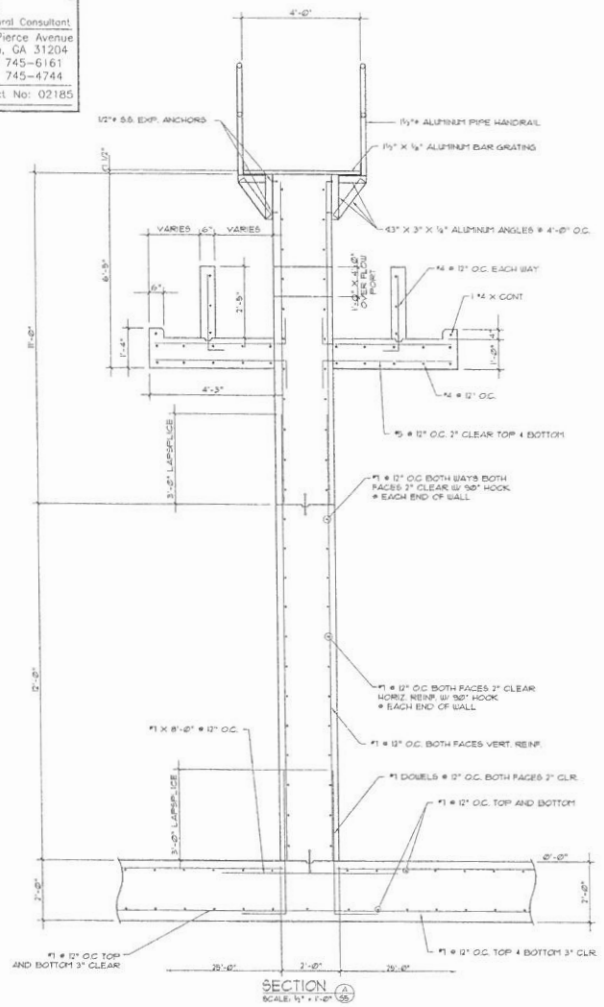
PIEDMONT WATER FACILITY
CAREY STATION URBAN WATER REUSE FACILITY
SECTIONS

DATE	PROJ. NO.	SCALE	DWG. NO.
10/30/02	C5001	SHOWN	S5

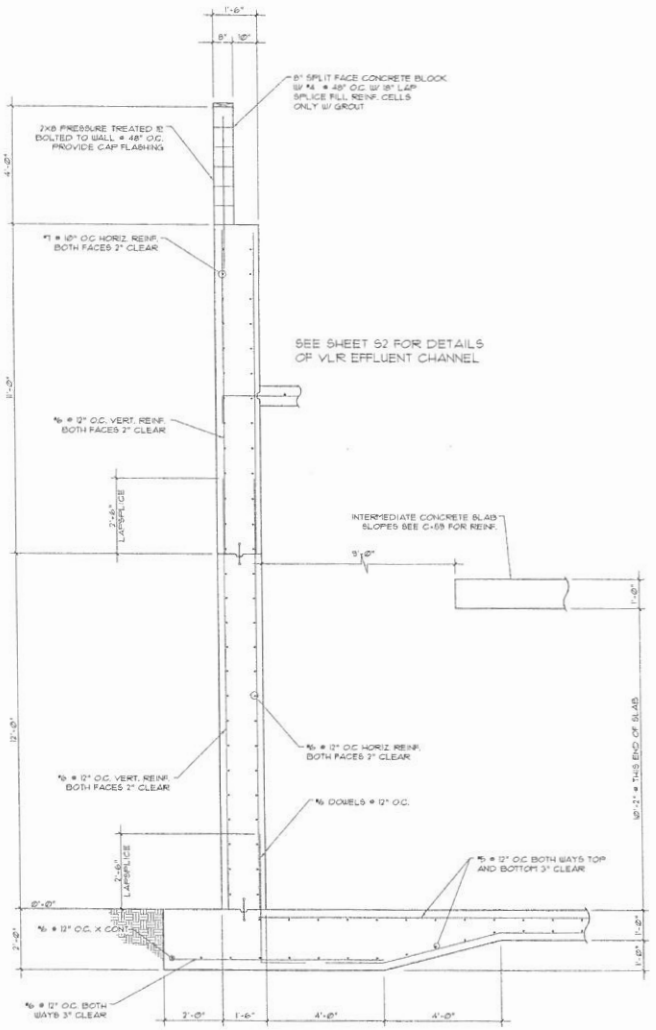
REVISION DATE: 02/11/03 | CAD FILE: 02-185

KEI
Kornegay Engineering Inc.
Structural Consultant
363 Pierce Avenue
Macon, GA 31204
(912) 745-6161
FAX 745-4744
Project No: 02185

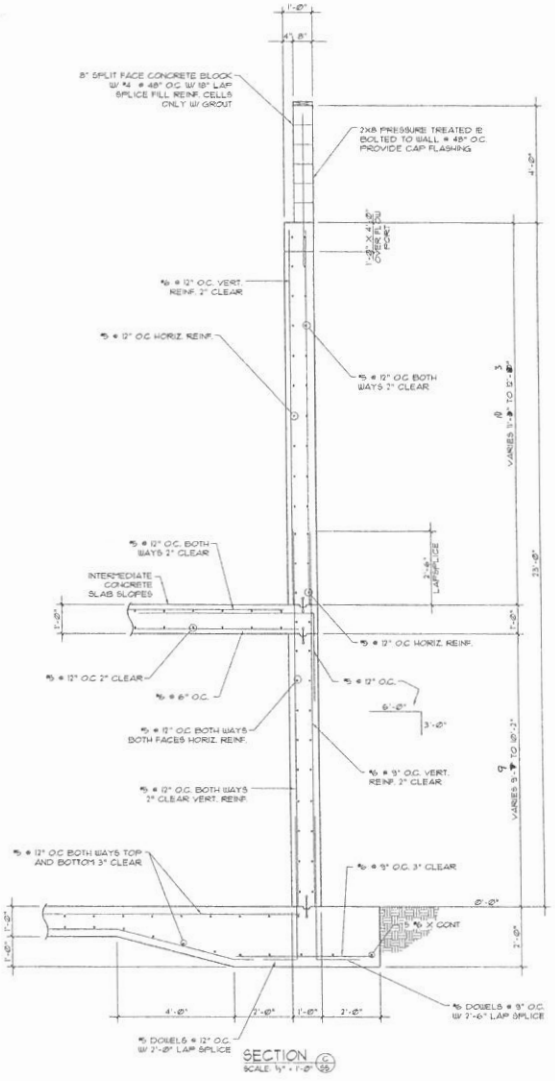
GEORGIA REGISTERED No. 11253 PROFESSIONAL ENGINEER



SECTION
SCALE: ½" = 1'-0" (A/S5)



SECTION
SCALE: ½" = 1'-0" (B/S5)



SECTION
SCALE: ½" = 1'-0" (C/S5)

H. S. FELDMAN, Inc.
Water and Wastewater Facilities
Design/Build, Operations and Maintenance
341 Monroe Highway
Winder, Georgia 30680
PHONE: 770-868-0863
FAX: 770-868-0953

QUALIFLUENT
WASTEWATER TREATMENT FACILITY

NO.	DATE	REVISION
1	2/11/03	GENERAL REVISIONS

PIEDMONT WATER FACILITY
CAREY STATION URBAN WATER REUSE FACILITY
SECTIONS

DATE	PROJ. NO	SCALE	DWG. NO
10/30/02	C0211	3/4"=1'-0"	S5
REVISION DATE: 2/11/03			CAD FILE: 12-185

Appendix B

SECTION 32 05 19 – GEOSYNTHETICS FOR EXTERIOR IMPROVMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This specification includes furnishing and installing HDPE and LLDPE geomembranes with a formulated sheet density of 0.940 g/cc or greater associated with HDPE geomembranes and a formulated sheet density of 0.939 or less for LLDPE geomembranes.

1.2 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM):

1. D 638, Standard Test Method for Tensile Properties of Plastics.
2. D 751, Standard Test Methods for Coated Fabrics.
3. D 792, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
4. D 1004, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
5. D 1204, Standard Test Method for Linear Dimensional Changes of Non Rigid Thermoplastic Sheeting or Film at Elevated Temperature.
6. D 1238, Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
7. D 1505, Standard Test Method for Density of Plastics by Density-Gradient Technique.
8. D 1603, Standard Test Method for Carbon Black in Olefin Plastics.
9. D 3895, Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.
10. D 4218, Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
11. D 4437, Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
12. D 4833, Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.
13. D 5199, Standard Test Method for Measuring Nominal Thickness of Smooth Geomembranes.
14. D 5397, Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefins using Notched Constant Tensile Load Test.
15. D 5596, Standard Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds.
16. D 5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
17. D 5721, Practice for Air-Oven Aging of Polyolefin Geomembranes.
18. D 5820, Test Method for Air Testing.
19. D 5885, Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.
20. D 5994, Standard Test Method for Measuring Nominal Thickness of Textured Geomembranes
21. D 6365, Standard Practice for the Nondestructive Testing of Geomembrane Seams using The Spark Test

22. D5820-95, Pressurized Air Channel Test for Dual Seamed Geomembranes

B. Geosynthetic Research Institute (GRI):

1. GRI GM 9, Cold Weather Seaming of Geomembranes
2. GRI GM 10, The Stress Crack Resistance of HDPE Geomembrane Sheet
3. GRI GM 13, Test Properties, Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
4. GRI GM 14, Test Frequencies for Destructive Seam Testing Selecting, variable intervals for taking geomembrane destructive samples using the method of attributes.
5. GRI GM 12, Measurement of the Asperity Height of Textured Geomembranes Using a Depth Gage
6. GRI GM 17, Test Methods, Test Properties and Testing Frequency for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes
7. GRI GM 19, Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes

1.3 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 31 25 00 – Erosion and Sedimentation Controls
2. Section 33 31 00 – Sanitary Utility Sewerage Piping
3. Section 33 05 13 – Manholes and Structures

1.4 QUALIFICATIONS

A. Manufacturer's Qualifications: The manufacturer of geomembrane of the type specified or similar product shall have at least five years experience in the manufacture of such geomembrane. In addition, the geomembrane manufacturer shall have manufactured at least 1,000,000 M^2 (10,000,000 FT^2) of the specified type of geomembrane or similar product during the last five years.

B. Installer's Qualifications

1. The Geomembrane Installer shall be the Manufacturer, approved Manufacturer's Installer or a contractor approved by the Owner's Representative to install the geomembrane.
2. The Geomembrane Installer shall have at least three years experience in the installation of the specified geomembrane or similar. The Geomembrane Installer shall have installed at least 10 projects involving a total of 5,000,000 ft^2 of the specified type of geomembrane or similar during the last three years.
3. Installation shall be performed under the direction of a field Installation Supervisor who shall be responsible throughout the geomembrane installation, for geomembrane panel layout, seaming, patching, testing, repairs, and all other activities of the Geomembrane Installer. The Field Installation Supervisor shall have installed or supervised the

installation and seaming of a minimum of 10 projects involving a total of 5,000,000 ft^2 of geomembrane of the type specified or similar product.

4. Seaming shall be performed under the direction of a Master Seamer (who may also be the Field Installation Supervisor or Crew Foreman) who has seamed a minimum of 3,000,000 ft^2 of geomembrane of the type specified or similar product, using the same type of seaming apparatus to be used in the current project. The Field Installation Supervisor and/or Master Seamer shall be present whenever seaming is performed.
5. All seaming, patching, other welding operations, and testing shall be performed by qualified technicians employed by the Geomembrane Installer.

1.5 SUBMITTALS

A. Submit the following items in accordance with Section 01 33 00

B. Submit the following to the Engineer or Owner, for review and approval, within a reasonable time so as to expedite shipment or installation of the Geomembrane:

1. Documentation of manufacturer's qualifications.
2. Manufacturer's Quality Control program manual or descriptive documentation.
3. A material properties sheet, including at a minimum all properties specified in GRI GM 13, including test methods used.
4. Sample of the material.
5. Documentation of Installer's qualifications.

    a. Submit a list of at least ten completed facilities. For each installation, provide: name and type of facility; its location; the date of installation; name and telephone number of contact at the facility; type and thickness of geomembrane and; surface area of the installed geomembrane.
    b. Submit resumes or qualifications of the Installation Supervisor, Master Seamer and Technicians to be assigned to this project.
    c. Quality Control Program.

6. Example Material Warranty and Liner Installation Warranty

C. Shop Drawings

1. Submit copies of shop drawings for engineer's approval within a reasonable time so as not to delay the start of geomembrane installation. Shop drawings shall show the proposed panel layout identifying seams and details. Seams should generally follow the direction of the slope. Butt seams or roll-end seams should not occur on a slope unless approved by the Owner's Representative. Butt seams on a slope, if allowed, should be staggered.
2. Placement of geomembrane should not be allowed to proceed until Owner's Representative has received and approved the shop drawings.

D. Additional Submittals (In-Progress and at Completion)

1. Manufacturer's warranty.
2. Geomembrane installation warranty.
3. Daily written acceptance of subgrade surface.

4. Low-temperature seaming procedures if applicable.
5. Prequalification test seam samples.
6. Field seam non-destructive test results.
7. Field seam destructive test results.
8. Daily field installation reports.
9. Installation record drawing.

1.6 DELIVERY, STORAGE AND HANDLING

A. Each roll of geomembrane delivered to the site shall be labeled by the manufacturer. The label shall be firmly affixed and shall clearly state the manufacturer's name, product identification, material thickness, roll number, roll dimensions and roll weight.

B. Geomembrane shall be protected from mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.

C. Rolls shall be stored away from high traffic areas. Continuously and uniformly support rolls on a smooth, level prepared surface.

1.7 PROJECT CONDITIONS

A. Geomembrane should not be installed in the presence of standing water, while precipitation is occurring, during excessive winds, or when material temperatures are outside the limits specified in Section 3.3.

1.8 WARRANTY

A. The manufacturer shall provide a 20-year prorated warranty on the geomembrane material. The warranty shall take effect upon project substantial completion.

B. The Geomembrane Installer shall guarantee the geomembrane installation against defects in the installation and workmanship for 1-year commencing with the date of final acceptance.

PART 2 - PRODUCTS

2.1 GEOMEMBRANCE

A. Manufacture
1. Agru America
2. Or Equal

B. The geomembrane shall consist of new, first quality products designed and manufactured specifically for the purpose of this work which shall have been satisfactorily demonstrated by prior testing to be suitable and durable for such purposes. The geomembrane rolls shall be seamless, high density polyethylene (HDPE - Formulated Sheet Density $\geq$ 0.94g/cc) or linear low density polyethylene (LLDPE - Formulated Sheet Density $\leq$ 0.939 g/cc) containing no

plasticizers, fillers or extenders and shall be free of holes, blisters or contaminants, and leak free verified by 100% in line spark or equivalent testing. The geomembrane shall be supplied as a continuous sheet with no factory seams in rolls.

C. Material conformance testing by the Owner's Representative, if required, will be conducted using in-plant sampling or as specified for the project.

2.2 GEOTEXTILE

A. Manufacture
1. Agru America - AGRUTEX
2. Or Equal

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

A. The subgrade shall be prepared in accordance with the project specifications. The geomembrane subgrade shall be uniform and free of sharp or angular objects that may damage the geomembrane prior to installation of the geomembrane.

