

**TECHNICAL SPECIFICATIONS
FOR
MENDOCINO CITY COMMUNITY SERVICES DISTRICT
RECYCLED WATER PROJECT**



3/25/2026



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SECTION 01 10 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 PROJECT DESCRIPTION

- A. The project is located in Mendocino, California. The work includes, but is not limited to, furnishing all labor, equipment, materials, and supplies to construct new recycled water pipelines and appurtenances; irrigation services; irrigation system; a new 250,000-gallon recycled water storage tank; replacement sewer main and manholes; and upgrades to the wastewater treatment plant's (WWTP) aeration system, disinfection system and recycled water production, storage and pumping system. The work will also include the replacement of the liner system for the equalization basin, and an upgrade to the plant utility water system.
- B. Work includes clearing and grubbing; excavation and fill; trenching; horizontal directional drilling; grading; reinforced concrete; demolition/ abandonment of existing utilities; installing recycled water mains, including fittings, flow meters, pressure reducing valves, check valves, gate valves, fire hydrants, seismic joints, and associated piping and appurtenances; a chlorine generation system; replacement and rehabilitation of aeration piping; pumps; electrical and instrumentation improvements; telemetry equipment; backfill and compaction; pavement and gravel surface restoration, and all other work described in the plans and specifications in accordance with the Contract Documents.
- C. Base Bid: The Base Bid includes Schedules A through E. For the determination of the apparent low Bidder, the total amount for each Bid shall be the sum of the Base Bid Schedules A through E. These are:
 - 1. Schedule A: Recycled Water Distribution System
 - 2. Schedule B: Stainless Steel Recycled Water Tank
 - 3. Schedule C: Friendship Park Irrigation System
 - 4. Schedule D: Wastewater Treatment Plant Improvements
 - 5. Schedule E: Sewer Main Replacement
- D. Alternate Bid: District may award some or all Alternate Bid Schedules F through H. District may award Alternate Bid Schedule I in lieu of Base Bid Schedule B. These are:
 - 1. Schedule F: Replace Equalization Basin Liner
 - 2. Schedule G: Replace Filter Backwash Return Pipe
 - 3. Schedule H: Existing Chlorine Contact Basin Baffles
 - 4. Schedule I: Bolted Glass-Fused-to-Steel Tank
- E. All work to be performed is located at the Mendocino City Community Services District (MCCSD or District) WWTP, on Ukiah Street, Kasten Street, Little Lake Street, Lansing Street, Little Lake Road, School Street, State Route 1 and property owned by the Mendocino Unified School District (MUSD) at Mendocino High School, Friendship Park, Community Center of Mendocino, and the Mendocino K-8 School, as shown on the Contract Documents.
- F. Questions regarding the work should be directed to the Engineer.
- G. The Contractor shall coordinate all related work with affected parties including, but not limited to the California Department of Transportation, County of Mendocino, Mendocino City Community Services District, Mendocino Unified School District, Pacific Gas and Electric Company, AT&E and CableCom.

- H. The Contractor shall take careful and accurate pre-construction photographs and video of the existing conditions prior to the start of construction. Copies of the photographs and video must be delivered to the Engineer prior to start of construction.
- I. The Contractor shall provide a detailed schedule of work. See Section 01 32 16, "Construction Progress Schedules," for schedule requirements. Contractor shall coordinate daily with the District.

1.2 RELATED SECTION:

- A. Contract General Conditions.

1.3 APPLICABLE CODES

- A. In instances where these specifications do not state exact materials or methods of construction, the applicable minimum requirements of the 2022 edition of the California Building Code shall govern, as amended by local agencies.
- B. In instances where these specifications do not state exact specifications or lack specifications, the 2025 California Department of Transportation Standard Specifications.

1.4 SEQUENCE AND SPECIAL CONDITIONS

- A. After the Notice to Proceed has been issued, the Contractor shall immediately begin work on items that can be completed prior to mobilization, including obtaining County of Mendocino Encroachment Permit, California Department of Transportation Encroachment Permit, District and Engineer approval of critical path and long lead product and material submittals, procurement of products and materials and related services. These include submittal preparation, and purchase of materials, and delivery and storage of materials off the construction site. Purchased materials may be submitted for payment if they are stored at a site where the District has access for inspection. The Contractor is responsible for all security and any material loss or damage.
- B. The Contractor may mobilize materials and equipment to the project site upon approval of the District and Engineer.
- C. The Contractor shall phase construction activities to ensure a continuous and uninterrupted operation of the WWTP, collection system, MUSD water system and other utility systems not owned and operated by the District.
- D. Coordination with Others: The Contractor is advised that the site of the recycled water tank contains an active potable and fire water supply and storage system owned and operated by MUSD which must remain in operation during construction. The Contractor shall coordinate work activities with MUSD and their contract water system operator to ensure a continuous potable water supply. The MCCSD WWTP must remain in continuous operation during construction, except for partial system shut downs to complete Work as permitted under this contract with District approval.
- E. Prebid Conference. A prebid conference will be held to afford all bidders an opportunity to request information or interpretations of the drawings and specifications and to visit the sites. The time of this meeting and inspection of the construction site is provided in the Notice to Bidders.
- F. At least two weeks prior to the start of construction, Contractor shall contact Underground Service Alert (USA) at (800) 642-2444 or 811 for utility mark outs and to pothole all existing utilities that are in the vicinity of the work where required. Contractor shall survey the horizontal and vertical location to determine the position and elevation of each utility exposed

by Contractor's potholing. Contractor shall provide a copy of the survey with horizontal coordinates and vertical elevations to the Engineer as potholing progresses. Notify the Engineer if any differences are noted and if there are any conflicts anticipated.

- G. Contractor shall proceed with construction in a manner that limits the inconvenience to traffic, complies with encroachment permit requirements, and minimizes inconvenience to the property owners adjacent to the construction area.
- H. All costs of construction staging, phasing, or sequencing shall be included in the Contractor's bid. No additional compensation will be made therefore.

1.5 SUBSTANTIAL COMPLETION

- A. Substantial Completion is defined as "the time at which the new recycled water distribution system, recycled water storage tank, Friendship Park irrigation system, sewer main replacement, and WWTP improvements, as defined in the Base Bid Schedules A through E and any awarded Bid Alternates items are operational" and can be used for the purpose for which it is intended. This includes completion of hydrostatic testing, leak testing, calibration of instrumentation and controls and SCADA system, commissioning of pumps, valves, chlorine generation system, coagulant system, instruments, and the storage, distribution and irrigation systems are fully functional and operable, including other preparations and proof of Regional Water Quality Control Board acceptance, as necessary for District's use. Include the Substantial Completion date as a project milestone of the progress schedule required under Section 01 32 16 – Construction Progress Schedule.

1.6 FINAL COMPLETION

- A. Final Completion: Final Completion is defined as completing and obtaining District acceptance of all Work required under this Bid. Work includes punch list work, warranty work, replacement work and warranty periods required by law or this bid. Final Completion shall be no later than 60 calendar days following Substantial Completion. Include the Final Completion date as a project milestone of the progress schedule required under Section 01 32 16 – Construction Progress Schedule.

1.7 FACILITY OPERATIONS

- A. Continuous operation of District's and other affected utility's facilities is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified.
- B. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of District's operations.
- C. When necessary, plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items to maintain continuous operations of District's facility.
- D. Do not close lines, open or close valves, or take other action that would affect the operation of existing systems, except as specifically required by the Contract Documents and after authorization by District and Engineer. Such authorization will be considered within 48 hours after receipt of Contractor's written request.
- E. Process or Facility Shutdown:
 - 1. Provide seven (7) calendar days advance written request for approval of need to shut down a process or facility to District and Engineer.

2. Power outages will be considered upon 48 hours written request to District and Engineer. Describe the reason, anticipated length of time, and areas affected by the outage. Provide temporary provisions for continuous power supply to critical facility components.
- F. Install and maintain bypass facilities temporary connections required to keep District's sewer system operations online. Sequences other than those specified will be considered upon written request to District and Engineer, provided they afford equivalent continuity of operations.
- G. Do not proceed with Work affecting a facility's operation without obtaining District's and Engineer's advance approval of the need for and duration of such Work.
- H. Relocation of Existing Facilities:
 1. During construction, it is expected that minor relocations of Work will be necessary.
 2. Provide complete relocation of existing structures and Underground Facilities, including piping, utilities, equipment, structures, electrical conduit wiring, electrical duct bank, and other necessary items. Call USA Underground Service Alert (1-800-227-2600 or 811).
 3. Use only new materials for relocated facility. Match materials of existing facility, unless otherwise shown or specified.
 4. Perform relocations to minimize down time of existing facilities.
 5. Install new portions of existing facilities in their relocated position prior to removal of existing facilities, unless otherwise accepted by Engineer.

1.8 CONTRACTOR USE OF SITE AND PREMISES

Limit use of site and premises to allow:

- A. District occupancy. The Contractor shall coordinate any utility shutdowns or cut-overs with the District, MUSD and other utility owners. The Contractor shall allow for unlimited District access to the project site through the duration of construction.
- B. Use of site by the public when permitted.
- C. Work by other contractors.
- D. The Contractor shall cooperate fully with the District, MUSD and other Contractors to provide continued access to their respective work sites. The Contractor's failure to do so shall not constitute the basis for delay claims by the Contractor.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Contractor shall receive, unload, store in a secure place, and deliver from storage to the site all materials and equipment required for the performance of the work. The storage facilities and methods of storing shall be designed to keep such materials and equipment in a new condition, free from deterioration and protected from damage by weather or construction activities. Such facilities and methods are subject to the Engineer's approval and the Engineer shall have the right to inspect all storage facilities and stored materials and equipment at reasonable times. Materials and equipment subject to degradation by outside exposure or the elements, such as mechanical equipment, building insulation, ornamental metal fabrications, gypsum board or case work, shall be suitably stored by Contractor in an indoor weather tight enclosure provided by the Contractor. Contractor shall keep complete and accurate records of all materials and equipment received, stored, and delivered for use in the work. Such records shall be made available for inspection by the Engineer.