B. Geotextiles may be used to compensate for irregular subgrades.

C. The Geomembrane Installer and Owner's Representative shall inspect the surface to be covered with the geomembrane on each day's operations prior to placement of geomembrane to verify suitability.

D. The Geomembrane Installer and Owner's Representative shall provide daily written acceptance for the surface to be covered by the geomembrane in that day's operations. The surface shall be maintained in a manner, during geomembrane installation, to ensure subgrade suitability.

E. All subgrade damaged by construction equipment and deemed unsuitable for geomembrane deployment shall be repaired prior to placement of the geomembrane. All repairs shall be approved by the Owner's Representative and the Geomembrane Installer. This damage, repair, and the responsibilities of the contractor and Geomembrane Installer shall be defined in the preconstruction meeting.

3.2 GEOMEMBRANE PLACEMENT

A. The geomembrane shall be installed to the limits shown on the project drawings and essentially as shown on approved panel layout drawings.

B. No geomembrane material shall be unrolled and deployed if the material temperatures are lower than 32 degrees F unless otherwise approved by the Owner's Representative. The specified minimum temperature for material deployment may be adjusted by the Owner's Representative. Temperature limitations should be defined in the preconstruction meeting. Typically, only the

quantity of geomembrane that will be anchored and seamed together in one day should be deployed.

C. No vehicular traffic shall travel on the geomembrane other than an approved low ground pressure Vehicle or equivalent.

D. Sand bags or equivalent ballast shall be used as necessary to temporarily hold the geomembrane material in position under the foreseeable and reasonably - expected wind conditions. Sand bag material shall be sufficiently close- knit to prevent soil fines from working through the bags and discharging on the geomembrane.

E. Geomembrane placement shall not be done if moisture prevents proper subgrade preparation, panel placement, or panel seaming. Moisture limitations should be defined in the preconstruction meeting.

F. Damaged panels or portions of the damaged panels which have been rejected shall be marked and their removal from the work area recorded.

G. The geomembrane shall not be allowed to "bridge over" voids or low areas in the subgrade. The geomembrane shall rest in intimate contact with the subgrade.

H. Wrinkles caused by panel placement or thermal expansion should be minimized.

I. In general, seams shall be oriented parallel to the line of the maximum slope. In corners and odd shaped geometric locations, the total length of field seams shall be minimized. Seams shall not be located at low points in the subgrade unless geometry requires seaming at such locations and if approved by the Owner's Representative.

J. Overlapping: The panels shall be overlapped prior to seaming to whatever extent is necessary to affect a good weld and allow for proper testing. In no case shall this overlap be less than 3 in..

3.3 SEAMING PROCEDURES

A. Cold weather installations should follow guidelines as outlined in GRI GM9.

B. No geomembrane material shall be seamed when liner temperatures are less than 32 degrees F unless the following conditions are complied with:

1. Seaming of the geomembrane at material temperatures below 32 degrees F is allowed if the Geomembrane Installer can demonstrate to the Owner's Representative, using pre-qualification test seams, that field seams comply with the project specifications, the safety of the crew is ensured, and geomembrane material can be fabricated (i.e. pipeboots, penetrations, repairs. etc.) at sub-freezing temperatures.
2. The Geomembrane Installer shall submit to the Owner's Representative for approval, detailed procedures for seaming at low temperatures, possibly including the following:

    a. Preheating of the geomembrane
    b. The provision of a tent or other device if necessary to prevent heat losses during seaming and rapid heat losses subsequent to seaming.

c. Number of test welds to determine appropriate seaming parameters

C. No geomembrane material shall be seamed when the sheet temperature is above 170 degrees F as measured by an infrared thermometer or surface thermocouple unless otherwise approved by the Owner's Representative. This approval will be based on recommendations by the manufacturer and on a field demonstration by the Geomembrane Installer using prequalification test seams to demonstrate that seams comply with the specification.

D. Seaming shall primarily be performed using automatic fusion welding equipment and techniques. Extrusion welding shall be used where fusion welding is not possible such as at pipe penetrations, patches, repairs and short (less than a roll width) runs of seams.

E. Fishmouths or excessive wrinkles at the seam overlaps shall be minimized and when necessary cut along the ridge of the wrinkles back into the panel so as to effect a flat overlap. The cut shall be terminated with a keyhole cut (nominal 10 mm (1/2 in) diameter hole) so as to minimize crack/tear propagation. The overlay shall subsequently be seamed. The key hole cut shall be patched with an oval or round patch of the same base geomembrane material extending a minimum of 150 mm (6 in.) beyond the cut in all directions.

3.4 PIPE AND STRUCTURE PENETRATION SEALING SYSTEM

A. Provide penetration sealing system as shown in the Project Drawings.

B. Penetrations shall be constructed from the base geomembrane material, flat stock, prefabricated boots and accessories as shown on the Project Drawings. The pre-fabricatedor field fabricated assembly shall be field welded to the geomembrane as shown on the Project Drawings so as to prevent leakage. This assembly shall be tested as outlined in section 3.5.C. Alternatively, where field non destructive testing cannot be performed, attachments will be field spark tested by standard holiday leak detectors in accordance with ASTM 6365 Spark testing should be done in areas where both air pressure testing and vacuum testing are not possible.

1. Equipment for Spark testing shall be comprised of but not limited to: A hand held holiday spark tester and conductive wand that generates a high voltage.
2. The testing activities shall be performed by the Geomembrane Installer by placing an electrically conductive tape or wire beneath the seam prior to welding. A trial seam containing a non welded segment shall be subject to a calibration test to ensure that such a defect (non welded segment) will be identified under the planned machine settings and procedures. Upon completion of the weld, enable the spark tester and hold approximately 25mm (1 in) above the weld moving slowly over the entire length of the weld in accordance with ASTM 6365. If there is no spark the weld is considered to be leak free.
3. A spark indicates a hole in the seam. The faulty area shall be located, repaired and retested by the Geomembrane Installer.
4. Care should be taken if flammable gases are present in the area to be tested.

3.5 FIELD QUALITY CONTROL

A. The Owner's Representative shall be notified prior to all pre qualification and production welding and testing, or as agreed upon in the pre construction meeting.

B. Prequalification Test Seams

1. Test seams shall prepare and tested by the Geomembrane Installer to verify that seaming parameters (speed, temperature and pressure of welding equipment) are adequate.
2. Test seams shall be made by each welding technician and tested in accordance with ASTM D 4437 at the beginning of each seaming period. Test seaming shall be performed under the same conditions and with the same equipment and operator combination as production seaming. The test seam shall be approximately 10 feet long for fusion welding and 3 feet long for extrusion welding with the seam centered lengthwise. At a minimum, tests seams should be made by each technician 1 time every 4–6 hours; additional tests may be required with changes in environmental conditions.
3. Two 1 in wide specimens shall be die-cut by the Geomembrane Installer from each end of the test seam. These specimens shall be tested by the Geomembrane Installer using a field tensiometer testing both tracks for peel strength and also for shear strength. Each specimen should fail in the parent material and not in the weld, "Film Tear Bond" (F.T.D. failure). Seam separation equal to or greater than 25% of the track width shall be considered a failing test.
4. The minimum acceptable seam strength values to be obtained for all specimens tested are listed in Subsection 3.6.D.4 of this Section. Four specimens shall pass for the test seam to be a passing seam.
5. If a test seam fails, an additional test seam shall be immediately conducted. If the additional test seam fails, the seaming apparatus shall be rejected and not used for production seaming until the deficiencies are corrected and a successful test seam can be produced.
6. A sample from each test seam shall be labeled. The label shall indicate the date, geomembrane temperature, number of the seaming unit, technician performing the test seam and pass or fail description. The sample shall then be given to the Owner's Representative for archiving.

C. Field Seam Non-destructive Testing

1. All field seams shall be non-destructively tested by the Geomembrane Installer over the full seam length before the seams are covered. Each seam shall be numbered or otherwise designated. The location, date, test unit, name of tester and outcome of all non-destructive testing shall be recorded and submitted to the Owner's Representative.
2. Testing should be done as the seaming work progresses, not at the completion of all field seaming, unless agreed to in advance by the Owner's Representative. All defects found during testing shall be numbered and marked immediately after detection. All defects found should be repaired, retested and remarked to indicate acceptable completion of the repair.
3. Non-destructive testing shall be performed using vacuum box, air pressure or spark testing equipment.
4. Non-destructive tests shall be performed by experienced technicians familiar with the specified test methods. The Geomembrane Installer shall demonstrate to the Owner's Representative all test methods to verify the test procedures are valid.
5. Extrusion seams shall be vacuum box tested by the Geomembrane Installer in accordance with ASTM D 4437 and ASTM D 5641 with the following equipment and procedures:

    a. Equipment for testing extrusion seams shall be comprised of but not limited to: a vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket attached to the base, port hole or valve assembly and a vacuum

gauge; a vacuum pump assembly equipped with a pressure controller and pipe connections; a rubber pressure/vacuum hose with fittings and connections; a plastic bucket; wide paint brush or mop; and a soapy solution.

b. The vacuum pump shall be charged and the tank pressure adjusted to approximately 35 kPa (5 psig).

c. The Geomembrane Installer shall create a leak tight seal between the gasket and geomembrane interface by wetting a strip of geomembrane approximately 12 in by 48 in (length and width of box) with a soapy solution, placing the box over the wetted area, and then compressing the box against the geomembrane. The Geomembrane Installer shall then close the bleed valve, open the vacuum valve, maintain initial pressure of approximately 35 kPa (5 psig) for approximately 5 seconds. The geomembrane should be continuously examined through the viewing window for the presence of soap bubbles, indicating a leak. If no bubbles appear after 5 seconds, the area shall be considered leak free. The box shall be depressurized and moved over the next adjoining area with an appropriate overlap and the process repeated.

d. All areas where soap bubbles appear shall be marked, repaired and then retested.

e. At locations where seams cannot be non-destructively tested, such as pipe penetrations, alternate nondestructive spark testing (as outlined in section 3.5.B) or equivalent should be substituted.

f. All seams that are vacuum tested shall be marked with the date tested, the name of the technician performing the test and the results of the test.

6. Double Fusion seams with an enclosed channel shall be air pressure tested by the Geomembrane Installer in accordance with ASTM D 5820 and ASTM D 4437 and the following equipment and procedures:

a. Equipment for testing double fusion seams shall be comprised of but not limited to: an air pump equipped with a pressure gauge capable of generating and sustaining a pressure of 210 kPa (30 psig), mounted on a cushion to protect the geomembrane; and a manometer equipped with a sharp hollow needle or other approved pressure feed device.

b. The Testing activities shall be performed by the Geomembrane Installer. Both ends of the seam to be tested shall be sealed and a needle or other approved pressure feed device inserted into the tunnel created by the double wedge fusion weld. The air pump shall be adjusted to a pressure of 210 kPa (30 psig), and the valve closed,. Allow 2 minutes for the injected air to come to equilibrium in the channel, and sustain pressure for 5 minutes. If pressure loss does not exceed 28 kPa (4 psig) after this five minute period the seam shall be considered leak tight. Release pressure from the opposite end verifying pressure drop on needle to ensure testing of the entire seam. The needle or other approved pressure feed device shall be removed and the feed hole sealed.

c. If loss of pressure exceeds 28 kPa (4 psig) during the testing period or pressure does not stabilize, the faulty area shall be located, repaired and retested by the Geomembrane Installer.

d. Results of the pressure testing shall be recorded on the liner at the seam tested and on a pressure testing record.

D. Destructive Field Seam Testing

1. One destructive test sample per 500 linear ft seam length or another predetermined length in accordance with GRI GM 14 shall be taken by the Geomembrane Installer from a location specified by the Owner's Representative. The Geomembrane Installer shall not be informed in advance of the sample location. In order to obtain test results prior to completion of geomembrane installation, samples shall be cut by the Geomembrane Installer as directed by the Owner's Representative as seaming progresses.
2. All field samples shall be marked with their sample number and seam number. The sample number, date, time, location, and seam number shall be recorded. The Geomembrane Installer shall repair all holes in the geomembrane resulting from obtaining the seam samples. All patches shall be vacuum box tested or spark tested. If a patch cannot be permanently installed over the test location the same day of sample collection, a temporary patch shall be tack welded or hot air welded over the opening until a permanent patch can be affixed.
3. The destructive sample size shall be 12 in wide by 36 in long with the seam centered lengthwise. The sample shall be cut into three equal sections and distributed as follows: one section given to the Owner's Representative as an archive sample; one section given to the Owner's Representative for laboratory testing as specified in paragraph 5 below; and one section retained by the Geomembrane Installer for field testing as specified in paragraph 4 below.
4. For field testing, the Geomembrane Installer shall cut 10 identical 1 in wide replicate specimens from his sample. The Geomembrane Installer shall test five specimens for seam shear strength and five for peel strength. Peel tests will be performed on both inside and outside weld tracks. To be acceptable, 4 of 5 test specimens must pass the stated criteria in section 2.1 with less than 25% separation. If 4 of 5 specimens pass, the sample qualifies for testing by the testing laboratory if required.
5. If independent seam testing is required by the specifications it shall be conducted in accordance with ASTM 5820 or ASTM D4437.
6. Reports of the results of examinations and testing shall be prepared and submitted to the Owner's Representative.
7. For field seams, if a laboratory test fails, that shall be considered as an indicator of the possible inadequacy of the entire seamed length corresponding to the test sample. Additional destructive test portions shall then be taken by the Geomembrane Installer at locations indicated by the Engineer; typically 10ft on either side of the failed sample and laboratory seem tests shall be performed. Passing tests shall be an indicator of adequate seams. Failing tests shall be an indicator of non-adequate seams and all seams represented by the destructive test location shall be repaired with a cap-strip extrusion welded to all sides of the capped area. All cap-strip seams shall be non-destructively vacuum box tested until adequacy of the seams is achieved. Cap strip seams exceeding 150 ft in length shall be destructively tested.

E. D. Identification of Defects

1. Panels and seams shall be inspected by the Installer and Owner's Representative during and after panel deployment to identify all defects, including holes, blisters, undispersed raw materials and signs of contamination by foreign matter.

F. Evaluation of Defects: Each suspect location on the liner (both in geomembrane seam and non-seam areas) shall be non-destructively tested using one of the methods described in Section 3.6.B. Each location which fails non-destructive testing shall be marked, numbered, measured and posted on the daily "installation" drawings and subsequently repaired.

1. If a destructive sample fails the field or laboratory test, the Geomembrane Installer shall repair the seam between the two nearest passed locations on both sides of the failed destructive sample location.
2. Defective seams, tears or holes shall be repaired by reseaming or applying a extrusion welded cap strip.
3. Reseaming may consist of either:

    a. Removing the defective weld area and rewelding the parent material using the original welding equipment; or
    b. Reseaming by extrusion welding along the overlap at the outside seam edge left by the fusion welding process.

4. Blisters, larger holes, and contamination by foreign matter shall be repaired by patches and/or extrusion weld beads as required. Each patch shall extend a minimum of 6 in beyond all edges of the defects.
5. All repairs shall be measured, located and recorded.

G. Verification of Repairs on Seams: Each repair shall be non-destructively tested using either vacuum box or spark testing methods. Tests which pass the non-destructivetest shall be taken as an indication of a successful repair. Failed tests shall be reseamed and retested until a passing test results. The number, date, location, technician and test outcome of each patch shall be recorded.

H. Daily Field Installation Reports: At the beginning of each day's work, the Installer shall provide the Engineer with daily reports for all work accomplished on the previous work day. Reports shall include the following:

1. Total amount and location of geomembrane placed;
2. Total length and location of seams completed, name of technicians doing seaming and welding unit numbers;
3. Drawings of the previous day's installed geomembrane showing panel numbers, seam numbers and locations of non-destructive and destructive testing;
4. Results of pre-qualification test seams;
5. Results of non-destructive testing; and
6. Results of vacuum testing of repairs.

I. Destructive test results shall be reported prior to covering of liner or within 48 hours.

3.6 LINER ACCEPTANCE

A. Geomembrane liner will be accepted by the Owner's Representative when:

1. The entire installation is finished or an agreed upon subsection of the installation is finished;
2. All Installer's QC documentation is completed and submitted to the owner
3. Verification of the adequacy of all field seams and repairs and associated geomembrane testing is complete.

3.7 ANCHOR TRENCH

A. Construct as specified on the project Drawings

3.8 DISPOSAL OF SCRAP MATERIALS

A. On completion of installation, the Geomembrane Installer shall dispose of all trash and scrap material in a location approved by the Owner, remove equipment used in connection with the work herein, and shall leave the premises in a neat acceptable manner. No scrap material shall be allowed to remain on the geomembrane surface.

END OF SECTION 32 05 19

Appendix C

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: ± 1/16 inch, measured at door rabbet on a line 90° from jamb perpendicular to frame head.
    b. Alignment: ± 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: ± 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: ± 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 ± 1/32 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch ± 1/32 inch.
    c. At Bottom of Door: 5/8 inch ± 1/32 inch.
    d. Between Door Face and Stop: 1/16 inch to 1/8 inch ± 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

Appendix D

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. Nomenclature

1. Manufacturer List

Code	Name
BE	Best Access Systems
DM	Dorma Door Controls
NA	National Guard
PR	Precision
ST	Stanley
TR	Trimco

2. Option List

Code	Name
36"	36" Door Width
3RO	Prefix option for 2000 Apex Series
B4E-HEAVY-KP	BEVELED 4 EDGES - KICK PLATES
CSK	COUNTER SINKING OF KICK and MOP PLATES
NFHD	Narrow Frame Bracket - Heavy Duty Arms
SNB (2)	SEX BOLTS (2)
VIB	Double Visual Indictor Option

3. Finish List

Code	Name
600	Primed for Painting
603	Zinc Plated
619	Satin Nickel Plated, Clear Coated
626	Satin Chromium Plated
630	Satin Stainless Steel
689	Aluminum Painted
AL	Aluminum

B. Hardware Set #1

1. Door #: 101A
2. Doors: Typical exterior single door

Qty	Unit	Product	Description	Color	Manufacturer
1	ea	Continuous Hinge	HD1100A x LAR		NA
1	ea	Lockset-Dormitory	45H-7T14H PATD	630	BE
1	ea	Closer w/ Spring Stop	8916 S-DS NFHD	689	DM
1	ea	Kick Plate	K0050 8" x 2" LDW B4E CSK	630	TR
1	ea	Door Sweep w/ Drip	C627 A x LAR		NA
1	ea	Drip Cap	16 A +4" ODW		NA
1	ea	Perimeter Gasketing	2525 C x LAR		NA
1	ea	Threshold	896 S x LAR	AL	NA

END OF SECTION 08 71 00

Appendix E

SECTION 07 41 13 – STANDING-SEAM METAL ROOF PANELS

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. Prefinished standing seam roof panels, trim, and all related work, of the following type:

   a. Formed roof panels with machine seamed sealed joints, at 16-inches on-center.
   b. Finished underside of panels where exposed to view, similar to topside, except 2-coat system (primer and color coats).

2. Scope - Roofing Systems: The work in the Section includes all labor, materials, accessories, services and incidentals necessary for supplying, installing and testing of the prefinished metal roofing system described herein. Provide prefinished - all flashing, fascia panels, caps, copings, curbs, trim, closures, gutter design, etc., which are associated with and/or come in contact with roofing system's components, in same base metal as roofing panels, and panels, and make watertight junctions with work of other trades.

   a. Curbs for mechanical equipment and other work as indicated or required by project conditions.

B. 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 05 50 00 - Metals Fabrication
   b. Section 07 92 00 - Joint Sealants
   c. Section 0 99 600 - High Performance Coatings

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide certified test results by a recognized testing laboratory or agency in accordance with specified test methods for each system.

B. Air Infiltration: Provide roof panel system with no air leakage when tested in accordance with ASTM E 283 at pressure differentials up to 1.57 psf.

C. Water Penetration: Provide panel systems with no water penetration as defined in the test method, when tested in accordance with ASTM E 331 at an inward static air pressure differential of not less than 6.24 psf and not more than 12.0 psf.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data including manufacturer's product specifications, standard details, certified product test results, installation instructions, and general recommendations, as applicable to materials and finishes for each component and for total panel system.

C. Shop Drawings specific to this project showing layouts of panels on roofs, details of edge conditions, joints, corners, panel profiles, supports, anchorages, trim, flashings, closures, and special details. Distinguish between factory and field assembly work. The manufacturer's technical engineering department shall approve the drawings before they are submitted.

1.5 QUALITY ASSURANCE

A. Wind Uplift: Provide roof panel system including supports meeting at least the requirements of Underwriters Laboratories, Inc. for Class 90 wind uplift resistance. Wind load at the project site is 140 mph, unless a higher wind load is indicated on Structural Drawings or otherwise required by applicable codes.

B. Field Measurements: Where possible, prior to fabrication of panels, take field measurements of structure or substrates to receive panel system. Allow for trimming panel units where final dimensions cannot be established prior to fabrication. Terminal edges of panels, closures, and turned-down caps shall be to a neat straight line.

C. Manufacturer's Project Manager: The Manufacturer shall provide a Project Manager, who shall work with the personnel to develop the shop drawings for the project prior to installation of the roof. When beginning installation procedures, the manager shall be present at all times to instruct and manage the installer's crew. The entire installation shall be subject to the direction of the Project Manager, who shall be responsible for the proper and timely installation of the system.

1. The Project Manager shall attend a required Pre-Roofing Conference, and return to the project site when requested by the installer, and at beginning of this work, and 50% and 100% roof completion stages.

D. The Contractor shall hold a Pre-Roofing Conference prior to beginning roofing work, and provide typed minutes to Owner's Representative, Engineer, Roofing Contractor, Roofing Manufacturer, who are all required to be present.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver panels and other components so they will not be damaged or deformed. Package panels for protection against transportation damage.

B. Handling: Exercise care in unloading, storing, and erecting panels to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weather-tight ventilated covering. Store metal panels so that they will not accumulate water. Do not store panels in contact with earth, water, or other materials that might cause staining, denting, or other surface damage.

D. Deliver accessories, such as reglets, inserts, etc., which are to be installed by other trades and/or in conjunction with the work of other trades, far enough in advance so as not to delay the Work on the project.

1.7 WARRANTY AND GUARANTEE

A. Roofing Panel Warranty: Furnish the roofing system manufacturer's written warranty, covering failure of the metal roof system 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 warrantees and guarantees.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers Vertical Rib, Machine-Seamed Joint, Standing Seam Metal Roof Panels; Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and mechanically seaming panels together. Roofing panels, closures, and all exposed trim, gutters, downspouts, and similar items shall be factory prefinished.

1. AEP Span.
2. American Buildings Company.
3. Architectural Building Components.
4. Architectural Roofing and Siding, Inc.
5. ATAS International, Inc.

6. Butler Manufacturing Co.
7. CENTRIA Architectural Systems.
8. Copper Sales Inc.
9. Fabral, Inc.
10. McElroy Metal, Inc.
11. Merchant & Evans, Inc.
12. Metal Fab Manufacturing, LLC.
13. Metal Sales Manufacturing Corporation.
14. Steelox Systems Inc.

2.2 MATERIALS

A. Prefinished Panels and Trim: Fabricate of minimum 24-gage metal, with minimum 50,000 p.s.i. yield, with prefinished roofing panels and closures, and 3-coat full strength (70-percent) Kynar 500 resin (20-year) finish for all roofing panels, exposed trim, gutters, downspouts, and similar items; Provide 2-coat finish on underside of panels where exposed to view in the finished work. Provide one of the following base metals:

1. ASTM A 792 aluminum-zinc allow coated steel sheet ("Galvalume"), or
2. ASTM A 653, G-90 (galvanized) zinc-coated steel sheet.
3. Panels shall be formed full length, without laps in a given run.
4. Where indicated with standing seams, all roof panels shall be formed with a 2-inch high vertical seam and finished width of 16 inches, with two intermediate stiffening ribs. All roof panels shall be roll formed in a single length from panel-break to plane-break.

B. Vertical Seams: Fabricate panel vertical seams of the same material, finish and length as the panels. Vertical seams shall contain factory applied sealant and shall be designed so that neither the paint finish nor metal are damaged by the required machine seaming.

C. Clips: Clips shall be 300-series SS (ASTM A-167) which shall provide for unlimited, unimpeded panel movement.

D. Ridge Caps, Flashing and Trim: All flashings and cover over all curbs, roof penetrations, etc., shall be of the same material, gauge and finish as the panels with which they are used, unless heavier gauge is required by project conditions.

E. Fasteners: All fasteners in the plane of the roof deck shall be covered. No exposed fasteners which would penetrate the panels, flashings, etc., will be permitted. Penetrating type fasteners will be allowed only in the vertical plane (i.e. fastening of ridge caps, hip covers, etc., and then only if neoprene washers are used externally). Materials used in all fasteners shall be non-magnetic stainless steel. All exposed fasteners shall match adjacent material, finish and/or color. Length and diameter of screws shall be sufficient to meet design criteria.

F. Closures: Precut closures from gray cross-linked closed-cell polyethylene composition foam to the exact profile of the members with which they are to function.

G. Sealants: Non-skinning, non-hardening, non-oxidizing butyl sealant, designed for metal-to-metal concealed joints. Field applied adhesive tape sealants shall be extruded polymeric butyl tape, non-skinning. Use no exposed sealants.

H. Bituminous Coating: Cold-Applied asphalt mastic, SSPC-12, compounded for 15-mil dry film thickness per coat, and approved for the intended use by both the mastic and roofing manufacturers.

2.3 METAL FINISHES

A. General: Apply coatings either before or after forming and fabricating panels, as required by coating process and as required for maximum coating performance capability. Protect coating either by application of strippable film or by packing plastic film or other suitable material between panels in a manner to properly protect the finish. Furnish air drying spray finish in matching color for touch up, in the event touch-up is allowed by the Engineer; However, it is probable that the Engineer will require replacement of any materials which exhibit any damage to finishes.

B. Roof Panels, Closures, Exposed Trim, Gutters, Downspouts, and Similar Items - Fluoropolymer Coating: Manufacturer's standard "Premium 70" three-coat (i.e.: primer, color coat and clear top coat), thermo-cured, full-strength 70 percent resin "Kynar 500" coating and 30 percent reflective gloss when tested in accordance with ASTM D 523; Provide 2-coat finish on underside of panels where exposed to view in the finished work.

1. Durability: Provide coating that has been field tested under normal range of weathering conditions for minimum of 20 years without significant peel, blister, flake, chip, crack, or check in finish; without chalking in excess of No. 8 in accordance with ASTM D 659; and without fading in excess of 5 NBS units; and as otherwise indicated.
2. Colors: As selected by Engineer after Bid Date, from manufacturer's "standard" non-metallic colors; Minimum 15 colors to select from.

2.4 PANEL FABRICATION

A. General: Fabricate and finish panels and accessories at the factory, by manufacturer's standard procedures and processes, as required to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and dimensional requirements and with structural requirements.

B. Apply bituminous coating or other permanent separation materials on concealed panel surfaces where panels would otherwise be in direct contact with substrate materials that are non-compatible or could result in corrosion or deterioration of either material or finishes.

C. Fabricate panel joints with captive gaskets or separator strips, which provide a tight seal and prevent metal to metal contact in a manner that will minimize noise from movements within panel system.

D. Roll Forming: Field forming of panels is not acceptable.

PART 3 - EXECUTION

3.1 GENERAL

A. Installer shall examine all substrates and verify that they are acceptable, which will be acknowledged and accepted by his beginning work. Installer shall verify that all penetrations, expansion joints, blocking, etc., are securely anchored into place, and that substrate is clean and free of all debris or other substance detrimental to the roofing work.

1. Notify the Contractor in writing of conditions requiring corrections, for proper completion of the Work. Do not proceed until unsatisfactory conditions have been satisfactorily completed.

B. The use of square head nails, staples, and pneumatic or electric nail guns are strictly prohibited.

3.2 PANEL SUPPORTS AND ANCHORAGE

A. When installed by the roofing contractor, all girts, purlin, and other secondary structural panel support members and anchorage (if any) shall be installed in accordance with AISC Manual of Steel Construction "Code of Standard Practice." When installed by others, compliance shall be field verified prior to proceeding with installation.

3.3 PANEL INSTALLATION

A. General: Comply with manufacturer's written instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the work securely in place, with provisions for thermal and structural movement and insulation system.

1. Field cutting of exterior panels by torch is not permitted.
2. Install panels with concealed fasteners.
3. Install insulation support system, insulation, thermal spacer blocks, and other internal components as the work progresses.
4. Use only non-magnetic stainless steel roofing nails and fasteners.

B. Accessories: Install components required for a complete roof panel system, including in part, trim, copings, fascias, stops, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items.

1. Provide and install counterflashing to match roofing over flashing at vent stacks, flues, curbs, and other penetrations, except those indicated to be field painted.

C. Joint Seals: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of panel systems and accessories. Provide types of gaskets, sealants, and fillers indicated or, if not otherwise indicated, types recommended by panel manufacturer.

1. Flash and seal roof panels at eave and rake with rubber, neoprene, or other closures to exclude weather.

2. Counter-flash over otherwise exposed flashings with metal and finish to match adjacent roof metal.
3. Refer to other sections of these specifications for product and installation requirements applicable to indicated joint sealers.

D. Joint Sealers: Refer to other sections of these specifications for post installation requirements on joint sealers; not work of this section.

E. Lap Seams: Provide sealant tape at lapped joints of ribbed or fluted roof sheets and between roof sheets and protruding equipment, vents, and accessories.

F. Standing Seam Roof Panel Systems: Fasten roof panels to supports with concealed clip in accordance with the manufacturer's current written instructions and recommendations, and as required to meet site wind load conditions.

1. Install clips at each support with self-drilling/self-tapping fasteners.
2. At end laps of panels, install tape caulk between panels.
3. Install factory-caulked cleats at standing-seam joints.
4. Seaming: Complete seaming of panel joints by operation of portable power-driven equipment of type recommended by panel manufacturer to provide a weather-tight joint.

G. 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. Installation Tolerances: Shim and align panel units within installed tolerance of 1/4-inch in 20' 0" on level/plumb/slope and location/line as indicated, and within 1/8 inch offset of adjoining faces and of alignment of matching profiles.