1.10 ARCHAEOLOGICAL AND HISTORICAL DISCOVERIES

- A. The Contractor shall immediately stop work if paleontological, archaeological or historical remains (including burials or skeletal material) are encountered during performance of this contract. The Contractor shall promptly notify the designated Inspector or the Engineer (if the Inspector is absent or one was not designated for this contract).
- B. After receiving such notification, the Engineer will contact an Archaeologist so that the provisions of 36 CFR 800.7 (Resources Discovered During Construction) and other relevant laws are followed. Work will cease in the immediate vicinity until permitted by written order from the Engineer. The Contractor may proceed with work in other areas as approved by the Archaeologist.

1.11 DRAWINGS

- A. Contractor shall use approved drawings. Any questions shall be brought to the attention of the Engineer. Any revisions or clarifications to the drawings will be issued in writing.

1.12 COORDINATION OF DOCUMENTS GOVERNING THE WORK

- A. The standard District forms, specifications, associated plans, solicitation provisions and contract clauses, made a part of the contract are essential parts thereof and the requirements in one are as binding as though contained in all. They are intended to be mutually supplementary to describe and provide for complete work.
- B. All discrepancies in the Drawings shall be brought to the attention of the Engineer for resolution. Drawings shall not be scaled to obtain missing or conflicting dimensions. The Contractor shall keep a check on dimensions and details as the work progresses and any errors or discrepancies discovered shall be promptly reported to the Engineer.
- C. In cases of conflict between plans, specifications, contract provisions, supplemental agreements and provisions, the provisions of contract shall govern. In all cases of dispute in respect to such conflict or as to what part or parts of the specifications apply to any given parts of the work, decisions shall be made by the Engineer.

1.13 COPIES OF DRAWINGS AND SPECIFICATIONS

- A. Full size prints shall be used for construction. The Contractor will be furnished with one (1) hard copy and electronic copies of the Drawings and specifications and will be responsible for providing additional hard copies of the Drawings and specifications he/she may require to carry on the work in a satisfactory manner. The Contractor shall also be responsible for providing copies of the Drawings and specifications to all subcontractors and trades performing work under this contract.

1.14 EXISTING UTILITIES AND OBSTRUCTIONS

- A. Unless otherwise permitted by the District, the Contractor shall conduct his operations in a manner that will permit continuous operation of all utilities. The locations of existing underground utilities and structures, as can be determined from record information, have been shown on the Drawings. The Contractor is responsible for contacting local utilities agencies at least 72 hours (or with more advance notice if required by the utility company or local agency) before excavation so that utilities may be marked in the field. Locations of existing utilities as shown on the Drawings are only approximate. The Engineer assumes no responsibility for the accuracy or completeness of said data, which is offered solely for the convenience of the Contractor.

- B. It shall be the responsibility of the Contractor to verify the exact location of all utilities. This verification shall be done far enough ahead of excavation to ensure that the excavations can be located as shown and that the planned line and grade will clear any obstructions. Prior to the start of construction, the locations of crossings of existing utilities shall be exposed to verify that planned line and grade are adequate to provide minimum clearance.
- C. Contractor shall include in their bid adjustments up to four feet horizontally and two feet vertically in the recycled water pipeline to accommodate actual field conditions and locations of existing utilities.
- D. The Contractor shall relocate any utility conflicting with line and grade of the new utilities and facilities. Contractor shall prepare a plan for relocation of any utility. Said plan must be reviewed and approved by the Engineer prior to commencement of the work. Disruption of utility services shall be kept to a maximum of 2 hours total for any one service.
- E. Any changes required in line or grade of the new facilities, due to interferences with existing utilities or other obstructions, shall be performed by the Contractor and shall have prior approval of the Engineer. If the Contractor fails to adequately verify the locations of utilities or tie-ins, and such failure necessitates additional fittings and /or the removal of previously laid pipe, to adjust the line or grade, then the cost of such changes shall be borne entirely by the Contractor.

1.15 RESTORATION OF EXISTING IMPROVEMENTS

- A. Existing paving, curbs, gutters, sidewalks, utilities, landscaping, irrigation systems, planting or other improvements removed, damaged or disturbed due to the installation of new work and appurtenances shall be replaced in kind to the satisfaction of the Engineer and owning agency at no additional expense to the District.

1.6 PRE-CONSTRUCTION CONFERENCE

- A. Refer to Section 01 30 00, "Administrative Requirements" for required attendees. Scheduling and location of the Pre-Construction Conference shall be confirmed with the District and the Engineer at least 14 days prior to the meeting, and no more than 10 days after the Notice to Proceed.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 GENERAL

- A. Contract Bid Items are a combination of unit prices and lump sum prices.
- B. This Section describes each Contract Bid Item, including the materials, equipment and labor included for payment within each bid item.
- C. This Section defines the process whereby the Schedule of Values (lump sum price breakdown) shall be developed and utilized by the Contractor for preparation of Contractor's Progress Payment Requests.
- D. All lump sum price breakdown items shall include all manpower, equipment and material costs such that the total of all items equals the Contract Bid Price.
- E. The Contractor shall install all equipment and appurtenances required to construct the complete, fully operational system as specified and shown in the project drawings and specifications to receive full contract payment upon completion.
- F. Payment for the various items of the Bid Schedule, as further specified herein, shall include all compensation to be received by the Contractor for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, operations, and incidentals appurtenant to the items of Work being described, as necessary to complete the various items of the Work in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of permits and cost of compliance with the regulations of public agencies having jurisdiction, including Division of Drinking Water, Safety and Health Requirements of the California Division of Industrial Safety and the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). No separate payment will be made for any item that is not specifically set forth in the Bid Schedule, and all costs therefore shall be included in the prices named in the Bid Schedule for various appurtenant items of Work.

1.2 SCHEDULE OF VALUES

- A. A Schedule of quantities is included at the end of this section for the major components of the various lump sum Base Bid items. Contractor shall provide associated schedule of values corresponding to the schedule of quantities for payment purposes. Overhead and profit shall not be shown as a separate item and each line item shall include pro-rated amounts for the Contractor's costs, overhead, profit, temporary facilities, and other expenses in connection with the item of work. The total of all items listed in the schedule shall be equal to the lump sum bid contract amount. The items included in each Schedule of Values shall include the major Work components of the bid item.
- B. The Engineer shall review the preliminary Schedule of Values and make any adjustments in the listing of major Work components of the bid item and associated value allocations if, in the opinion of the Engineer, these are necessary to establish fair and reasonable allocation of values for the major Work components. Front end loading will not be permitted. The Engineer may require reallocation of major Work components from items in the above listing if in the opinion of

the Engineer such reallocation is necessary. This review and any necessary revisions shall be completed within fifteen (15) days from the date of the Notice of Proceed.

- C. Mobilization/Demobilization. Payment for mobilization and demobilization shall be based on the lump sum price established in the bid schedule and paid for monthly in a percentage amount as completed. Maximum value not to exceed five percent (5%) of total contract Base Bid price.

1.3 CHANGES TO SCHEDULE OF VALUES

- A. In the event that the Contractor and Engineer agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made.
- B. Revise schedule to list approved Change Orders with each Application for Payment.

1.4 APPLICATION FOR PAYMENT

- A. Submit electronic file in Microsoft Excel and Adobe PDF of each Application for Payment on EJCDC C-620 - Contractor's Application for Payment. Alternative equivalent formats are acceptable with approval of the Engineer.
- B. Content and Format: Use Bid Item list and Schedule of Values for listing items in Application for Payment.
- C. Submit updated construction schedule with each Application for Payment.
- D. Payments: General Conditions Article 15.
- E. Substantiating Data: When Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
 - 1. Partial release of liens from major Subcontractors and vendors.
 - 2. Affidavits attesting to off-Site stored products.

1.5 CHANGE PROCEDURES

- A. Submittals: Submit name of individual who is authorized to receive change documents and is responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. Carefully study and compare Contract Documents before proceeding with fabrication and installation of Work. Promptly advise Engineer of any error, inconsistency, omission, or apparent discrepancy.
- C. Requests for Interpretation (RFI) and Clarifications. Use AIA G716—Request for Information and CSI Form 13.2A—Request for Interpretation for requesting interpretations unless otherwise approved by Engineer.
 - 1. Submit all RFIs in writing in a format approved by the Engineer.
 - 2. Allot time in construction scheduling for liaison with Engineer; establish procedures for handling queries and clarifications.
 - 3. Engineer shall provide written responses to RFIs within 7 calendar days.
- D. Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions to Contractor.