I. Roofer shall install curbs supplied by other trades for roof mounted equipment and other items, and cover with metal to match roofing.

3.4 CLEANING AND PROTECTION

A. Damaged Units: Replace panels and other components of the work that have been damaged or have deteriorated beyond successful repair by means of finish touch up or similar minor repair procedures, as determined solely by the Engineer.

B. Cleaning: Remove temporary protective coverings and strippable films (if any) as soon as each panel is installed. Upon completion of panel installation, clean finished surfaces as recommended by panel manufacturer, and maintain in a clean condition during construction.

END OF SECTION 07 41 13

Appendix F

SECTION 09 51 13 – ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Acoustical panels and exposed suspension systems for ceilings.

B. Extent of each type acoustical ceiling is shown and scheduled on drawings.

C. Related work specified elsewhere includes:

1. Division 6 Section – Rough Carpentry. (concealed P.T. wood blocking and grounds)
2. Division 7 Section – Joint Sealants.
3. Division 9 Section – Gypsum Board Assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated.

B. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

C. Surface-Burning Characteristics: Complying with ASTM E 1264 for Class A materials and tested per ASTM E 84; testing performed by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less,
2. Smoke-Developed Index: 50 or less.

D. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

1.4 SUBMITTALS

A. Product Data: Manufacturer's product specifications and installation instructions for each acoustical ceiling material required, and for each suspension system, including certified laboratory test reports and other data as required to show compliance with these specifications.

1. Include manufacturer's seismic installation details.
2. Include manufacturer's recommendations for cleaning and refinishing acoustical units, including precautions against materials and methods, which may be detrimental to finishes and acoustical performance.

B. Shop Drawings: Show layout of ceiling including locations of light fixtures, grilles, diffusers and sprinkler heads.

1. Indicate hanger spacings, clip anchors or inserts, fastening details, splicing methods for main and cross runners.
2. Include details for ceiling level changes, support methods for light fixture, diffusers, grilles and similar items.

C. Samples:

1. Set of 6-inch by 4-inch square samples for each acoustical unit required, showing full range of exposed color and texture to be expected in completed work.
2. Set of 12-inch length samples of each exposed runner and molding.

D. Qualification Data: Submit for qualified installer to demonstrate their capabilities and experience; include documentation indicating compliance with specified qualification requirements. (Submit for Architect's information only.)

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling. (Submit for Architect's information only.)

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Firm with not less than three (3) years of successful experience in installation of acoustical ceilings similar to requirements for this project and which is acceptable to manufacturer of acoustical units, as shown by current written statement from manufacturer.

B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install a minimum 12-ft by 12-ft. area of each ceiling type specified, in spaces designated by Architect.
2. Notify Architect when spaces are ready for observation and review. Obtain Architect's approval of mockups before starting installation.

3. Approved mock up shall serve as a standard of quality for ceiling installations. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Pre installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination or other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. Space Enclosure: Do not install interior acoustical ceiling until space is enclosed and weatherproof, wet work in space is completed and nominally dry, work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

B. Coordination:

1. Coordinate layout and installation of acoustical ceiling units and suspension system components with other work supported by or penetrating through, ceilings, including light fixtures, HVAC equipment, food service exhaust hoods, fire suppression system components (if any), conveyor systems and partition system (if any).
2. Schedule installation to occur after other work which can generate dust is completed. Schedule acoustical material installation to minimize need for removal and replacement to accommodate work of other trades.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver maintenance materials to Owner.

1. Acoustical Ceiling Units: Furnish quantity of full size units equal to two percent (2.0%) of amount installed.
2. Exposed Suspension Components: Furnish quantity of each exposed component required for actual installation equal to two percent (2.0%) of amount installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL CEILING PANELS

A. Basis of Design: Product as scheduled on drawings.

1. Acoustical ceiling panels of similar design, material, construction and of matching color, pattern and texture by other acceptable manufacturers may be submitted for Architect's acceptance.
2. Acceptance is subject to compliance with specified requirements as evidenced by submittal of manufacturer's product data, test reports and samples.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

C. Panel Type: ASTM E 1264, Type IV, Form 2, Pattern E; water felted mineral fiber, membrane-faced overlay panels with painted finish.

1. Size: 24 by 24 inches (2-ft. by 2-ft.), unless otherwise indicated on Drawings.
2. Thickness: 7/8 inch.
3. Edges: Rabbeted and beveled (Beveled Tegular).
4. Noise Reduction Coefficient (NRC): 0.80, minimum.
5. Ceiling Attenuation Class (CAC): 35, minimum.
6. Light Reflectance: 0.86.
7. Surface Finish: Factory applied latex paint finish, white color.

D. Suspension System: Grid profile size as indicated on Drawings for scheduled ceiling panel. Provide grid module matching ceiling panel size.

2.2 METAL SUSPENSION SYSTEMS

A. Acceptable Manufacturers; subject to compliance with specified requirements:

1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. USG Interiors, Inc.

B. Narrow Profile Exposed Grid System: Narrow-face, capped, double-web, galvanized steel suspension system.

1. Structural Classification: Intermediate duty system in accord with ASTM C635.
2. Main and Cross Runners: Roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653, not less than G30 coating designation; with prefinished metal caps on flanges.
3. End Condition of Cross Runners: Override (stepped) type.
4. Face Design: Flat, flush.
5. Cap Material: Galvanized cold-rolled steel.
6. Cap Face Size: 9/16 inch width.

7. Cap Finish: Factory applied low gloss paint finish; white color.

C. Standard Exposed Grid System: Wide-face, capped, double-web, galvanized steel suspension system.

1. Structural Classification: Intermediate duty system in accord with ASTM C635.
2. Main and Cross Runners: Roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653, not less than G30 coating designation; with prefinished metal caps on flanges.
3. End Condition of Cross Runners: Override (stepped) type.
4. Face Design: Flat, flush.
5. Cap Material: Galvanized cold-rolled steel.
6. Cap Face Size: 15/16 inch width.
7. Cap Finish: Factory applied low gloss paint finish; white color.

D. Finishes and Colors: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

2.3 SUSPENSION SYSTEM ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Cast-in-place or Postinstalled expansion anchors.
b. Corrosion Protection: Either type as specified.

1) Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
2) Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.

2. 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 hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

B. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 12 gauge (0.106 inch) diameter wire.

C. Hanger Rods and Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint; sized to support design loads.

D. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04 inch thick, galvanized-steel sheet complying with ASTM A 653, G90 coating designation; with bolted connections and 5/16 inch diameter bolts.

E. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches on center on all cross tees.

F. Edge Moldings and Trim: Roll-formed, sheet-metal type in profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.4 MISCELLANEOUS MATERIALS

A. Fasteners: Cadmium plated, type recommended by suspension system manufacturer, but for not less than 1/2 inch penetration of substrate.

B. Acoustical Sealants:

1. Acceptable Products: Subject to compliance with requirements, provide one of the following:

a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
b. Pecora Corporation; AIS-919.
c. Specified Technologies, Inc.; SpecSeal Smoke N' Sound Acoustical Caulk.
d. Tremco, Inc.; Acoustical Sealant.
e. USG Corporation; Sheetrock Acoustical Sealant.

2. Characteristics: Manufacturer's non-hardening, non-bleeding, nonstaining, gunnable, synthetic rubber or acrylic latex compound complying with ASTM C834.

a. Acoustical Performance: Effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
b. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of acoustical ceilings. Furnish concrete inserts, hanger clips and similar devices to other trades for installation well in advance of time needed for coordination of other work.

B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

C. Where suspended acoustical ceilings are indicated to be hung below drywall sub ceilings, install sub-ceiling hanger clips at locations for hanger wire attachment. Attach clips screw fastened through gypsum board into support framing spaced at grid locations required for securing suspension system hangers wires.

3.3 INSTALLATION

A. Install acoustical panel ceilings to comply with ASTM C 636 and design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts,

eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post installed mechanical anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches on center along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post installed anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches on center and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange acoustical units and orient directionally patterned units, (if any) in a manner shown by reflected ceiling plans.
2. Install panels with pattern running in one direction, as indicated, or if not indicated, as directed by Architect.
3. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
4. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.

5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and in spaces as recommended by panel manufacturer's written instructions, unless otherwise indicated.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

Appendix G

SECTION 46 61 23 - DISC CLOTH TERTIARY FILTRATION

PART 1 - GENERAL

1.1 SUMMARY

A. Scope of Work:

1. Modification of Two (2) existing Disc cloth filters. Add additional 4 Discs in each existing Disc cloth filter, add necessary backwash nozzles for the new discs, replace the backwash pump and a new motor starter to accommodate the larger backwash pump in the existing control panel.

B. Related Requirements:

1. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electrical connections to equipment specified by this Section.

1.2 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with Work of other Sections.

1.3 SCHEDULING

A. Section 01 31 00 – Project Management and Coordination: Requirements for scheduling.

1.4 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.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Tools: Furnish special tools and other devices required for Owner to maintain equipment.

1.6 QUALITY ASSURANCE

A. Applicable Standards:

1. ASTM -American Society for Testing and Materials
2. AISI -American Iron and Steel Institute
3. AGMA -American Gear Manufacturer's Association
4. NEMA- National Electrical Manufacturer's Association
5. NEC -National Electric Code

B. To assure unity of responsibility, the additional 4 Discs in each existing Disc cloth filter, the necessary backwash nozzles for the new discs, the replacement of the backwash pump and a new motor starter to accomodate the larger backwash pump in the existing control panel shall be furnished and or coordinated 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. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store and protect materials according to manufacturer instructions.

1.8 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 date the goods are put into service, 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

1. Veolia Water Technologies, Inc (Kruger)

2.2 PERFORMANCE REQUIREMENTS:

Design Average Flow per unit, MGD	1.0
Peak Hour Flow per unit, MGD	2.0
Maximum Influent TSS, mg/L	20 mg/L
Effluent TSS, mg/L	<5
Filter Opening, µ	10
Filter Cloth Material	Polyester (woven)
Number of Filter Elements (Existing)	4 Disc / 2×64 panels
Number of Filter Elements (Additional added)	4 Disc / 2×64 panels
Filter Disc Diameter, m	2.1
Total Filter Area, ft^2	194×2
Filter Submergence, %	60
Filter Rotational Speed, RPM	2.8
Material of Construction (Disc)	AISI 304 stainless
Drive Motor (Existing)	1.5 hp, 460v, 3 phase
Drive Motor Service Factor	1.3
Drive Assembly (Existing)	Helical wormgear with riveted chain and sprocket
Number of Backwash Nozzles (per Disc)	12
Backwash Pressure, psi	110
Backwash Flowrate, GPM	60
Backwash Pump	7.5 hp, 460v, 3 phase

2.3 Filter System General Design Information:

A. The automatic backwash filter system shall be suitable for filtering domestic wastewater after secondary treatment and clarification. Each filter shall be designed to operate on a continuous basis and shall be designed to operate while receiving varying flows.

B. The proposed disc filtration system shall not exceed a hydraulic loading rate of 5.96 gpm/sf at peak flow.

2.4 MATERIALS AND EQUIPMENT

A. All fabricated metal shall be minimum grade AISI 304 stainless steel unless otherwise stated in this specification. Filter panels shall be polyester filter cloth mounted on AISI 304 stainless steel frames with integrated rubber seals. Filter disc segments shall be 304 stainless steel.

B. The valves, equipment, materials of construction and controls specified under this section supersede valves, equipment, materials of construction and controls specified elsewhere in the contract documents. Purchased components such as gear reducers, pumps, motors, valves, and actuators shall be provided as per filter manufacturer's standard designs and with standard recommended manufacturer's paint.

2.5 DISC ASSEMBLY

A. The filter shall be composed of modular and removable discs. Each disc shall consist of disc segments that can be easily mounted or dismounted as required. The segments of one disc will be bolted to each other, and the completed disc assembly will be secured to the center drum with stainless steel F clips and hardware.

B. Filter panels (filter media) shall be mounted on the sides of the disc segments. The filter panels shall consist of stainless steel frames with PET monofilament filter fabric attached to the frames. Each panel shall be equipped with a gasket that is fitted to and provided integral to the media frame to provide a watertight seal between the filter panels and disc segments. The panels will be held in place by a locking frame and one bolt per panel for easy exchange.

C. Nominal media pore size shall not exceed 10 microns.

2.6 BACKWASH CLEANING SYSTEM

A. The Discfilter shall be equipped with a single oscillating back-washing system with non-motorized moving spray headers for efficient cleaning of the filter cloth and for reduction of the consumption of backwash water. All panels shall receive 110 psi pressure backwash spray.

B. The backwash system shall be comprised of stainless steel backwash spray headers installed between the discs. The spray headers shall oscillate in an upward and downward motion during drum rotation. The spray header oscillation shall be operated by a cam system that is connected to the drum drive. Each header shall have flat pattern spray nozzles for each disc side. The spray nozzles shall consist of nozzle tips, mounting cap for quick removal, nozzle body and seals. The replacement of spray nozzles must be possible from outside the filter tank. A swivel joint shall allow the spray header manifold to rotate out for nozzle access without disassembly of the manifold or headers.

C. Each filter shall have one externally mounted low-pressure Grundfos centrifugal pump for the backwash system. The backwash pump shall be of the vertical multi-stage design with the motor mounted directly to the top of the pump. The motor shall be supplied by Grundfos integral with the pump. The motor shall be standard efficiency rated for 460V, 3 phase, 60 HZ operation. Filtered water shall be discharged from the pump to the backwash header piping constructed of stainless steel.

2.7 CONTROL PANEL MODIFICATION

A. The existing motor starter located in the Disc Filter Control Panel to manage the start/stop of the Backwash Pump motor will be replaced with a new motor starter as per this specification. The motor starter will be sized appropriately to match the requirements of the Backwash Pump

motor. The motor starter will be an IEC starter rated between 0.1 and 50 Amps @ 460VAC 3 phase, with rotary handle operator, visible trip indication, protection by overload, short circuit, undervoltage and shunt. The motor starter will be equipped with auxiliary contacts for monitoring and control. The IEC motor starter shall be Square D TeSys or approved equal.

2.8 DISCFILTER SPARE PARTS

A. The following spare parts will be supplied: 5 Backwash Spray Nozzles, 2 Filter Panels. Parts inventory shall be based in the United States.

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor shall install the disc filter system per the Equipment Manufacturer's directions and the drawings. The Contractor will provide all required supports and anchoring required to install the disc filter unit. The plumbing and electrical connections shall be provided as detailed on the drawings and specifications. The Equipment Manufacturer will provide adequate crating and protection of the disc filter panel screen for shipment to the project site. Installation instructions will be provided that specifically outline installation of this drum screen. Lifting instructions will be provided to assist the Contractor in placing the unit into the concrete scree n sump.

3.2 FIELD SERVICES

A. The Equipment Manufacturer shall furnish the services of a factory-trained representative based in the United States and employed by the manufacturer, for a minimum of two (2) working days and one (1) trip. This trip shall consist of inspection and check-out (dry/wet/electrical) and for start-up.. The Contractor will provide to the Equipment Manufacturer a minimum prior notice of three (3) weeks in order to schedule these services.

END OF SECTION 46 61 23

Appendix H

BID FORM FOR CONSTRUCTION CONTRACT

The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 1—OWNER AND BIDDER

1.01 This Bid is submitted to: Piedmont Water Company

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2—ATTACHMENTS TO THIS BID

2.01 The following documents are submitted with and made a condition of this Bid:

A. Required Bid security;

B. List of Proposed Subcontractors;

C. List of Proposed Suppliers;

D. Evidence of authority to do business in the State of Georgia;

E. Georgia Utility Contractor's license number as evidence of Bidder's State Contractor's License; and

F. Required Bidder Qualification Statement with supporting data.

ARTICLE 3—BASIS OF BID—LUMP SUM BID AND UNIT PRICES

3.01 *Lump Sum Bids*

A. Bidder will complete the Work in accordance with the Contract Documents for the following lump sum (stipulated) price:

1. Lump Sum Price (Single Lump Sum)

Lump Sum Bid Price	$
Owner's Contingency	$ 550,000
Total	$

2. Alternative Bid Equipment (Deductive or Additive to Total Above):

Influent Pumps (ABS)	$

ARTICLE 4—TIME OF COMPLETION

4.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

4.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 5—BIDDER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

5.01 *Bid Acceptance Period*

A. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

5.02 *Instructions to Bidders*

A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

5.03 *Receipt of Addenda*

A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

ARTICLE 6—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

6.01 *Bidder's Representations*

A. In submitting this Bid, Bidder represents the following:

1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
2. Bidder 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. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
4. Bidder 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. Bidder 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. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding 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 Bidder, if selected as Contractor; and (c) Bidder's (Contractor's) safety precautions and programs.
7. Based on the information and observations referred to in the preceding paragraph, Bidder 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. Bidder 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 Bidding Documents.

9. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

6.02 *Bidder's Certifications*

A. The Bidder certifies the following:

1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.

2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.

3. Bidder has not solicited or induced any individual or entity to refrain from bidding.

4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 8.02.A:

a. 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.

b. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.

c. 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.

d. 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.

BIDDER hereby submits this Bid as set forth above:

Bidder:

_____
(typed or printed name of organization)

By: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(typed or printed)

If Bidder is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.

Attest: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(typed or printed)

Address for giving notices:

_____
_____

Bidder's Contact:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Phone: _____

Email: _____

Address:

_____
_____
_____

Bidder's Contractor License No.: (if applicable) _____

Appendix I

Carey Station WRF 0.5 MGD to 1.0 MGD Expansion
Or-Equal Equipment

No.	Equipment Name	Manufacturer or Local Rep	Associated Spec. Section(s)	Base of Design	Equipment Location	
1	Slide Gates and Weir Gates	Rodney Hunt (Local rep: Heyward)	40 05 59	1. Whipps, Inc. 2. Waterman Industries 3. Hydro Gate 4. Golden Harvest, Inc.	Headworks, VLR basins and Clarifier Splitter box	Approved as ""or-equal"
2	Slide Gates and Weir Gates	RW Gate (Local rep: Principle Environmental, Inc.)	Same as above	Same as above	Same as above	Approved as ""or-equal"
3	VFD	Amtech	26 29 23	A. Square D B. Eaton C. Allen-Bradley D. ABB	Influent Pumps, Blowers	**Amtech not approved as or-equal**
4	Submersible Pump	ABS (Local Rep: Hydra Service Inc.)	43 25 13	1. INFLUENT PUMPS a. Flygt. b. KSB. 2. SCUM PUMP a. ABS	Influent pump station	**Alternative Bid Equipment**
5	Submersible Pump	KSB (Local Rep: Pump and Process Equipment Inc.)	Same as above	Same as above	Same as above	Approved as ""or-equal"
6	Refrigerated Auto Sampler	Teledyne ISCO (Local Rep: Kazmier and Associates Inc.)	40 75 00	1. Hach	Headworks	Approved as ""or-equal"
7	FRP Weirs, FRP Scum Baffles, FRP Building, and FRP Parshall Flume	EDGENG	06600- FRP Weirs, FRP Scum Baffles 133100- FRP Building 407169- FRP Parshall Flume	A. The weir plates and scum baffles shall be manufactured by: 1. Warminster Fiberglass Company 2. NEFCO Inc. A. The fiberglass reinforced building enclosure shall be manufactured by: 1. TRACOM, Inc., Alpharetta, GA A. The equipment, parshall flume, shall be manufactured by: 1. Warminster Fiberglass Company 2. Tracom Fiberglass Products 3. Enduro Composities, Inc. 4. Strongwell 5. Virtual Polymer Compounds	Weirs and scum baffles at Clarifier No. 3 FRP building for chemical pumps Parshall Flume at Headworks	**Approved as or-equal for 06600- FRP Weirs, FRP Scum Baffles & 407169- FRP Parshall Flume, Not Approved as or-equal for 133100- FRP Building**
8	Ultrasonic Level Meters	Emerson Rosemount (Local Rep: Kazmier and Associates Inc.)	40 72 13	1. Siemens	Headworks, chemical tank	Approved as ""or-equal"

GMC

ADDENDUM NO.2

PROJECT: **Carey Station Urban Water Reuse Facility 0.5 MGD to 1.0 MGD Expansion**
For Piedmont Water Company
GMC PROJECT NO. CAUG230002

---

1. Questions

1.1 **Need to clarify thickness of HDPE liner.**
Answer: 60 Mil HDPE liner.

1.2 **Drawing E-316 references Note 5 and there are only three notes on the page.**
Answer: Please disregard the note reference shown next to DS-M4300 and DS-P4310. The disconnect switches description is provided on the one line diagram E-102 (480V, 30A, 3P, NFDS, NEMA 4X SS).

1.3 **Drawing E-318 indicates a float switch is to be installed in the pond. Please provide installation details and conduit routing method.**
Answer: The contractor shall install the float switch by securing to a corrosion-resistant post at the shore of the pond. The cable shall be laid along the sloped side of the pond, following the natural shape of the slope. Weights shall be added along the cable to keep the float switch in place and prevent movement caused by water currents. The float switch height shall be set to the required level, and its operation tested to make sure it turns on and off as expected.

1.4 **Sheet E-317show that the Level indication equipment and DO readings are to be routed to LCP-2. LCP-2 is located in the new electrical room outside of the plant building. Can these signals be routed to LCP-1 in the control room inside the building. This would be easier to facilitate then getting them to the new electrical building.**
Answer: The design intent is for the dissolved oxygen (DO) and level sensors to be connected to LCP-2, as these instruments are directly related to the operation of the digester blowers, which are controlled by LCP-2. The Engineer's preference is to maintain the instrumentation connections to the plant SCADA panels as originally designed.

1.5 **We need some information on connecting to the existing forcemain. How long can the flow be interrupted? Is there sufficient storage in the existing wetwell to drain the contents of the FM back before cutting the line? If not please provide the length and size of the existing FM. Also please provide a suggested tie-in / startup sequence for the new headworks and IPS. We are uncertain how the flow currently enters the plant in terms of the two force mains shown on the piping plan and what they service.**
Answer: The connection will need to be done in an expeditious manner but Piedmont Water Company should be able to give the contractor a couple of hours. There will be about 5500 ft of 12" and 8" line that will drain. (The 8" force main connects to the 12" just outside the fence).

GMC

1.6 **The schematic on G-005 shows two lines to the new reject pond, one un-valved and the other with a valve. C-201 and C-301, seem to only show the un-valved line. Please determine if changes need to be made.**
Answer: There is no line with a valve out of new reject pond. C-201 and C-301 are correct.

1.7 **C-301 shows connection the #4 Wye & #7 Tee connections tying into the existing force main. Connection 4 can easily be done while the new EQ Basin is filling up, but connection 7 would require the force main to be shut down, drained, and bypassed depending upon the operational needs of this line. How long can this line be taken out of service? Where is the nearest point west of the connection point to intercept the force main? Would a 12"x12" clamp on taping saddle be acceptable to allow a live tap of this line? Another idea to eliminate the need for bypass is to mirror the headworks structure so that the #7 connection is after the existing valve that bypasses the plant.**
Answer: #7 connection can be applied after the existing valves.

1.8 **C-301 shows cutting into the plant effluent line to connect the new CCT to the effluent line. We assume that if the new Influent EQ basin is on-line that a few hour shutdown of the plant and this line will be achievable without the need for bypass piping and pumping. Please confirm.**
Answer: Yes, if the new influent EQ basin is on-line, a couple of hours shutdown of the plant will be okay without need for bypass piping and pumping.

1.9 **Also this same line, on D-601 the new line approaching the CCT is shown at elevation 504.0 while the line exiting the CCT is shown at elevation 500.58. We would not expect the existing line to vary in elevation this much in this distance of piping. Is the elevation of the piping entering the reuse pond known? Should the inlet piping be installed flat from the existing line and then the vertical piece extended to match the elevation change or should the new piping be slope to make this elevation change?**
Answer: The elevation of the piping entering the reuse pond is unknown. The new piping shall be sloped to make this elevation change as required.

1.10 **C-301 shows the installation of a new 10" line. Key Notes 31 – 35. We assume that this is connected to the discharge piping of the Reuse Pump Station however no new work is shown on the schematic provided on G-005. From field observations the existing 90 degree bend is above grade, and then combines to an existing buried single line. Should this new line connect to the single line under ground? Please confirm this and confirm that the reuse pump station can be taken out of service long enough to remove the 90 elbow and install the Tee and the valve, such that temporary piping/pumping will not be required for this connection.**
Answer: Yes, the new 10" line connect to the single line underground. The reuse pump station can be taken out of service for a couple of hours to remove the 90 elbow and install the Tee and the valve.

1.11 **C-301 shows the new 6" drains from the chemical containment and CCT connecting to an existing manhole but does not provide elevation or slopes of the piping. Drawing D-601 calls out the drain to be at invert 497.31 as it leaves the CCT, Drawing D-801 does not call it out but we approximate the invert to be 505.84 as it leaves the chemical containment. The drain line from the chemical containment seems like it will be able to be above the Effluent Line which is called out to be at IE 504.0 on D-601. The drain line from the CCT will be below the Effluent Line. Do we know the invert at the existing**

GMC

manhole? Does this need to be drop manhole or can the manhole be simply cored and the piping brought into the manhole. Do we know the elevation of the reject line?
Answer: Existing Manhole, RIM 503.64, invert in 496.29, invert out 496.18. The existing manhole can be simply cored and the new drain piping brought into the manhole. Elevation of the reject line was unknown.

1.12 **Speaking of Reject Line, what make the determination that the flow in the Filter Effluent Box needs to be rejected or if it can be sent to the CCT. Previously this determination was made after the UV disinfection. Does the determination now need to be made post CCT?**
Answer: The determination is based on the turbidity after the filter, not related to UV disinfection or Chlorine disinfection.

1.13 **C-301 shows the bypass line being rerouted around the new clarifier but then turns back towards the building before the end of the new building. Perhaps this line should be reroute beyond the end of the new eastern end of the building in case another building expansion is needed.**
Answer: Yes, reroute beyond the end of the new eastern end of the building in case another building expansion is needed.

1.14 **C-301 Key Note 22 seems to the discharge of the reject pond pump station which combines with the Influent Pump Station Discharge Line. Is there a concern that these pumps might fight to both produce into the same line? If so, perhaps instead of cutting and capping Key Note 16, this line could be connected to the 8" Digester drain line to be able to send the Reject to the Influent EQ Basin.**
Answer: Keep the current design.

1.15 **A-812 shows that the door height is only 7'-4", the door schedule on A-814 calls for a 7'-1" door, is the frame head to be 3" tall? The detail calls for it to 4" tall. We recommend a taller door to be able to easily remove and replace the electrical equipment in this room in the future without needing to "lay it down".**
Answer: Door height 7'-0", frame head to be 4" tall. Total height 7'-4".

1.16 **S-102 shows the concrete infill surrounding the grit equipment. Should this be omitted in the future grit basin?**
Answer: Yes, this shall be omitted in the future grit basin.

1.17 **S-402 shows 1" expansion joints where the new clarifier meets the existing structure. How will the head shaft for the clarifier account for this possible movement of the opposite sides of the tank?**
Answer: This possible movement will be accounted for within the clarifier equipment.

1.18 **D-003 Elevation C shows discharge lines coming out of each of the digesters, D-701 shows them as 8" valves with downward facing 90 degree elbows. What is the purpose of these? Are these the agricultural reuse line(s) shown on G-005?**

GMC

Answer: These are digested sludge discharge line. Yes, these are the agricultural reuse line(s) shown on G-005.

1.19 **D-101 calls out a 1.5" water line to be run exposed and heat traced. The table on G-008 calls out this line to be galvanized steel, stainless steel, or copper. Is this our choice? Also where is the source for this line it is not shown on C-301? Does this line need a backflow preventer and/or PRV?**
Answer: The 1.5" water line shall be galvanized steel, PVC (not stainless steel), or copper. The source for this line is the existing water line which was shown only a small portion in the C-301 based on survey. This line needs a backflow preventer, and PRVs (in sheet D-921 valve schedule CV1012 and CV1016).

1.20 **D-101 and S-101show the floor sloping to the drain under the dumpster however there does not seem to be piping for this drain shown. A clean out to the left of dumpster containment might be a good idea. Also mud valves and drains in each of the three screen channels might be a good idea too.**
Answer: Add 6" drain piping below the dumpster area, and connect with the drain from washer using 11.25° bend, tee instead of 90, and 90° bend – all MJ.

1.21 **D-103 Key Note #4 shows a dumpster. Is this furnished by the Contractor or will the refuse removal company provide this?**
Answer: The contractor shall provide the dumpster.

1.22 **D-105 shows the future grit and fluidizing lines going to the right of the page. Would it be better enlarge the grit pump area and route this piping to the left so that both grit pumps can be on the roadway side?**
Answer: Keep the current design.

1.23 **D-101 to D-105 does not show a section cut through the grit washer compactor. Can this be provided?**
Answer: See Appendix A with section views.

1.24 **D-201 and D-202 seem to show a HDPE liner like the existing onsite ponds however the 312000 spec only refers to a bentonite liner and there does not seem to be a specification for a HDPE liner. Assuming that it is a HDPE liner, what is the size of the anchor curb at the upper perimeter? does it have reinforcing? Seems odd that the bottom of the pond would not be sloped slightly to the sump, please confirm. Do you want the mooring cable supports to be within the HDPE liner as shown or just outside and anchor ring curb? What type of material is the ¼" x2" batten? Is this continuous?**
Answer: See addendum No. 1

1.25 **D-211, the future pump does not show the installation of guide rails by the omission of Key Note #13. Please confirm. If no guide rails are needed, does the interior Key Note #6 Elbow need to be installed for the future pump? What about the riser, reducer and base elbow?**

GMC

Answer: Other than the future pump, guide rails, elbow, riser, reducer and base elbow shall all be installed.

1.26 **D-212, section A seems to show a tide flex valve on the end of the drain line from the meter vault, please confirm if this is needed by adding to the key note list.**
Answer: Yes, this shall be a tide flex duckbill check valve.