- E. Engineer may issue Proposal Request or Notice of Change including a detailed description of proposed change with supplementary or revised Drawings and Specifications, a change in Contract Time for executing the change and with the period of time during which the requested price will be considered valid. Contractor will prepare and submit estimate within 14 calendar days.
- F. Contractor may propose changes by submitting a request for change to Engineer describing proposed change and its full effect on the Work. Include a statement describing reason for the change and the effect on Contract Sum/Price and Contract Time with full documentation, time impact analysis and a statement describing effect on the Work by separate or other Contractors. Refer to General Conditions, Article 11.
- G. Stipulated Sum/Price Change Order: Based on Notice of Change and Contractor's fixed price quotation.
- H. Unit Price Change Order: For Contract unit prices and quantities, the Change Order will be executed on a fixed unit price basis. For unit costs or quantities of units of that which are not predetermined, execute Work under Construction Change Directive. Changes in Contract Sum/Price or Contract Time will be computed as specified for Change Order.
- I. Construction Change Directive: Architect/Engineer may issue directive, on Construction Change Directive signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.
- J. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Architect/Engineer will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.
- K. Maintain detailed records of Work done on time and material basis. Provide full information required for evaluation of proposed changes and to substantiate costs for changes in the Work.
- L. Document each quotation for change in Project Cost or Time with sufficient data to allow evaluation of quotation.
- M. Execution of Change Orders: Architect/Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.
- N. Correlation of Contractor Submittals:
 - 1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
 - 2. Promptly revise Progress Schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of Work affected by the change, and resubmit.
 - 3. Promptly enter changes in Record Documents.

1.6 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. If, in the opinion of Engineer, it is not practical to remove and replace the Work, Engineer will direct appropriate remedy or adjust payment.

- C. The defective Work may remain or will be partially repaired according to instructions of Engineer, but unit sum/price will be adjusted to new sum/price at discretion of Engineer and Owner.
- D. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.
- E. Authority of Engineer and Owner to assess defects and identify payment adjustments is final.
- F. Nonpayment for Rejected Products: Payment will not be made for rejected products for any of the following reasons:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from transporting vehicle.
 - 4. Products placed beyond lines and levels of the required Work.
 - 5. Products remaining on hand after completion of the Work.
 - 6. Loading, hauling, and disposing of rejected products.

1.7 UNIT PRICES

- A. Take measurements and compute quantities. District will verify measurements and quantities.
- B. Unit Quantities: Quantities and measurements indicated on Bid Form are for Contract purposes only. The actual quantities provided shall determine payment.
 - 1. When actual Work requires more or fewer quantities than those quantities indicated, provide required quantities at contracted unit sum/prices.
 - 2. When actual Work requires 10 percent or greater change in quantity than those quantities indicated, Owner or Contractor may claim a Contract Price adjustment.
- C. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application, or installation of item of the Work; overhead and profit.
- D. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Engineer multiplied by unit sum/price for Work incorporated in or made necessary by the Work.
- E. E. Measurement of Quantities:
 - 1. Weigh Scales: Inspected, tested, and certified by applicable State weights and measures department within past year
 - 2. Platform Scales: Of sufficient size and capacity to accommodate conveying vehicle.
 - 3. Metering Devices: Inspected, tested, and certified by applicable State department within past year.
 - 4. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel, or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
 - 5. Measurement by Volume: Measured by cubic dimension using mean length, width, and height or thickness.
 - 6. Measurement by Area: Measured by square dimension using mean length and width or radius.
 - 7. Linear Measurement: Measured by linear dimension, at item centerline or mean chord
 - 8. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of the Work.

1.8 ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the District's option. Accepted Alternates will be identified in District-Contractor Agreement. The District-Contractor Agreement may identify certain Alternates to remain a District option for a stipulated period.
- B. Coordinate related Work and modify surrounding Work. Description for each Alternate is recognized to be abbreviated but requires that each change shall be complete for the scope of Work affected.
 - 1. Coordinate related requirements among Specification Sections as required.
 - 2. Include as part of each Alternate: Miscellaneous devices, appurtenances, and similar items incidental to or necessary for complete installation.
 - 3. Coordinate Alternate with adjacent Work and modify or adjust as necessary to ensure integration.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 22 00

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 GENERAL

- A. Unless otherwise specified in other individual sections of these Specifications, quantities of work shall be determined from measurements or dimensions in horizontal planes. However, linear quantities of pipe shall be considered as being the horizontal length as measured along the ground surface.
- B. Units of measurement shall be in accordance with U.S. Standard Measures.
- C. Materials and unit price items of work are to be paid for on a measurement basis in accordance with Part 2 of this section.

1.2 LUMP SUM PRICE BREAKDOWN (SCHEDULE OF VALUES)

- A. Immediately after award of the Contract and prior to approval of initial payment request, the Contractor shall submit a cost breakdown list (Schedule of Values) to the Engineer for all lump sum bid items. This list shall consist of the major components of work that make up the lump sum bid items and shall be used for determining progress pay estimates. The Contractor shall fill in the amounts for each component, prorating general costs (such as, setup, overhead, and profit) in each component. The total of all components of each lump sum bid item shall equal the total of that lump sum bid item. If the amount indicated in the Contractor's Schedule of Values for any item on the list appears unbalanced, the Engineer may request that the Contractor revise the item as deemed necessary by the Engineer, unless the Contractor can substantiate these costs.
- B. Only work items of value to the Owner shall be included in the list. An item for cleanup shall be listed in the breakdown, in the amount of at least one quarter of one percent (0.25%) of the total bid item. If cleanup proceeds as the job progresses, then partial payments of these amounts will be made accordingly.

PART 2 PRODUCTS

2.1 BID ITEMS

- A. The Bid Amounts for each Bid Item will be used for comparative bid analysis. The Bid amounts will also form the basis of monthly progress payments. Each Lump Sum bid amount will undergo further breakdown as described previously in this section. Bid items are not intended to be exclusive descriptions of Work categories and the Contractor shall determine and include in its pricing all materials, labor, and equipment necessary to complete each Bid Item (Work phase) as shown and specified.
- B. All pay line items will be paid for at the prices named in the Bid Schedule for the respective items of Work. The quantities of work or materials stated as unit price items on the Bid Schedule are supplied only to give an indication of the general scope of the Work.

- C. Payment for dewatering, field engineering and all other work required to complete the work in this contract is included in the various items of work. No separate payment will be made for any of these items of work.
- D. A bid item quantity shown as a final (F) pay item is for payment purposes only. For a final pay item, accept payment based on the Bid Item List quantity, regardless of the actual quantity used unless dimensions are changed by the Engineer.
- E. All bid items including pipelines, conduits, vaults and buried valves, including but not limited to recycled water mains, recycled water services, sewer mains, storm drains, electrical conduits and telecommunication conduits shall include, but not be limited to sawcutting and removing pavement, removal of AC dikes and berms, removal of concrete, excavation and disposal of trench material, root pruning, bedding, pipe, joints and other fittings as required, pipe embedment material, import backfill material, tunnelling above and below existing utilities, underground detection tape, tracer wire, concrete thrust blocks, potholing existing utilities as required to positively verify their location and for adequate protection, supporting exposed utilities and pipes, trench backfill, protective trench cover, polyethylene wrap, bedding and cover on existing utility conduits and pipes, compaction, control of grades, control of groundwater, dewatering, cleaning, flushing, testing, removal and replacement of signs and mailboxes, temporary paving or trench plating, permanent paving and surfacing, replacement of AC dikes and berms, replacement of vehicle detector loops, replacement of concrete, traffic markers, alignment survey staking, field engineering and all other related work as described in the Contract Documents unless otherwise included in another bid item.
- F. Contractor shall include in their bid minor adjustments of up to three feet in the recycled water pipeline horizontal alignment, which may be necessary during construction to avoid existing underground utilities and full lane repaving.

2.2 BASE BID ITEM DESCRIPTIONS

- A. **SCHEDULE A: Recycled Water Distribution.** The following SCHEDULE A Bid item descriptions are numbered in accordance with Bid Schedule A in the Bid Proposal Form.
 - 1. Bid Item A-1: Mobilization and Demobilization
Full compensation for **Mobilization and Demobilization** will be paid for at the contract **lump sum** price, which price shall constitute full compensation for all such work. Maximum value shall not exceed five percent (5%) of total Schedule A contract price. The scope of work for Mobilization shall include, but not be limited to, obtaining all bonds, insurance and permits, moving onto and out of the site of all plant and equipment, submitting a construction schedule, obtaining approval of a schedule of values for lump sum items and approval of critical path submittals. Payment for Mobilization shall not exceed 75% of the contract lump sum price. Payment for Demobilization shall occur when all required items per the contract are fulfilled and the site is free of equipment and clean and ready for use by the public as determined by the Engineer.
 - 2. Bid Item A-2: Water Pollution Control
Full compensation for **Water Pollution Control** will be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for preparing and obtaining approval for a Water Pollution Control Plan (WPCP) for the project and for implementation of the WPCP, including furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in installing temporary erosion control measures within the limits shown on the Plans, approved WPCP and as specified in the Standard Specifications and these Technical Specifications, including but not limited to temporary construction fence, silt fence, seed, hydroseed, fiber rolls, erosion control blankets, covers, gravel bags, filter bags, hydraulic mulch, tacked straw, top soil, fine grading, cleaning and removing sediment

deposits inside existing storm drains and drainage ditches, sampling, testing and reporting, and related work as enumerated in the Plans and these Specifications.

3. Bid Item A-3: Temporary Traffic Control

Full compensation for **Temporary Traffic Control** will be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for preparing and obtaining approval for a Traffic Control Plan as part of County of Mendocino Department of Transportation Encroachment Permit and California Department of Transportation Encroachment Permit, and for implementation of the TCP, including furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in installing and maintaining temporary traffic control measures within the limits shown on the Plans and beyond as necessary to provide safe passage of vehicular and non-vehicular traffic, as specified in the Standard Specifications and these Technical Specifications, including but not limited to temporary construction delineators, striping, signing, flagging, staging, and reporting, and related work, as enumerated in the Plans and these Specifications.