1.27 **D-301, Key Note #1. Is this meant to be a poured concrete wall? Dowels at what centers? What is the existing starting elevation? Sequencing wise, when will this be completed? (one tank at a time?)**
Answer: Yes, this means to be a poured concrete wall, dowels at center @ 12". The existing starting elevation is 527.58. After VLR tank No. 3, Clarifier splitter box and Clarifier No. 3 all be complete, this wall can be built.

1.28 **D-301, Key Note #3. Depth of channel? Dowel reinforcement?**
Answer: Depth of channel is 3'-8". Yes, add dowel reinforcement.

1.29 **D-302 shows the new air piping rising up the wall and we assume penetrating the wall into the blower room. We find no continuation of this piping on the other side. Should something be shown on D-304**
Answer: This air pipe connected with the existing air pipe which penetrating the wall from the blower room to the VLR basin No. 3.

1.30 **D-303 shows the piping demo and reworking for the WAS/RAS but does not mention what if anything is to be done with the existing screen and manual bypass screen. E-101 calls for the demolition of the electrical control panel and feed for the screen**
Answer: Demolish and salvage the existing screen and manual bypass screen.

1.31 **D-304 shows removal and replacement of the blowers with new reducers going to a box. What is this box, is that the existing header?**
Answer: Yes, it is the existing header.

1.32 **D-401, Key Note #7. Depth of channel? Dowel reinforcement? We believe these are the same as shown on D-301, please confirm.**
Answer: Yes, it is the same as shown on D-301.

1.33 **D-501 shows the 16" SE line being run along the upper portion of the page in bold from the Key Note 1 Tee to the Wall. We believe that it penetrates the wall and has a 90 degree elbow heading upward on the page. This is shown in the section view on the lower portion of this page. Elevation D on D-003 shows the piping but does not call out the piping size or process. Please confirm.**
Answer: In D-501, 16" SE line penetrates the wall (from clarifier No. 3) and run along the upper portion of the page. It is the same pipe on D-003 section D upper pipe.

1.34 **D-501 does not show the RAS line work in bold but calls out Key Note 3 to replace the existing 90 with a Tee. We believe the new piping then also penetrates the wall and also has a 90 degree bent heading toward the top of the page. It is not shown in Section A on this page. Elevation D on D-003 shows this piping but does not call out the piping size or**

GMC

process. It shows these lines entering the filter room staggered but we believe this line to be directly below the SE line. Please confirm.
Answer: The lower pipe on D-003 section D is the sludge pipe, which penetrates the wall and flow into the existing clarifier sludge channel (not into filter room). Key note in D-501 shall be deleted, this 90-degree reducing bend will be kept without any change.

1.35 **D-501 calls for the installation of a new Filter Effluent line starting with the 12x8 Tee to the concrete box. Review of the existing conditions show that there is a valve and plug on the concrete wall. Are we to connect to this? The drawing also does not show the existing UV units on the other two lines. Are these to be removed and replaced with straight piping? E-101 calls for the electrical demolition of these units. Should this line be shown on G-005?**
Answer: No need to install the new filter effluent line. Demolish and salvage two (2) existing UV units. Replace UV with straight piping. No work needs to be done on the center line (existing gap between 2 blind flanges).

1.36 **D-602 calls out a scale of 1" =200' this is clearly wrong when the reject pond is 222'x144' and takes up a majority of the page. Also again, the liner questions from D-201& D-202. Key note 1 states to connect the piping the reject pond, but C-301 has it connected to the existing piping, please confirm C-301 is correct.**
Answer: the scale shall be 1" = 200". Liner shall follow Addendum No. 1 item 2.2. C-301 is correct.

1.37 **D-701 Section C shows a drop pipe to the diffusers that we believe should not be shown in this section, it would be behind the section line near the separating wall. Please confirm.**
Answer: D-701 Section C shows a drop pipe to the diffusers; this drop pipe would be behind the section line near the separating wall. Your statement above is correct.

1.38 **D-710 and D-711 call out the air piping as SSTL piping for both the exposed and the buried portions. The table on G-008 calls for buried air piping to DIP. Please confirm which is correct.**
Answer: G-008 is correct. Buried air piping shall be DIP.

1.39 **D-801and D-802 show and emergency shower, but there is no a water line shown to connect to it on these drawings nor C-301.**
Answer: Find the existing water line and extend to the emergency shower.

1.40 **D 802 shows the 2" HOCL coming out of the Containment wall, dropping down underground and then turning up into the slab of the building. Are there intended to be any valves before it connects to the pump skid? What about on the discharge side which is not shown?**
Answer: No valves before it connects to the pump skid. No valves on the discharge side, other than valves included in the pump skid.

1.41 **Specification 09 96 00 Part 3.6 states to refer to the plans for a paint schedule. We do not find this in the plans.**
Answer: See attached schedule in Appendix C.

GMC

1.42 **6.01 EJCDC – Lists warranty terms to be 2 years from substantial completion. 016000 1.07.D.1 lists warranty 1 year from acceptance of work. 46 23 23 lists 1 year from substantial completion. Which warranty terms should we base our pricing on? If it is acceptance of work when will that likely fall with respect to substantial completion?**
Answer: Grit removal equipment warranty see specification 46 23 23, which is 1 year from substantial completion.

1.43 **Sections 26 05 03, 46 05 13, and 46 05 53 are referenced in section 46 23 23, but they do not appear to be included for our review. Are these specification sections available for review?**
Answer: Sections 26 05 03, 46 05 13, and 46 05 53 will not be provided. Delete the reference in section 46 23 23

1.44 **Section 46 23 23 does not refer to Div 26. Specification section 26 29 23 outlines VFD requirements such as spare parts (1.8), line reactors, VFD and field surge protection, panel mounted keypad, Ethernet connection, etc. Please advise if these items should be included in the grit system control panel.**
Answer: These items should not be included in the grit system control panel.

1.45 **Plan Sheet G-006: This drawing indicates the headworks is to be designed for a peak of 4.2 mgd. Section 46 23 23 indicates a peak of 4.11 mgd. Which are we to design to?**
Answer: 4.2 MGD will be the peak flow.

1.46 **Plan Sheet I-102 – P&ID shows E-stop on the grit classifier. This item not listed in 46 23 23, please confirm this will be supplied by Others.**
Answer: Delete E-stop in sheet I-102, E-stop shall be provided for system within panel per specification.

1.47 **Plan Sheet E-313 / E-602 – There is a E-Stop pushbutton (HS1120) shown for the grit system. This is not listed in 46 23 23, please confirm this is supplied by others.**
Answer: Delete E-stop pushbutton in E-313 / E-602. E-stop shall be provided for system within panel per specification.

1.48 **Plan Sheet E-602 – Two pull cord switches are listed as part of the grit system control panel. What are these tied to? They are not addressed in the specs.**
Answer: Delete Two pull cord switches in sheet E-602.

1.49 **Note 2 Plan Sheet E-602 requires additional components for the control panel that are not listed in section 46 23 23. Some of the components listed are a folding shelf, panel light, surge protection, lighting arrestors, 480V air conditioner, analog indicators, 24VDC power supply, dead front, etc. Please confirm these items should be included in the grit system control panel.**
Answer: Follow specification 46 23 23, delete additional components shown on sheet E-602.

GMC

1.50 **What about the telescoping valve in the existing digester? Do you want it removed?**
Answer: Yes, remove the telescoping valve in the existing digester and replace with blind flange.

2. Acknowledgement

2.1 Receipt of Addendum No. 2 shall be acknowledged via e-mail to liang.wang@gmcnetwork.com and confirm that the addendum has been received.

3. Conclusion

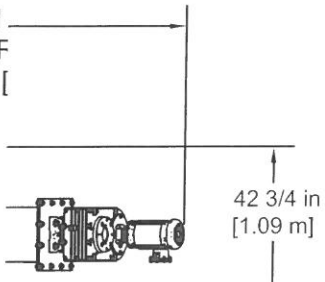
3.1 This is the end of Addendum Number 2, dated February 17, 2025

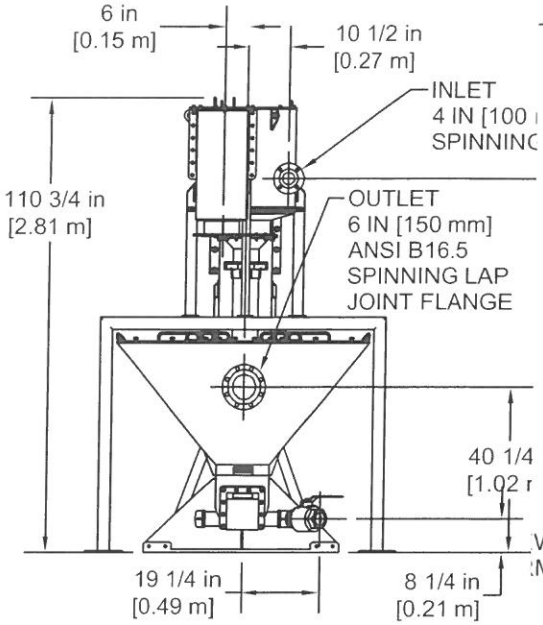
Liang Wang

Liang Wang, PE

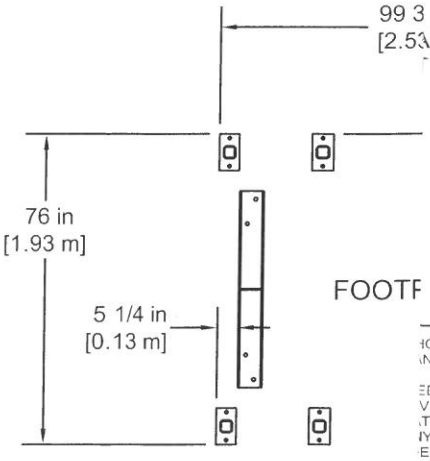
Appendix A

NOTES:
1. DRY WEIGHT = 3,100 lbs [1,410 kg]
2. APPROX. OPERATING WEIGHT WITH
3. PROVIDE ADEQUATE CLEARANCE AF
OPERATION AND MAINTENANCE: 18 in [





FRONT VIEW



FOOTF

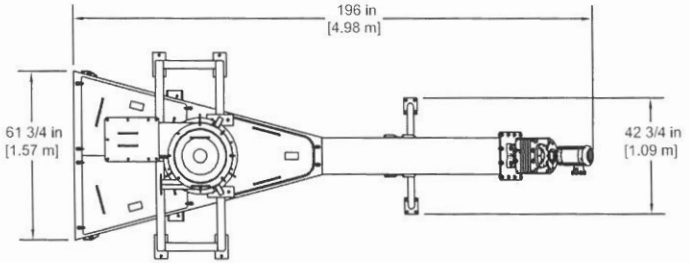
PROJECTION	
IF IN DOUBT ASK	
DATE: 5/16/2023	SCALE: 1:40
DRAWN BY: LS	CHECKED BY: AS / APPROVED BY: LS
Title: PROPOSAL	
24" OPTEACUP SPIRASNAIL COMPACT	
Hydro International, hydro-int.com	
©2021 HYDRO INTERNATIONAL	
WEIGHT: 3099 lbmass	MATERIAL:
STOCK NUMBER:	
DRAWING NO.: -24OTC-SPSC	
SHEET SIZE: B / SHEET: 1 OF 1	Rev: -

HOSE ITEMS
NY
ED BY ANY
VELOPMENT
TIONAL
Y PART
ESIGN
RAWING,
OSE OTHER
WHOLE OR
IONAL.

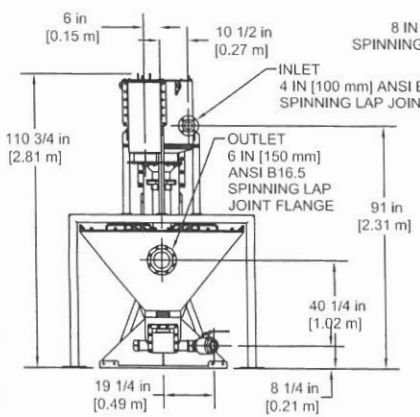
NOTES:
1. DRY WEIGHT = 3,100 lbs [1,410 kg]
2. APPROX. OPERATING WEIGHT WITH WATER AND GRIT = 6,600 lbs [3,000 kg].
3. PROVIDE ADEQUATE CLEARANCE AROUND UNIT FOR
OPERATION AND MAINTENANCE: 18 in [460 mm] AROUND AND 36 in [915 mm] ABOVE.