4. Bid Item A-4: Trench Sheet piling, Shoring and Bracing

Full compensation for **Trench Sheet piling, Shoring and Bracing** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in trench bracing, sheet piling and shoring or equivalent method as needed to construct the distribution system including but not limited to that required by Sections 6700-6708 of the Labor Code as specified herein.

5. Bid Item A-5: Reservoir Site and Utility Improvements

Full compensation for **Tank Site and Utility Improvements** will be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the construction of the recycled water tank site piping, check valves and vault, gate valves, flexible expansion joints, drain pipes, drain and overflow inlet, pipe supports, bollards, electrical and instrumentation, excavation, backfill, resurfacing and site restoration, all items of work described in Paragraph 2.1.E, and related work, as enumerated in the Plans and these Specifications, and no additional allowances will be made therefor.

6. Bid Item A-6: Reservoir Site Excavation

Full compensation for **Reservoir Site Excavation** will be paid for at the contract **cubic yard final (CY-F)** price, which final price and quantity shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the soil excavation and subgrade preparation improvements for the recycled water tank foundation pad, as enumerated in the Plans and these Specifications, and no additional allowances will be made therefor.

7. Bid Item A-7: Reservoir Site Fill

Full compensation for **Reservoir Site Fill** will be paid for at the contract **cubic yard final (CY-F)** price, which final price and quantity shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the filling and compaction of the foundation pad for the recycled water tank foundation, as enumerated in the Plans and these Specifications, and no additional allowances will be made therefor.

8. Bid Item A-8: Open-Trench Recycled Water Main, AC Pavement Surface Restoration

Full compensation for **Open-Trench Recycled Water Main, AC Pavement Surface Restoration** will be paid for at the contract unit price per **linear foot (LF)** for each size shown on the bid schedule, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in establishing lines and grades and constructing open-trench new recycled water mains including but not limited to, permits, saw cutting, trench excavation, subgrade preparation, scarification, moisture conditioning, pipe bedding, pipeline materials, fittings, joint restraint, installation, backfilling, compaction, connections to existing pipelines and irrigation services, removal and disposal of abandoned asbestos-cement pipe in conflict with the work,

- abandonment, quality control testing, paving and resurfacing, surface restoration, striping, signing, all items of work described in Paragraph 2.1.E, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
9. Bid Item A-9: 1-Inch Open-Trench Recycled Water Service, Unpaved Surface Restoration
Full compensation for **1-Inch Open-Trench Recycled Water Main, Unpaved Surface Restoration** will be paid for at the contract unit price per **linear foot (LF)**, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in establishing lines and grades and constructing open-trench new recycled water service including but not limited to, submittals, saw cutting, trench excavation, subgrade preparation, scarification, moisture conditioning, pipe bedding, pipeline materials, fittings, installation, backfilling, compaction, connections to pipelines and services, Community Garden quick coupling, abandonment, quality control testing, unimproved surface restoration, all items of work described in Paragraph 2.1.E, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
10. Bid Item A-10: SR1 HDD of 10-Inch FPVC RW Main in 14-inch FPVC Casing
Full compensation for **SR1 HDD of 10-Inch FPVC RW Main in 14-inch FPVC Casing** will be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in establishing lines and grades and installing a new recycled water main and casing by horizontal directional drilling (HDD) including but not limited to, submittals, permits, surveying, monitoring, engineering, HDD Work Plan, saw cutting, trench excavation, subgrade preparation, scarification, moisture conditioning, pipe bedding, carrier pipe materials, casing pipe materials, drilling fluids and management and disposal of drilling fluids, fittings, installation, backfilling, compaction, connections to pipelines, abandonment, quality control testing, paving and resurfacing, CCTV inspection, pressure testing, surface restoration, striping, signing, all items of work described in Paragraph 2.1.E, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
- Measurement of this item is from the gate valves located on each side of the casing as shown on the Drawings.
11. Bid Item A-11: Gate Valve
Full compensation for **Gate Valve** will be paid for at the contract unit price per **each (EA)** for each size shown on the bid schedule, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in providing valves on pipelines including valves on fire hydrant laterals, submittals, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
12. Bid Item A-12: 8-Inch and 3-Inch PRVs in Vault
Full compensation for **8-Inch and 3-Inch PRVs in Vault** will be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the construction of the recycled water piping, pressure reducing valves and vault, 4-inch and 3-inch piping and valves, drain pipes, all items of work described in Paragraph 2.1.E, submittals, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
13. Bid Item A-13: 10-Inch Check Valve in Vault
Full compensation for **10-Inch Check Valve in Vault** will be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the construction of the recycled water piping, check valve and vault, drain pipes, all items of work described in

Paragraph 2.1.E, submittals, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.

14. Bid Item A-14: 1-Inch Air Release/Vacuum Valve
Full compensation for **Air Release/Vacuum Valve** will be paid for at the contract unit price per **each (EA)** for each size shown on the bid schedule, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in providing air release/vacuum valves on pipelines, including submittals, piping, fittings, enclosure, concrete pad, dielectric fittings, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
15. Bid Item A-15: Fire Hydrant
Full compensation for **Fire Hydrant** will be paid for at the contract unit price per **each (EA)**, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work required to provide fire hydrants from the vertical reducing bend to the hydrant, including but not limited to submittals, saw cutting, trench excavation, grading, subgrade preparation, scarification, moisture conditioning, pipe bedding, pipeline materials, fittings, joint restraint, fire hydrant, break-off check valve, riser, concrete pad, installation, painting, signing, backfilling, compaction, quality control testing, start-up testing, adjusting, all items of work described in Paragraph 2.1.E, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
16. Bid Item A-16: 3-Inch Irrigation Service
Full compensation for **3-Inch Irrigation Service** will be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the construction of the recycled water service piping, water service meter, pressure reducing valve, double check backflow preventer, enclosures, boxes, valves, appurtenances, all items of work described in Paragraph 2.1.E, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
17. Bid Item A-17: Recycled Water Signing and Labeling
Full compensation for **Recycled Water Signing and Labeling** will be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in providing the recycled water labels, tags and signs except at Friendship Park baseball field, and including submittals, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
18. Bid Item A-18: Replace Survey Monument
Full compensation for **Replace Survey Monument** will be paid for at the contract unit price per **each (EA)** price, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the replacement of Mendocino County survey monuments as required by the County of Mendocino Department of Transportation, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
19. Bid Item A-19: Utility Conflict Resolution
Measurement for **Utility Conflict Resolution** for payment will be based upon, but not limited to, furnishing all labor, materials, tools, equipment and incidentals necessary to move, relocate or mitigate utility conflicts, conflicts with manmade buried objects or other unforeseen items that may be encountered during construction or during potholing investigations. **Utility Conflict Resolution** shall be paid for on a **Force Account (FA)** basis up to the contract allowance price and shall include full compensation for furnishing all labor, materials, permits, tools and equipment, and for doing all the work involved as required to complete the work, and as directed by the Engineer, and no additional allowance shall be made therefor.

20. Bid Item A-20: Recycled Water Tank Electrical and Instrumentation
Full compensation for **Recycled Water Tank Electrical and Instrumentation** will be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the construction of all project electrical and instrumentation improvements, including all conduits, conductors, pull boxes, fittings, instruments, enclosures, programming and integration, submittals and shop drawings, and all items of work described in Paragraph 2.1.E, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
- B. **SCHEDULE B: Bolted Stainless Steel Reservoir, Foundation and Appurtenances - 250,000 Gallon.** The following SCHEDULE B Bid item descriptions are numbered in accordance with Bid Schedule B in the Bid Proposal Form.
1. Bid Item B-1: Bolted Stainless Steel Reservoir, Foundation and Appurtenances - 250,000 Gallon
Full compensation for **Bolted Stainless Steel Reservoir, Foundation and Appurtenances - 250,000 Gallon** will be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the construction of the Type 304 bolted stainless steel recycled water tank and foundation, including but not limited to calculations and related submittals and shop drawings, any proposed modifications to the tank structural design, building permit approval, foundation excavation, aggregate base, formwork, reinforcing steel, reinforced concrete tank foundation, anchor bolts, drain sump, drain and overflow piping and supports, grounding, all steel tank materials and appurtenances attached to the tank, furnishing, transporting, staging, and assembly of the bolted tank at the location and dimensions shown on the Plans, including bolts, sealant and hydraulic testing, concrete mix designs, start-up testing and all other related tank improvement work as enumerated in the Plans and these Specifications, and no additional allowances will be made therefor.
- C. **SCHEDULE C: Friendship Park Irrigation System.** The following SCHEDULE C Bid item descriptions are numbered in accordance with Bid Schedule C in the Bid Proposal Form.
1. Bid Item C-1: Friendship Park Irrigation System
Full compensation for **Friendship Park Irrigation System** will be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in constructing the irrigation system at Friendship Park, including but not limited to submittals, piping, saw cutting, trench excavation, bedding, pipeline and conduit materials, fittings, joints, installation, backfilling, compaction, irrigation controller, sensor assembly, irrigation control valves, sprinkler heads, couplings, boxes, signs and labeling, quality control testing, start-up testing, adjusting, signs and labeling, all items of work described in Paragraph 2.1.E, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
- D. **SCHEDULE D: Wastewater Treatment Plant Improvements.** The following SCHEDULE D Bid item descriptions are numbered in accordance with Bid Schedule D in the Bid Proposal Form.
1. Bid Item D-1: Mobilization and Demobilization
Full compensation for **Mobilization and Demobilization** will be paid for at the contract **lump sum (LS)** price, which price shall constitute full compensation for all such work. Maximum value shall not exceed five percent (5%) of total Schedule D contract price. The scope of work for Mobilization shall include, but not be limited to, obtaining all bonds, insurance and permits, moving onto and out of the site of all plant and equipment, submitting a construction schedule, project sign, obtaining approval of a schedule of values for lump sum items. Payment for Mobilization shall not exceed 75% of the contract lump sum price. Payment for

Demobilization shall occur when all required items per the contract are fulfilled and the site is free of equipment and clean and ready for use by the public as determined by the Engineer.