PLAN VIEW

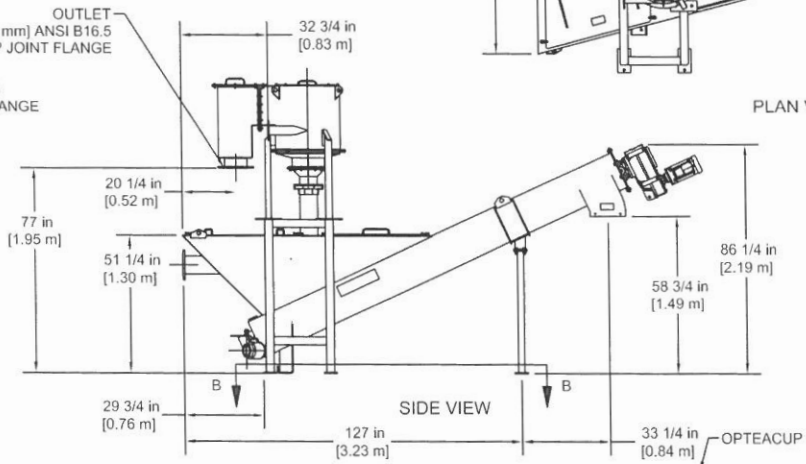
PLAN VIEW



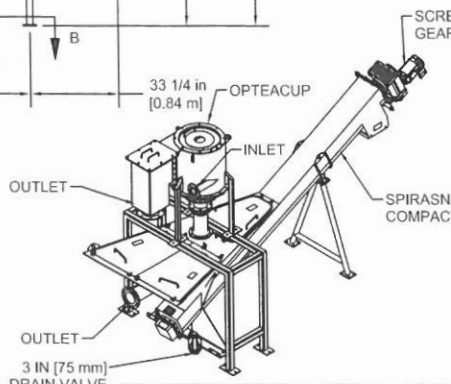
PLAN VIEW

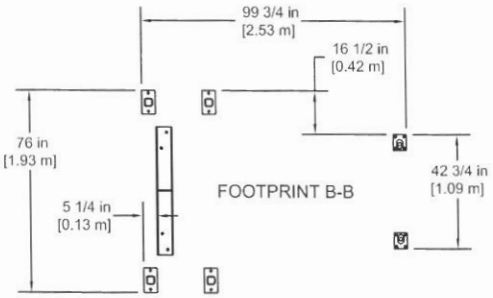


FRONT VIEW



SIDE VIEW





FOOTPRINT B-B

PROJECTION

IF IN DOUBT ASK

DATE:	SCALE:
5/16/2023	1:40

DRAWN BY:	CHECKED BY:	APPROVED BY:
LS	AS	LS

Title:
PROPOSAL

24" OPTEACUP
SPIRASNAIL COMPACT

Hydro International
hydro-int.com

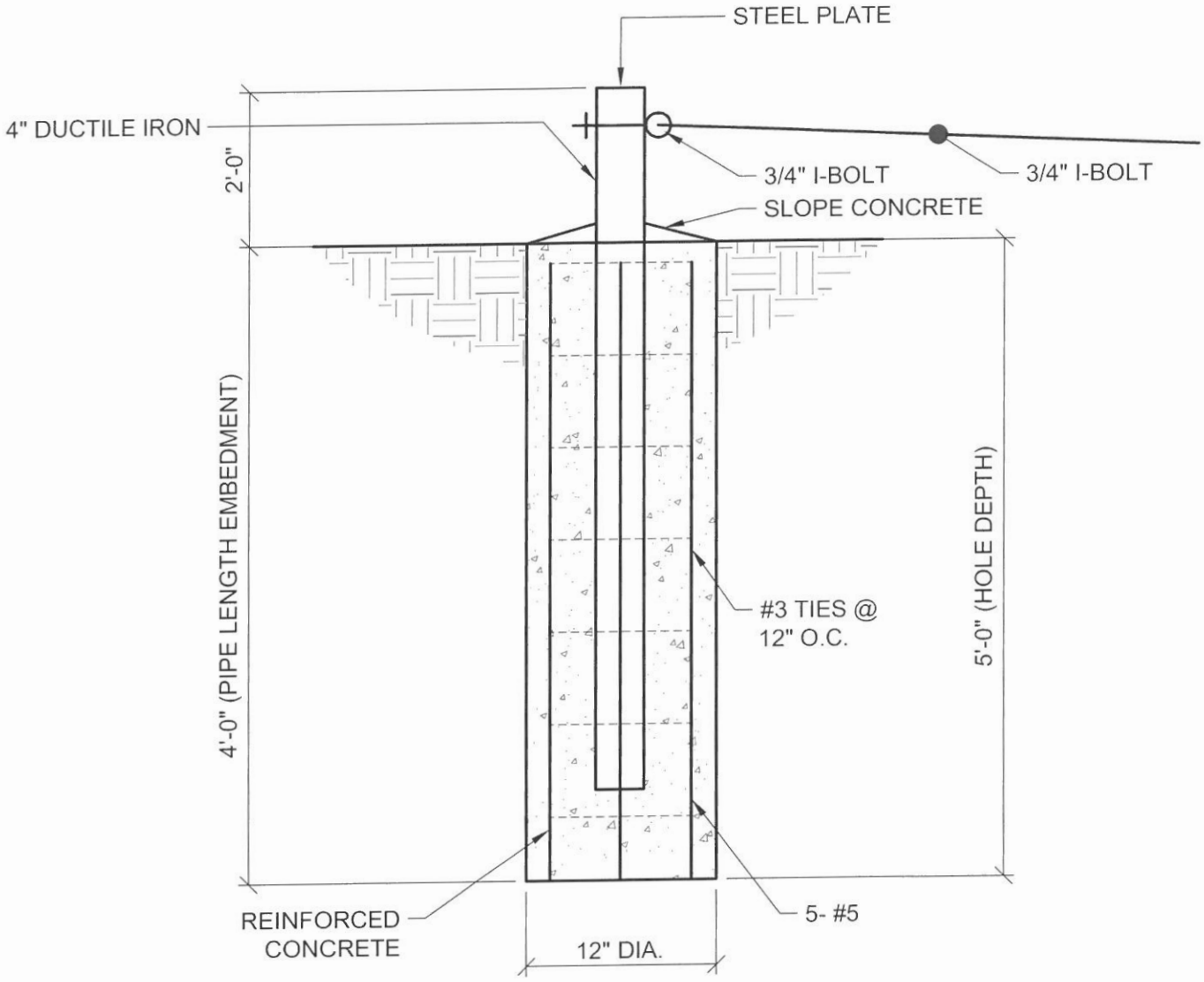
WEIGHT:	MATERIAL:
3099 lbmass	

STOCK NUMBER:

DRAWING NO.:
-24OTC-SPSC

SHEET SIZE:	SHEET:	Rev:
B	1 OF 1	-

Appendix B



D

D-905

MOORING ANCHOR

SCALE: NOT TO SCALE

Appendix C

Wastewater Coating

Code		Service	st Coat nimum Ft. per	Second Coat Minimum	Second Coat Minimum	Third Coat Minimum DFT (mils)	Fourth Coat Minimum	Fifth Coat Minimum DFT (mils)	Total Minimum DFT (mils)	Total Minimum Sq. Ft. per
IE1	Interior	Exposed		2.0		2.0			7.0	
IE2	Interior	Exposed		3.0		2.0			7.5	
IE3	Interior	Exposed		3.0		2.0			11.0	
IE4	Interior	Exposed	55.0	4.0		2.0			18.0	65.0
IE5	Interior	Exposed		4.0		2.0			9.0	
IPC1	Interior	Previously Coa		4.0		2.0			18.0	
IEX1	Interior	Existing		4.0		2.0			9.0	
EE1	Exterior	Exposed		2.0		2.0			6.0	
EE2	Exterior	Exposed		2.0		2.0			7.0	
EE3	Exterior	Exposed		3.0		2.0			7.5	
EE4	Exterior	Exposed		3.0		2.0			7.5	
EE5	Exterior	Exposed		2.0		2.0			6.0	
EE6	Exterior	Exposed		3.0		2.0			11.0	
EB1	Exterior	Buried		40.0					46.0	
EPC1	Exterior	Previously Coa		3.0		2.0			#REF!	
EEX1	Exterior	Existing		4.0		4.0			12.0	
IV1		Immersion/Vapor Zone		4.0		10.0			16.5	
IV2		Immersion/Vapor Zone		30.0		20.0			54.0	
IV3		Immersion/Vapor Zone		125.0		15.0			140.0	
IV4		Immersion/Vapor Zone		125.0					125.0	
IV5		Immersion/Vapor Zone		4.0		10.0			#REF!	

Insurance Requirements

wn expense maintain the following insurance:

ANCE	MINIMUM ACCEPTABLE LIMITS OF LIABILITY
ability	
	$1,000,000.00
bility (any one fire)	$50,000.00
(any one person)	$5,000.00
ertising Injury	$1,000,000.00
te	$2,000,000.00
OP AGG	$2,000,000.00
	$1,000,000.00
n	$1,000,000.00
	$1,000,000.00
lisease	$1,000,000.00
-disease	$1,000,000.00
ty (over primary)	$5,000,000.00
l Omissions) nal services and design construction where lans and specifications is ork or required to rk.)	$3,000,000.00

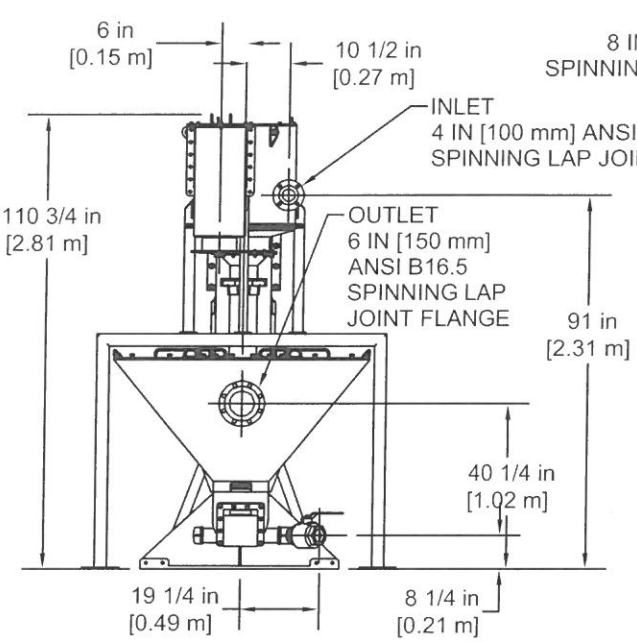
owner, Contractor may be required to provide a certificate of

Liability Contractor agrees to include the owner as an additional
y and non-contributory basis. If contractor utilizes an unmanned
actor is required to provide evidence of liability to cover its
e limit shown under 1.A above. The additional insured status applies
ns, products completed operations, personal injury and advertising
umed under an insured contract.
ctor agrees to include the owner as an additional insured.
ntractor agrees to include the owner as an additional insured on a

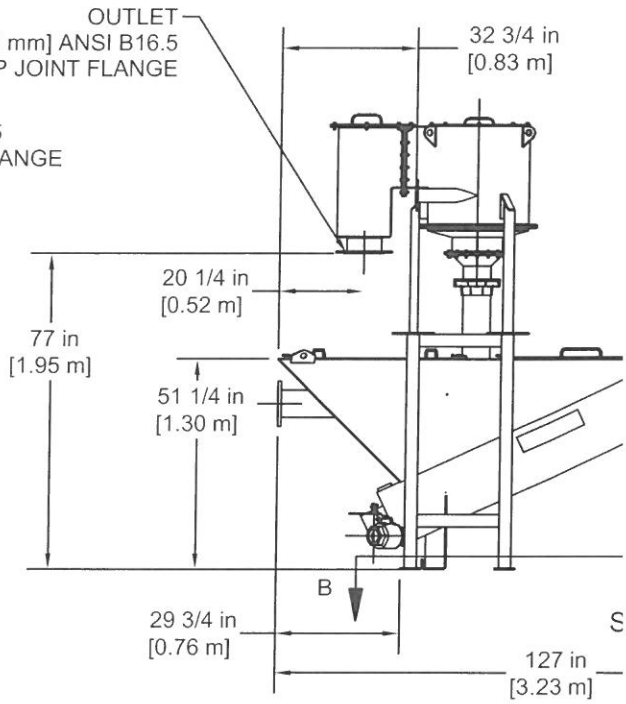
provide Waiver of Rights of Recovery against Others to Us in favor
bility policies shows above.

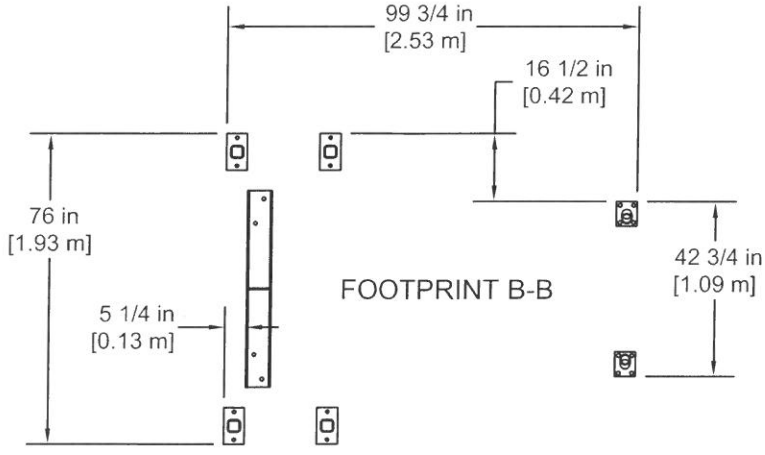
PLAN VIEW

NOTES:
1. DRY WEIGHT = 3,100 lbs [1,410 kg]
2. APPROX. OPERATING WEIGHT WITH WATER AND GRIT = 6,600 lbs [3,000 kg].
3. PROVIDE ADEQUATE CLEARANCE AROUND UNIT FOR
OPERATION AND MAINTENANCE: 18 in [460 mm] AROUND AND 36 in [915 mm] ABOVE.



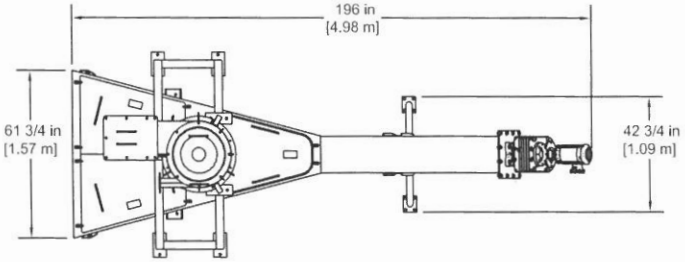
FRONT VIEW



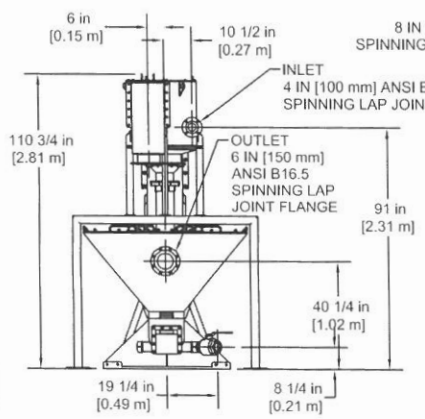


FOOTPRINT B-B

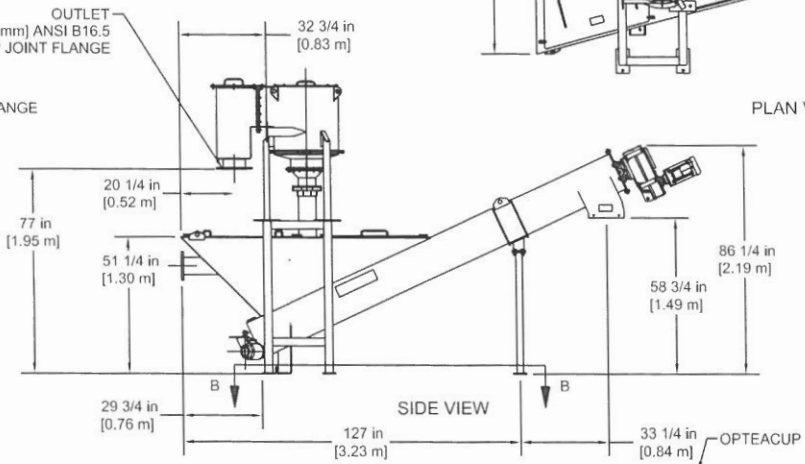
NOTES:
1. DRY WEIGHT = 3,100 lbs [1,410 kg]
2. APPROX. OPERATING WEIGHT WITH WATER AND GRIT = 6,600 lbs [3,000 kg].
3. PROVIDE ADEQUATE CLEARANCE AROUND UNIT FOR
OPERATION AND MAINTENANCE: 18 in [460 mm] AROUND AND 36 in [915 mm] ABOVE.



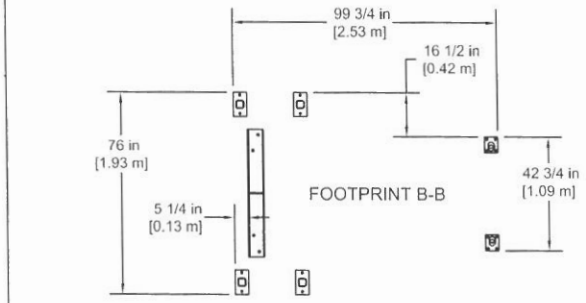
PLAN VIEW



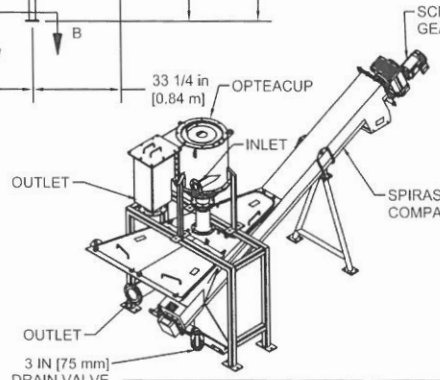
FRONT VIEW



SIDE VIEW



FOOTPRINT B-B



PROJECTION

IF IN DOUBT ASK

DATE: 5/16/2023		SCALE: 1:40
DRAWN BY: LS	CHECKED BY: AS	APPROVED BY: LS

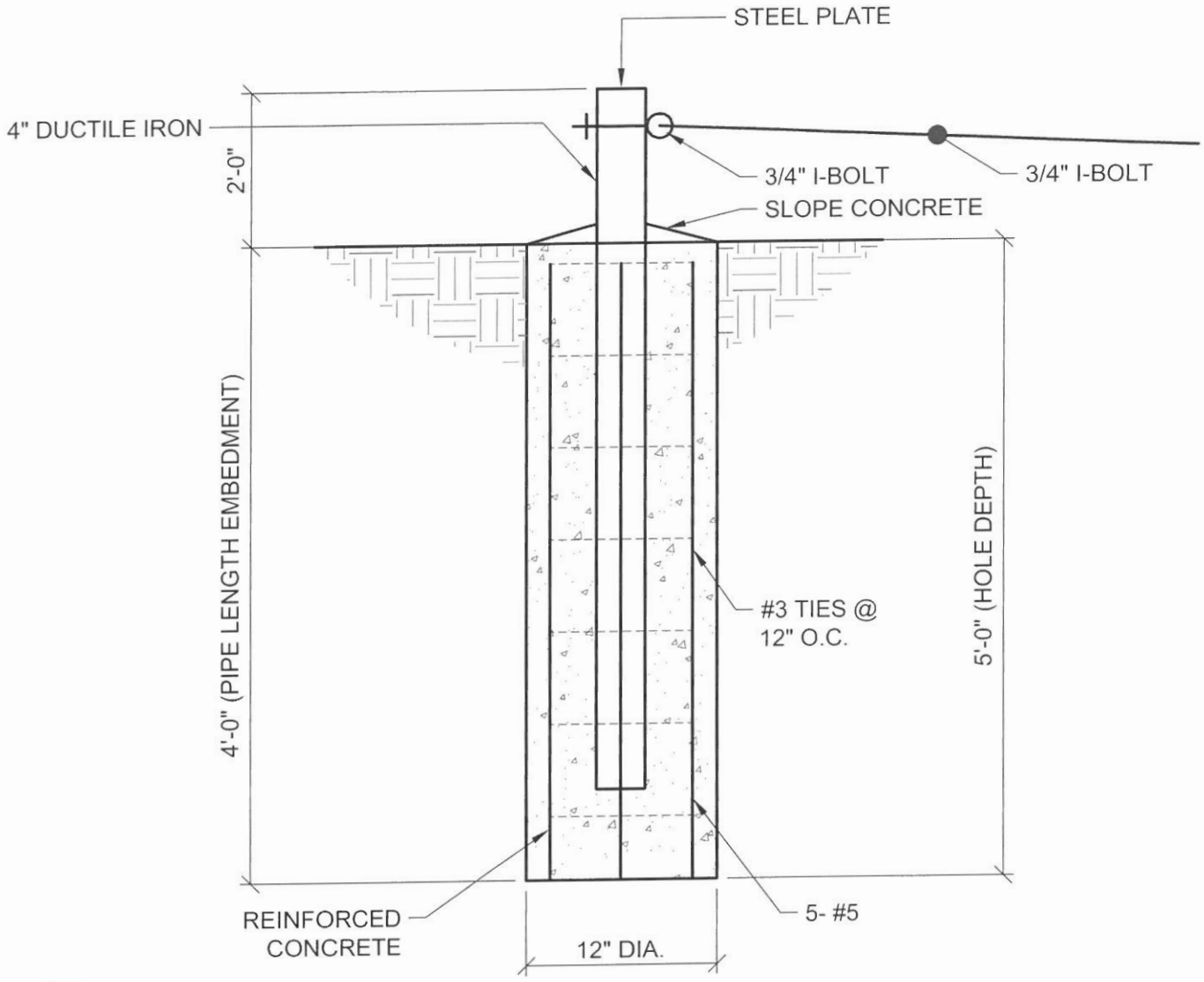
Title: PROPOSAL

24" OPTEACUP
SPIRASNAIL COMPACT

Hydro International
hydro-int.com

WEIGHT: 3099 lbmass		MATERIAL:
STOCK NUMBER:		
DRAWING NO.: -24OTC-SPSC		
SHEET SIZE: B	SHEET: 1 OF 1	Rev: -

Appendix B



D

D-905

MOORING ANCHOR

SCALE: NOT TO SCALE

Appendix C

Wastewater Coating

Code		Service	st Coat nimum Ft. per	Second Coat Minimum	Second Coat Minimum	Third Coat Minimum DFT (mils)	Fourth Coat Minimum	Fifth Coat Minimum DFT (mils)	Total Minimum DFT (mils)	Total Minimum Sq. Ft. per
IE1	Interior	Exposed		2.0		2.0			7.0	
IE2	Interior	Exposed		3.0		2.0			7.5	
IE3	Interior	Exposed		3.0		2.0			11.0	
IE4	Interior	Exposed	55.0	4.0		2.0			18.0	65.0
IE5	Interior	Exposed		4.0		2.0			9.0	
IPC1	Interior	Previously Coat		4.0		2.0			18.0	
IEX1	Interior	Existing		4.0		2.0			9.0	
EE1	Exterior	Exposed		2.0		2.0			6.0	
EE2	Exterior	Exposed		2.0		2.0			7.0	
EE3	Exterior	Exposed		3.0		2.0			7.5	
EE4	Exterior	Exposed		3.0		2.0			7.5	
EE5	Exterior	Exposed		2.0		2.0			6.0	
EE6	Exterior	Exposed		3.0		2.0			11.0	
EB1	Exterior	Buried		40.0					46.0	
EPC1	Exterior	Previously Coat		3.0		2.0			#REF!	
EEX1	Exterior	Existing		4.0		4.0			12.0	
IV1		Immersion/Vapor Zone		4.0		10.0			16.5	
IV2		Immersion/Vapor Zone		30.0		20.0			54.0	
IV3		Immersion/Vapor Zone		125.0		15.0			140.0	
IV4		Immersion/Vapor Zone		125.0					125.0	
IV5		Immersion/Vapor Zone		4.0		10.0			#REF!	

Wastewater Coating

Substrate				Coating System										
Code	Service		Material	Shop Primed	Surface Preparation	Coating Type	First Coat/Primer	First Coat Minimum Sq. Ft. per	Second Coat Minimum	Second Coat Minimum	Third Coat Minimum DFT (mils)	Fourth Coat Minimum	Fifth Coat Minimum DFT (mils)	Total Minimum DFT (mils)	Total Minimum Sq. Ft. per
IE1	Interior	Exposed	Previously Painted Non-Submerged Ferrous Metals or Ductile Iron	No	SSPC-SP3 [3]	Spot Prime - Modified Polyamidoamine Epoxy Full Prime - Modified Polyamidoamine Epoxy Finish - Aliphatic Acrylic Polyurethane	3.0		2.0		2.0			7.0	
IE2	Interior	Exposed	Ferrous	Yes	SSPC-SP10 / NACE 2	Primer - Aromatic urethane, Zinc-Rich Primer Intermediate - High-Build Epoxy Coating - Pure Polyamide Epoxy Finish - Aliphatic Acrylic Polyurethane	2.5		3.0		2.0			7.5	
IE3	Interior	Exposed	Non-Submerged Ferrous Metals & Ductile Iron	Yes	SSPC-SP10 / NACE 2, NAPF 500-03 for Ductile Iron	Primer - Polyamidoamine Epoxy Intermediate - High-Build Epoxy Coating - Pure Polyamide Epoxy Finish - Aliphatic Acrylic Polyurethane	6.0		3.0		2.0			11.0	
IE4	Interior	Exposed	Concrete Masonry Block and Pre-Cast Concrete	No	SSPC-SP13 / NACE 6, ICRI-CSP 2-4	First Coat - Waterborne Cementitious Acrylic Intermediate - Waterborne Acrylic Epoxy Finish - Waterborne Aliphatic Polyurethane	12.0	65.0	4.0		2.0			18.0	65.0
IE5	Interior	Exposed	Concrete	No	SSPC-SP13/NACE 6, ICRI-CSP 2-4	First Coat - Modified Polyamine Epoxy Intermediate - Waterborne Acrylic Epoxy Finish - Waterborne Aliphatic Polyurethane	3.0		4.0		2.0			9.0	
IPC1	Interior	Previously Coated	Concrete	No	SSPC-SP13 / NACE 6	First Coat - Waterborne Cementitious Acrylic Intermediate - Waterborne Acrylic Epoxy Finish - Waterborne Aliphatic Polyurethane	12.0		4.0		2.0			18.0	
IEX1	Interior	Existing	Concrete	No	SSPC-SP13 / NACE 6	First Coat - Modified Polyamine Epoxy Intermediate - Waterborne Acrylic Epoxy Finish - Waterborne Aliphatic Polyurethane	3.0		4.0		2.0			9.0	
EE1	Exterior	Exposed	Factory-Primed Ferrous Metals	Yes	SSPC-SP3 [1], ASTM D6386	First Coat - Phenolic Alkyd Intermediate - Alkyd Coating Finish - Alkyd Coating	2.0		2.0		2.0			6.0	
EE2	Exterior	Exposed	Previously Painted/Primed Non-Submerged Ferrous Metals & Ductile Iron	No	SSPC-SP3 or NAPF 500-03 for Ductile Iron	Spot prime - Modified Polyamidoamine Epoxy Full prime - Modified Polyamidoamine Epoxy Finish - Aliphatic Acrylic Polyurethane	3.0		2.0		2.0			7.0	
EE3	Exterior	Exposed	Ferrous Metals	Yes	SSPC-SP6 / NACE 3	Primer - Aromatic urethane, Zinc-Rich Primer	2.5		3.0		2.0			7.5	
EE4	Exterior	Exposed	Ferrous Metals; Digester Covers, etc.	Yes	SSPC-SP6 / NACE 3	Intermediate - High-Build Epoxy Coating - Pure Polyamide Epoxy	2.5		3.0		2.0			7.5	
EE5	Exterior	Exposed	Factory-Primed/Finished Equipment	No	SSPC-SP10	Finish - Aromatic Urethane, Zinc-Rich Primer or Aliphatic Acrylic Polyurethane	2.0		2.0		2.0			6.0	
EE6	Exterior	Exposed	Non-Submerged Ductile Iron	Yes	NAPF 500-03	Primer - Polyamidoamine Epoxy Intermediate - Polyamide Epoxy Finish - Aliphatic Acrylic Polyurethane	6.0		3.0		2.0			11.0	
EB1	Exterior	Buried	Pre-Cast Concrete	Yes	SSPC-SP13 / NACE 6	Primer - Waterborne Modified Polyamine Epoxy Mortar Finish - Modified Polyamine Ceramic Epoxy	6.0		40.0					46.0	
EPC1	Exterior	Previously Coated	Concrete	No	SSPC-SP13 / NACE 6	Primer - Waterborne Modified Polyamine Epoxy Intermediate - Inorganic Hybrid Water-Based Epoxy Finish - Aliphatic Acrylic Polyurethane	1.0		3.0		2.0			#REF!	
EEX1	Exterior	Existing	Concrete	No	SSPC-SP13 / NACE 6	Primer - Modified Waterborne Acrylate Intermediate - Waterborne Acrylic Epoxy Finish - Modified Waterborne Acrylate	4.0		4.0		4.0			12.0	
IV1	Immersion/Vapor Zone		Ferrous Metals or Ductile Iron Submerged or Intermittently Submerged in Wastewater (Closed Top / Head Space Exposure in Digesters, Secondary Clarifiers, etc.)	Yes	SSPC-SP10 / NACE 2 / NAPF 500-03 for Ductile Iron	Primer - Polyamide Epoxy Intermediate - Modified Polyamide Epoxy Finish - Novolac Epoxy	2.5		4.0		10.0			16.5	
IV2	Immersion/Vapor Zone		Ferrous Metals or Ductile Iron Submerged or Intermittently Submerged in Wastewater (Open Top /No Head Space Exposure in Digesters, Secondary Clarifiers, etc.)	Yes	SSPC-SP10 / NACE 2 / NAPF 500-03 for Ductile Iron	Primer - Modified Aromatic Polyurethane Intermediate - Polyamide Epoxy Finish - Modified Polyamine Epoxy	4.0		30.0		20.0			54.0	
IV3	Immersion/Vapor Zone		Concrete Submerged or Intermittently Submerged in Wastewater (Closed Top / Head Space Exposure in Digesters, Secondary Clarifiers, Lift Stations etc.)	No	SSPC-SP13/NACE 6, ICRI-CSP 5-6	Primer - Modified Polyamine Epoxy Mortar Intermediate - Modified Aliphatic Amine Epoxy Mortar Finish - Modified Polyamine Epoxy	1/16"		125.0		15.0			140.0	
IV4	Immersion/Vapor Zone		Concrete Subjected to High Levels of H2S	No	SSPC-SP13/NACE 6	Filler - Modified Polyamine Epoxy Finish - Aromatic Polyurethane Hybrid	1/8"		125.0					125.0	
IV5	Immersion/Vapor Zone		Ductile Iron Pipe Submerged or Intermittently Submerged in Wastewater (Open Top /No Head Space Exposure in Digesters, Secondary Clarifiers, etc.)	Yes	NAPF 500-03-04	Primer - Polyamidoamine Epoxy Intermediate - Polyamide Epoxy Finish - Modified Polyamine Epoxy	6.0		4.0		10.0			#REF!	

Insurance Requirements

Contractor shall, at their own expense maintain the following insurance:

TYPE OF INSURANCE	MINIMUM ACCEPTABLE LIMITS OF LIABILITY
1. Commercial General Liability	
A. Per Occurrence	$1,000,000.00
B. Fire and Legal Liability (any one fire)	$50,000.00
C. Medical Expense (any one person)	$5,000.00
D. Personal and Advertising Injury	$1,000,000.00
E. General Aggregate	$2,000,000.00
F. Product- COMP/OP AGG	$2,000,000.00
2. Automobile Liability	$1,000,000.00
3. Workers Compensation	$1,000,000.00
A. Each Accident	$1,000,000.00
B. Each Employee-disease	$1,000,000.00
C. Policy Aggregate-disease	$1,000,000.00
4. Umbrella Excess Liability (over primary)	$5,000,000.00
5. Professional (Errors and Omissions) Insurance (For all professional services and design build. Also required for all construction where interpretation of drawings, plans and specifications is included in the scope of work or required to complete the scope of work.)	$3,000,000.00

Upon request from the owner, Contractor may be required to provide a certificate of insurance.

Notes:

A. Commercial General Liability Contractor agrees to include the owner as an additional insured on a primary and non-contributory basis. If contractor utilizes an unmanned aerial vehicle, contractor is required to provide evidence of liability to cover its operation equal to the limit shown under 1.A above. The additional insured status applies to premises, operations, products completed operations, personal injury and advertising injury and liability assumed under an insured contract.
B. Auto Liability Contractor agrees to include the owner as an additional insured.
C. Umbrella Liability Contractor agrees to include the owner as an additional insured on a following form basis.
D. Contractor agrees to provide Waiver of Rights of Recovery against Others to Us in favor of the owner on all liability policies shows above.