2. Bid Item D-2: Trench Sheet piling, Shoring and Bracing
Full compensation for **Trench Sheet piling, Shoring and Bracing** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in trench bracing, sheet piling and shoring or equivalent method as needed to construct the WWTP improvements including but not limited to that required by Sections 6700-6708 of the Labor Code as specified herein, and no additional allowance will be made therefor.
3. Bid Item D-3: Clearing and Grubbing
Full compensation for **Clearing and Grubbing** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in clearing and grubbing vegetation, piping, debris and other materials indicated on the Drawings which require removal to construct the WWTP improvements, and related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.
4. Bid Item D-4: Chlorine Contact Basin Excavation
Full compensation for **Chlorine Contact Basin Excavation** will be paid for at the contract **cubic yard final (CY-F)** price, which final price and quantity shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the soil excavation and subgrade preparation improvements for the chlorine contact basin and tank, including off haul and disposal of excess material, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
5. Bid Item D-5: Chlorine Contact Basin Backfill
Full compensation for **Chlorine Contact Basin Backfill** will be paid for at the contract **cubic yard final (CY-F)** price, which final price and quantity shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the structure backfill for the chlorine contact basin and tank, including compaction, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
6. Bid Item D-6: Turf Restoration
Full compensation for **Turf Restoration** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in restoring unimproved surfaces with sod / turf, and related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.
7. Bid Item D-7: Chlorine Contact Basin and 50,000 Gallon RW Storage
Full compensation for **Chlorine Contact Basin and 50,000 Gallon RW Storage** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in constructing the reinforced concrete chlorine contact basin and recycled storage tank, including but not limited to submittals, all aggregate base, concrete, reinforcing, water stops, grating, and baffles, and related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.
8. Bid Item D-8: Modify Chlorine Room
Full compensation for **Modify Chlorine Room** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in modifying and improving the existing chlorine room to accommodate the new chlorine generation system, chlorine analyzer, chlorine dosing system and coagulant dosing system, including but not limited to concrete equipment pads, eye wash station, plumbing, piping, roof vent, structural supports for new equipment

and related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.

9. Bid Item D-9: Chlorine Generation System

Full compensation for **Chlorine Generation System** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in providing complete, functioning and commissioned on-site sodium hypochlorite generation system in the existing chlorine room, including but not limited to submittals, all system equipment, controller, displays, filters, water softener, tanks, hydrogen monitoring system, analyzer, water heater, pumps, appurtenances, piping valves, appurtenances, connections, cable, conduit, power connections, instrumentation connections, manufacturer commissioning, start-up and testing, training, and related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.

10. Bid Item D-10: Chlorine Analyzer

Full compensation for **Chlorine Analyzer** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in providing complete, functioning and commissioned chlorine analyzer, including but not limited to submittals, chlorine analyzer system equipment, enclosures, anchors, pumps, valves, gauges, appurtenances, piping, tubing, cables, conduit, controller, displays, power, instrumentation, all connections, manufacturer commissioning, start-up and testing, training, and all other related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.

11. Bid Item D-11: Chlorine Dosing System

Full compensation for **Chlorine Dosing System** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in providing complete, functioning and commissioned chlorine dosing system, including but not limited to submittals, pumps, enclosures, valves, gauges, appurtenances, trench excavation, bedding, backfill, compaction, piping, tubing, injection quill, vault supports, utility connections, controller, power, connections, brackets, manufacturer commissioning, start-up and testing, training, and all other related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.

12. Bid Item D-12: Coagulant Dosing System

Full compensation for **Coagulant Dosing System** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in providing complete, functioning and commissioned coagulant dosing system, including but not limited to submittals, pumps, controllers, displays, enclosures, valves, gauges, appurtenances, trench excavation, bedding, backfill, compaction, piping, tubing, mixing chamber, utility connections, controller, displays, power, connections, brackets, solution tank on drum cradle, manufacturer commissioning, start-up and testing, training, and all other related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.

13. Bid Item D-13: Process Air Piping, Valves, Diffusers & Supports

Full compensation for **Process Air Piping, Valves, Diffusers & Supports** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in removing the existing process air piping system, diffusers and supports and providing new process air piping system, diffusers and supports, including submittals, planning and coordination, piping, valves, pipe supports, connections, diffuser retrofits, wall penetrations and repairs, and related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.

14. Bid Item D-14: Aeration Basin Grit Removal

Full compensation for **Aeration Basin Grit Removal** shall be paid for at the contract **lump**

sum (LS) price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in the removal of approximately 20,000 gallons of grit from the aeration basin, temporarily dewatering the grit in the existing sludge drying beds, and transporting the dewatered grit to a dumpster bin for landfill disposal by MCCSD, including submittals, planning and coordination, and related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.

15. Bid Item D-15: Anoxic Basin Baffle

Full compensation for **Anoxic Basin Baffle** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in installing the anoxic basin baffle, including submittals, planning and coordination, brackets, anchors, baffle, and related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.

16. Bid Item D-16: Anoxic Basin Air Mixer

Full compensation for **Anoxic Basin Air Mixer** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in installing the anoxic basin air mixer, including submittals, planning and coordination, brackets, anchors, cables, hoses, floats, connections, and related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.

17. Bid Item D-17: Mixed Liquor Recycle Airlift Pump, Air Piping & Brackets

Full compensation for **Mixed Liquor Recycle Airlift Pump, Air Piping & Brackets** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in installing the airlift pump, including submittals, planning and coordination, brackets, anchors, hoses, connections, and related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.

18. Bid Item D-18: Mixed Liquor Recycle 8" Ductile Iron Piping & Brackets

Full compensation for **Mixed Liquor Recycle 8" Ductile Iron Piping & Brackets** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in installing the mixed liquor pipe, including submittals, planning and coordination, brackets, anchors, connections, and related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.

19. Bid Item D-19: Recycled Water Distribution Pumps

Full compensation for **Recycled Water Distribution Pumps** will be paid for at the contract unit price per **each (EA)** price, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the procurement, installation, commissioning, testing, start-up and training of the recycled water distribution pumps, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.

20. Bid Item D-20: Recycled Water Transfer Pump

Full compensation for **Recycled Water Transfer Pump** will be paid for at the contract unit price per **each (EA)** price, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the procurement, installation, commissioning, testing, start-up and training of the recycled water transfer pump, and refurbishing the pump support plate, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.

21. Bid Item D-21: Recycled Water Distribution Piping & Appurtenances

Full compensation for **Recycled Water Distribution Piping & Appurtenances** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in the installation, and testing for all above and below-grade -grade piping, valves, fittings, flow

meter, pipe supports, and appurtenances from the recycled water distribution pump discharge to the connection in Kelly Street and to the connection at the existing filter effluent wet well, including and all items of work described in Paragraph 2.1.E, and related work, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.

22. Bid Item D-22: Filter Effluent Piping and Appurtenances

Full compensation for **Filter Effluent Piping and Appurtenances** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in constructing the 2-inch filter effluent piping, valves and appurtenances from the recycled water transfer pump into the new chlorine contact basin, including submittals, excavation, aggregate, backfill, piping, valves, fittings, flow meter, static mixer, injection port, air relief valves, brackets, all items of work described in Paragraph 2.1.E, and related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.

23. Bid Item D-23: Plant Recycled Water Service & Fire Hydrant

Full compensation for **Plant Recycled Water Service & Fire Hydrant** shall be paid for at the contract **lump sum** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in constructing the piping, valves and appurtenances for the new recycled water service and fire hydrant connecting to the existing plant water piping, including submittals, excavation, aggregate, backfill, piping, valves, fittings, fire hydrant, pressure reducing valve and vault, all items of work described in Paragraph 2.1.E, and related work, as enumerated in the plans and these specifications, and no additional allowance will be made therefor.

24. Bid Item D-24: Electrical, Communications and Programming

Full compensation for **Electrical, Communications and Programming** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in the installation, commissioning, testing, start-up and training for electrical and communication systems, including SCADA system programming, integration, and all items of work described in Paragraph 2.1.E, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.

E. **SCHEDULE E: Sewer Main Replacement.** The following SCHEDULE E Bid item descriptions are numbered in accordance with Bid Schedule E in the Bid Proposal Form.

1. Bid Item E-1: Trench Sheet piling, Shoring and Bracing

Full compensation for **Trench Sheet piling, Shoring and Bracing** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in trench bracing, sheet piling and shoring or equivalent method as needed to construct the replacement sanitary sewer mains including but not limited to that required by Sections 6700-6708 of the Labor Code as specified herein, and no additional allowance will be made therefor.

2. Bid Item E-2: Open-Trench 8-Inch Sewer Main

Full compensation for **Open-Trench 8-Inch Sewer Main** will be paid for at the contract unit price per **linear foot (LF)**, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in establishing lines and grades and constructing open-trench sewer main including but not limited to, permits, temporary bypass pumping, saw cutting, trench excavation, subgrade preparation, scarification, moisture conditioning, pipe bedding, pipeline materials, fittings, installation, backfilling, compaction, connections to pipelines and manholes, tree removal, fence removal and replacement, hydrant removal and replacement, quality control testing, paving and resurfacing, surface restoration, striping, signing, all items of work described in Paragraph 2.1.E, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.

3. Bid Item E-3: 48-Inch Sewer Manhole
Full compensation for **48-Inch Sewer Manhole** will be paid for at the contract unit price per **each (EA)**, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in constructing new sewer manholes including but not limited to, saw cutting, excavation, subgrade preparation, scarification, moisture conditioning, backfilling, compaction, quality control testing, all items of work described in Paragraph 2.1.E, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
 4. Bid Item E-4: Connect Sewer Lateral
Full compensation for **Connect Sewer Lateral** will be paid for at the contract unit price per **each (EA)**, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in connecting existing sewer laterals to the new sewer main including but not limited to, saw cutting, excavation, subgrade preparation, scarification, moisture conditioning, backfilling, compaction, lateral materials, fittings, installation, quality control testing, all items of work described in Paragraph 2.1.E, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
 5. Bid Item E-5: Abandon Existing Sewer Main
Full compensation for **Connect Sewer Lateral** will be paid for at the contract unit price per **each (EA)**, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the abandonment of existing sewer mains, including but not limited to, removal and disposal of abandoned asbestos-cement pipe in conflict with the work, and all items of work described in Paragraph 2.1.E, and related work, as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
- F. **SCHEDULE F: Bid Item.** The following SCHEDULE F Bid item descriptions are numbered in accordance with Bid Schedule F in the Bid Proposal Form.
1. Bid Item F-1: Replace Equalization Basin Liner
Full compensation for **Replace Equalization Basin Liner** shall be paid for at the contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the removal and replacement of the existing Equalization Basin liner system, including but not limited to demolition, disposal, effluent flow routing, excavation, trenching, subgrade preparation, liner installation, piping modifications, pipe-to-liner connections, and all other work related to the liner replacement as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
- G. **SCHEDULE G: Bid Item.** The following SCHEDULE G Bid item descriptions are numbered in accordance with Bid Schedule G in the Bid Proposal Form.
1. Bid Item G-1: Replace Filter Backwash Return Pipe
Full compensation for **Replace Filter Backwash Return Pipe** shall be paid for at the contract unit price per **linear foot (LF)**, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the replacement of the existing filter backwash pipe, including but not limited to demolition, disposal, coring concrete walls, installation, brackets, grouting, connections, and all other related work as enumerated in the plans and these specifications, and no additional allowances will be made therefor.
- H. **SCHEDULE H: Bid Item.** The following SCHEDULE H Bid item descriptions are numbered in accordance with Bid Schedule H in the Bid Proposal Form.
1. Bid Item H-1: Existing Chlorine Contact Basin Baffles
Full compensation for **Existing Chlorine Contact Basin Baffles** shall be paid for at the

contract **lump sum (LS)** price, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work required to install the new baffles in the existing chlorine contact basin, including submittals, planning and coordination, brackets, anchors, baffle,, and all other work related to the liner replacement as enumerated in the plans and these specifications, and no additional allowances will be made therefor.

- I. **SCHEDULE I: Bid Item.** The following SCHEDULE I Bid item descriptions are numbered in accordance with Bid Schedule I in the Bid Proposal Form.

1. Bid Item I-1: Bolted Glass-Fused-to-Steel Reservoir, Foundation and Appurtenances - 250,000 Gallon

Full compensation for **Bolted Glass-Fused-to-Steel Reservoir Foundation and Appurtenances -250,000 Gallon** shall be paid for at the contract **lump sum (LS)** price in lieu of Schedule B Bolted Stainless Steel Reservoir, Foundation and Appurtenances - 250,000 Gallon, which price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for performing all work involved in the design and construction of the recycled water tank and foundation, including but not limited to submittals, shop drawings, calculations, excavation, aggregate base material over prepared subgrade, formwork, reinforcing steel, concrete tank foundation, anchor bolts, drain sump, drain and overflow piping and support, grounding, cathodic protection system, all steel tank materials and appurtenances attached to the tank, furnishing, transporting, staging, and assembly of the bolted tank at the location and dimensions shown on the Plans, including bolts, sealant and hydraulic testing, concrete mix designs, signing, start-up testing, any proposed modifications, and all other related tank improvement work as enumerated in the plans and these specifications, and no additional allowances will be made therefor.

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coordination and Project Conditions
- B. Preconstruction Meeting
- C. Site mobilization Meeting
- D. Progress Meetings
- E. Preinstallation Meetings
- F. Closeout Meeting
- G. Alteration Procedures

1.2 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various sections of project manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Verify that utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing operating equipment in service.
- C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes and conduits as closely as practical; place runs parallel with existing utility lines. Use spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
 - 1. Coordination Drawings: Prepare as required to coordinate all portions of Work. Show relationship and integration of different construction elements that require coordination during fabrication or installation to fit in space provided or to function as intended. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are important.
- D. Coordination Meetings: In addition to other meetings specified in this section, hold coordination meetings with personnel and Subcontractors to ensure coordination of Work.
- E. In finished areas except as otherwise indicated, conceal pipes and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of Work of separate sections in preparation for substantial completion and for portions of Work designated for District's partial occupancy and for portions of Work designated for District's occupancy.

- G. After Owner's occupancy of premises, coordinate access to Site for correction of defective Work and Work not complying with Contract Documents, to minimize disruption of District's activities.

1.3 SUBMITTALS

- A. Statement of Qualification (SOQ) for land surveyor or professional engineers employed by the Contractor in the work.
- B. Photographs and other records of examination, as required herein.

1.4 RELATED SECTION:

- A. Contract General Conditions.

1.5 OTHER WORK

- A. Refer to Contract General Conditions.
- B. Ensuring continuous operation of all utilities: Refer to General Contract Conditions, Section 01 10 00 "Summary of Work" and Section 02 01 10 "Existing Utilities and Underground Structures" for Contractor's responsibilities regarding existing utilities and obstructions.

1.6 UTILITIES

- A. Notify applicable utility providers:
 - 1. Prior to commencing Work,
 - 2. If damage occurs, or
 - 3. If conflicts or emergencies arise during Work.
- B. Prior to connecting to any existing structure or pipeline carrying wastewater, water, gas, storm water, or other material, the Contractor shall prepare and have approved by the Engineer his detailed plan on how the connection may be made without causing an uncontrolled discharge resulting in contamination of the soil or groundwater. By reviewing and approving the plan, the District does not accept responsibility for the adequacy thereof nor for any damages to public or private property caused by the Contractor.

1.7 PROJECT MEETINGS

- A. General:
 - 1. Schedule meetings throughout the progress of the Work, prepare meeting agenda and distribute with written notice of each meeting, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes within one day after each meeting to participants and parties affected by meeting decisions.
 - 2. Representatives of District, Contractor, and Subcontractors shall attend meetings, as needed.
 - 3. All subcontractors are required to be in attendance when safety issues and safety training requirements are presented.
- B. Preconstruction Conference:
 - 1. A preconstruction conference attended by the Contractor, major Subcontractors, the Engineer, Construction Manager, District staff and others as appropriate will be held to discuss the Work in accordance with the applicable procedures specified in Section 01 10 00, "Summary of Work."
 - 2. Engineer will schedule and preside over meeting after Notice of Award.

3. Minimum Agenda.
 - a. Execution of Owner-Contractor Agreement.
 - b. Submission of executed bonds and insurance certificates.
 - c. Distribution of Contract Documents.
 - d. Submission of list of Subcontractors, list of products, schedule of values, and Progress Schedule.
 - e. Designation of personnel representing parties in Contract, and Engineer.
 - f. Communication procedures.
 - g. Procedures and processing of requests for interpretations, field decisions, field orders, submittals, substitutions, applications for payments, proposal request, change orders, and Contract closeout procedures.
 - h. Scheduling.
 - i. Critical Work sequencing.
 4. Construction Manager: Record minutes and distribute digital copies to participants after meeting, to Engineer, Owner, and those affected by decisions made.
- C. Site Mobilization Meeting
1. Engineer will schedule meeting at Project Site prior to Contractor occupancy. Construction Manager presides over meeting.
 2. Attendance Required: Engineer, District, Contractor, Contractor's superintendent, special consultants, Construction Manager, and major Subcontractors.
 3. Agenda:
 - a. Use of premises by District and Contractor.
 - b. Owner's requirements and occupancy.
 - c. Construction facilities and controls provided by District.
 - d. Temporary utilities provided by Owner.
 - e. Survey and layout.
 - f. Security and housekeeping procedures.
 - g. Schedules.
 - h. Procedures for maintaining record documents
 - i. Requirements for startup of equipment
 - j. Inspection and acceptance of equipment put into service during construction period.
 4. Construction Manager: Record minutes and distribute digital copies to participants after meeting, to Engineer, Owner, and those affected by decisions made.
- D. Progress Meetings:
1. Schedule weekly progress meetings at the site. Conduct weekly meeting to review Work progress, progress schedule, submittal submissions schedule, Application for Payment, contract modifications, and other matters needing discussion and resolution.
 2. Attendees will include:
 - a. Construction Manager.
 - b. Engineer and other District representatives.
 - c. Contractor, and appropriate Subcontractors and Suppliers.
 - d. Engineer's representative(s).
 - e. Others as appropriate.
 3. Agenda:
 - a. Use of premises by District and Contractor.
 - b. District's requirements and occupancy.
 - c. Construction facilities and controls provided by District.
 - d. Temporary utilities provided by District.
 - e. Survey and layout.
 - f. Security and housekeeping procedures.
 - g. Schedules.
 - h. Procedures for maintaining record documents

- i. Requirements for startup of equipment
 - j. Inspection and acceptance of equipment put into service during construction period.
- E. Quality Control and Coordination Meeting(s):
 - 1. Schedule on a regular basis and as necessary to review test and inspection reports, and other matters relating to quality control of Work and work of other contractors.
 - 2. Attendees will include Engineer and other District Representatives, Contractor, Contractor's designated quality control representative, selected Subcontractors and Suppliers, and Engineer's representatives.
- F. Pre-installation Meetings:
 - 1. When required in individual specification sections, convene at site prior to commencing Work of that section.
 - 2. Require attendance of entities directly affecting, or affected by, Work of that section.
 - 3. Include meeting date on Construction Schedule. Notify the Engineer 5 days in advance of meeting date.
 - 4. Provide suggested agenda to the Engineer to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.
- G. Closeout Meeting
 - 1. Schedule Project closeout meeting with sufficient time to prepare for requesting substantial completion. Preside over meeting and be responsible for minutes.
 - 2. Attendance Required: Contractor, Construction Manager, major Subcontractors, Engineer, Owner, and others appropriate to agenda.
 - 3. Include meeting date on Construction Schedule. Notify Engineer five (5) days in advance of proposed meeting date.
 - 4. Agenda:
 - a. Start-up of facilities and systems.
 - b. Operations and maintenance manuals.
 - c. Testing, adjusting, and balancing.
 - d. System demonstration and observation.
 - e. Operation and maintenance instructions for District's personnel.
 - f. Contractor's inspection of Work.
 - g. Contractor's preparation of an initial "punch list."
 - h. Procedure to request Engineer inspection to determine date of substantial completion.
 - i. Completion time for correcting deficiencies.
 - j. Inspections by authorities having jurisdiction.
 - k. Certificate of Occupancy and transfer of insurance responsibilities.
 - l. Partial release of retainage.
 - m. Final cleaning.
 - n. Preparation for final inspection.
 - o. Closeout Submittals:
 - 1) Project record documents.
 - 2) Operating and maintenance documents.
 - 3) Operating and maintenance materials.
 - 4) Affidavits.
 - p. Final application for payment.
 - q. Contractor's demobilization of Site.
 - r. Maintenance.
 - 5. Record minutes and distribute digital copies to participants after meeting, to Engineer, District, and those affected by decisions made.

- H. Other Meetings: In accordance with Contract Documents and as may be required by District and Engineer.

1.8 SEQUENCE OF WORK

- A. Include the Milestones and sequences of Work specified herein as a part of the progress schedule required under Section 01 32 16, "Construction Progress Schedules."
- B. Construct Work in stages to allow for District continuous occupancy during construction. Coordinate construction schedule and operation with the District.
- C. Be responsible for temporary connections and structures required to maintain District operations. Sequences other than those specified will be considered by Engineer, provided they afford equivalent continuity of operations.
- D. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of District operations.
- E. Coordinate proposed Work with the Engineer and facility operations personnel before effecting unit shutdowns. Under no circumstances cease Work at the end of a normal working day if such actions may inadvertently cause a cessation of any facility operating process, in which case, remain onsite until necessary repairs are complete.
- F. Do not close lines, open switches, or take other action which would affect the operation of existing systems, except as specifically required by the Contract Documents and after approval of the Engineer. Such actions will be considered by District and Engineer upon one week written notice to the Engineer.

1.9 ADJACENT FACILITIES AND PROPERTIES

- A. The project area extends from the MUSD well and tank siren in the east to Mendocino High School, and includes the K-8 School, Friendship Park and Community Center. Contractor shall coordinate with the District in all construction operations to minimize conflicts pertaining to, but not limited to, construction noise, traffic access, and to ensure all necessary permits and easements are obtained.
- B. Examination:
 - 1. After Effective Date of the Agreement and before Work at site is started, Contractor, Engineer, and affected property owners and utility owners shall make thorough examination of pre-existing conditions including existing buildings, structures, pipelines, and other improvements in vicinity of Work, as applicable, which might be damaged by construction operations.
 - 2. Contractor shall take two sets of photographs and videotape pre-existing conditions prior to the start of the work. One set of photographs and videotape shall be given to the Engineer. Periodic reexamination shall be jointly performed to include, but shall not be limited to, cracks in structures, settlement, leakage, and similar conditions. Include public roads and improvements to adjacent private property as part of preexisting condition documentation.
 - 3. Record observations for signature of Contractor.
- C. Documentation:
 - 1. Submit one (1) electronic / digital copy of photographs, videotapes and other records documenting examination for Engineer's signature. Submit digitally via an FTP. Engineer will review, sign, and return one (1) record copy to Contractor to be kept on file in Contractor's field office as site records.

2. These observations and photographs and videotapes are intended for use as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of Contractor's operations, and are for protection of adjacent property owners, utility owners, Contractor, and District.
 3. Image Format and Quality:
 - a. JPEG Format.
 - b. Produce bright, sharp, clear images with accurate colors, free of distortion and other forms of picture imperfections.
 4. Video Format and Quality:
 - a. MP4 format, with sound
 - b. Video:
 - 1) Produce bright, sharp, clear images with accurate colors, free of distortion and other forms of picture imperfections.
 - 2) Electronically, and accurately display the month, day, year, and time of day of the recording.
 - c. Audio:
 - 1) Audio documentation shall be done clearly, precisely, and at a moderate pace.
 - 2) Indicate date, Project name, and a brief description of the location of recording, including:
 - a) Facility name
 - b) Street names or easements.
 - c) Addresses of private property.
 - d) Direction of coverage, including engineering stationing, if applicable.
- D. Notification: The Contractor shall notify all affected property owners at least one week prior to construction.

1.10 SITE SECURITY

- A. Contractor shall coordinate with the Engineer to ensure that site security is maintained at all times. Contractor shall take whatever measures are necessary to maintain site security, including the use of temporary fencing and gates if required. Contractor shall be completely responsible for the construction site security and for any vandalism or theft occurring thereto.

1.11 OWNER (DISTRICT) FACILITIES

- A. Operation and Shutdown of Existing Facilities:
1. Schedule and conduct activities to ensure minimal disturbance to the water distribution network, unless otherwise specified.
 2. Conduct Work outside regular working hours on prior written consent of Engineer in accordance with Section 01 32 16, "Construction Progress Schedules," to meet Project schedule and avoid undesirable conditions.
 3. Do not proceed with Work affecting a facility's operation without obtaining Engineer's advance approval of the need for and duration of such Work.
- B. Relocation of Existing Facilities:
1. During construction, it is expected that minor relocations of Work may be necessary.
 2. Provide complete relocation of existing structures and underground facilities; including piping, utilities, equipment, structures, electrical conduit wiring, electrical duct banks, and other necessary items.
 3. Use only new materials for relocated facilities. Match materials of existing facilities, unless otherwise approved by the Engineer.
 4. Perform relocations to minimize downtime of existing facilities.
 5. Install new portions of existing facilities in their relocated position prior to removal of existing facilities, unless otherwise accepted by Engineer.

C. Damage to Existing Facilities

1. The Contractor shall be responsible for restoring, repairing, or replacing District facilities damaged by the Contractor, to the satisfaction of the Engineer.

1.12 PHYSICAL CONDITIONS

- A. Exercise reasonable care to verify the location of existing subsurface structures and underground facilities, proceeding in accordance with Section 01 10 00, "Summary of Work" and of other applicable sections of the Specifications.
- B. Thoroughly check adjacent areas subject to excavation by visual examination (and by electronic metal and pipe detection equipment, as necessary) for indications of subsurface structures and underground facilities.
- C. Make exploratory excavations where existing underground facilities or structures may potentially conflict with proposed underground facilities or structures. Conduct exploratory excavations sufficiently ahead of construction to avoid possible delays to Contractor's Work.

1.13 REFERENCE POINTS AND SURVEYS

- A. Location and elevation of benchmarks are shown on the Survey Control Diagrams contained in the Drawings.
- B. Dimensions for lines and elevations for grades of structures, appurtenances, and utilities are indicated on the Plans, together with other pertinent information required for laying out Work. If conditions vary from those indicated, Contractor shall notify the District and Engineer immediately.
- C. District and/or Engineer may perform checks to verify accuracy of Contractor's layout Work and that completed Work complies with the Contract Documents.
- D. Any existing survey points or other control markers destroyed shall be replaced by a Land Surveyor licensed in the State of California and approved by District. Replacement shall be at the Contractor's expense.
- E. Contractor's Responsibilities:
 1. Provide additional survey and layout required, and construction staking as required.
 2. Locate and protect reference points prior to starting Work at site.
 3. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.
 4. In event of discrepancy in data provided by Engineer, request clarification before proceeding with Work.
 5. Preserve and leave undisturbed control staking.
 6. Re-establish reference points resulting from destruction by Contractor's operations.
 7. Retain professional Land Surveyor or Civil Engineer registered in California who shall perform or supervise engineering surveying necessary for additional construction staking and layout.
 8. Maintain complete accurate log of survey Work onsite as it progresses as a Record Document. Include in project as-builts. See Section 01 72 00, "Record Documents."
 9. Submit documentation, as requested.
 10. Provide competent employee(s), tools, stakes, and other equipment and materials as the Engineer may require to:
 - a. Check layout, survey, and measurement of Work.
 - b. Measure quantities for payment purposes.

11. Cooperate with the Engineer so that checking and measuring may be accomplished with least interference to Contractor's operations.

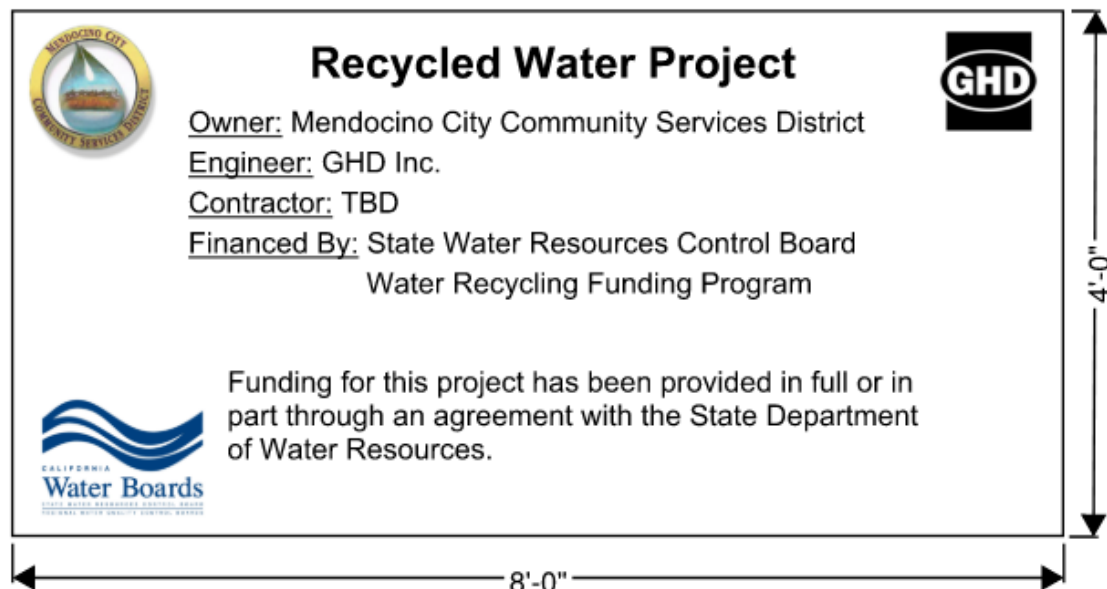
1.14 PERMIT REQUIREMENTS

- A. District has identified the following permits are required for the project and has coordinated with these agencies to initiate their procurement. Contractor is responsible for obtaining the following permits with District input and assistance:
 1. A building permit from the County of Mendocino is required.
 2. An Encroachment Permit from the County of Mendocino Department of Transportation is required for all work located in the County right-of-way.
 3. An Encroachment Permit from the California Department of Transportation is required for all work located in the State right-of-way.
- B. Notification
 1. The Contractor shall provide a contact name and mailing address for the purpose of notification in conformance with the approval or permit conditions. The Contractor shall provide the name(s), email addresses, and telephone numbers of representatives who can be reached at all times and who have the authority and responsibility to respond immediately to an emergency situation at the construction jobsite. Mailing addresses, email addresses, name and telephone numbers required for notification and emergency response shall be provided to the Engineer.
- C. The Contractor shall submit copies of all other permits and approvals from other government agencies with respect to the work. If a permit is not required from these agencies, the Contractor should provide copies of correspondence that indicates that a permit is not required.
- D. The above requirements shall be distributed to all Subcontractors working on the project site.

PART 2 PRODUCTS

2.1 PROJECT SIGN

- A. Contractor shall provide Project Sign and maintain sign in good condition for the duration of construction.
- B. Sign shall be at least four feet tall by eight feet wide made of ¾-inch thick exterior grade plywood (APA Rated A-B Grade Exterior) or other approved material.
- C. Sign shall include the project name, Owner name, Engineer name, Contractor name, financing agency name, and the following statements:
 1. "Funding for this project has been provided in full or in part through an agreement with the State Water Resources Control Board."
- D. Sign shall include the California State Water Resources Control Board color logo, District color logo and Engineer's logo.
- E. Conceptual sign detail:



- F. Sign shall be installed at location shown on the Drawings or approved by Engineer and District.

PART 3 EXECUTION

3.1 ALTERATION PROCEDURES

- A. Designated areas of existing facilities will be occupied for normal operations during progress of construction. Cooperate with District in scheduling operations to minimize conflict and to permit continuous usage.
 - 1. Perform Work not to interfere with operations of occupied areas.
 - 2. Keep utility and service outages to a minimum and perform only after written approval of District.
 - 3. Clean District-occupied areas daily. Clean spillage, overspray, and heavy collection of dust in District -occupied areas immediately.
- B. Materials: As specified in product sections; match existing products with new and salvaged products for patching and extending Work.
- C. Employ skilled and experienced installer to perform alteration and renovation Work.
- D. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion. Comply with Section 01 70 00 – Project Closeout Requirements.
- E. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
- F. Remove debris and abandoned items from area and from concealed spaces.
- G. Prepare surface and remove surface finishes to permit installation of new Work and finishes.
- H. Close openings in exterior surfaces to protect existing Work from weather and extremes of temperature and humidity.

- I. Remove, cut, and patch Work to minimize damage and to permit restoring products and finishes to original condition.
- J. Refinish existing visible surfaces to remain in renovated rooms and spaces, to renewed condition for each material, with neat transition to adjacent finishes.
- K. Where new Work abuts or aligns with existing Work, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- L. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Engineer for review.
- M. Patch or replace portions of existing surfaces that are damaged, lifted, discolored, or showing other imperfections.
- N. Finish surfaces as specified in individual product sections.

END OF SECTION

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.1 DESCRIPTION

- A. Summary: The work of this section consists of project schedule requirements including preparation of a project schedule, schedule updates, schedule revisions and time impact analysis. The project schedule shall be based upon the Critical Path Method (CPM) for planning, scheduling and reporting progress of the Work.
- B. Purpose: The purpose of the project schedule is to ensure adequate planning, coordination, scheduling, and reporting during execution of the work by the Contractor. The project schedule will assist the Contractor and the Engineer in monitoring the progress of the work, evaluating proposed changes, and processing the Contractor's monthly progress payment.
- C. Software: The software shall be the latest version of Primavera Project Planner (P3), SureTrak Project Scheduler, Microsoft Project, or approved equal.
- D. No work shall be done outside of the hours stated in the Contract Documents without written permission of the Engineer.

1.2 RELATED SECTION:

- A. Refer to Contract General Conditions for additional requirements.

1.3 SUBMITTALS

- A. Preliminary Project Schedule: Within 14 calendar days after date established in Notice to Proceed and at least 7 calendar days before the Pre-Construction conference, submit for Engineer's review one (1) electronic PDF copy and native schedule software file of the proposed overall project schedule, and accompanying CPM Schedule Reports.
- B. Initial Project Schedule: Within 7 calendar days after the Pre-Construction conference, submit for Engineer's review one (1) electronic PDF copy and native schedule software file of the updated overall project schedule for entire construction period, incorporating comments provided by the Engineer on the Preliminary Project Schedule.
- C. Baseline Project Schedule: Within 7 calendar days after receiving comments on the Initial Project Schedule, submit for Engineer's review and approval one (1) electronic PDF copy and native schedule software file of the overall project schedule for entire construction period, incorporating comments provided by the Engineer on the Initial Project Schedule. Upon submittal of final and accepted "Initial Project Schedule", the schedule shall be considered the "Baseline Project Schedule".
- D. Project Schedule Updates: At least two (2) working days before the weekly progress meeting, submit an updated 3-week lookahead schedule for review and discussion during the weekly progress meeting. With each monthly progress payment request, submit an updated overall project schedule including estimates of the percent completion of each schedule activity and necessary supporting data. Provide electronic PDF copy and native schedule software file.

- E. Project Schedule Revisions and Time Impact Analysis: Submit electronic PDF copy and native schedule software file of a Time Impact Analysis. Each Time Impact Analysis shall include a Fragmentary Network (Fragnet) demonstrating how the Contractor proposes to incorporate a modification, change, delay, or Contractor request into the project schedule.

1.4 PROJECT SCHEDULE

A. Schedule Development:

1. The last finish date shown on the schedule shall be the same date as the last day of the contract period.
2. The Contractor shall use the Precedence Diagram Method (PDM) with limited use of lead or lag durations between schedule activities. The Contractor's project schedule shall consist of procurement activities (including mobilization, submittal, and the fabrication and delivery of key and long-lead procurement items) and construction activities.
3. The Contractor's project schedule shall consist of, but not be limited to, the following for each activity:
 - a. Identify each activity number with numerical designations (maximum 5-digit). Numbering of activities shall be in increments of 10 digits.
 - b. Concise description of the work represented by the activity (maximum 48 characters). Avoid the use of non-standard abbreviations. The work related to each activity shall be limited to one work trade.
 - c. Activity duration in whole working days with a maximum duration of 15 workdays each, unless otherwise approved by the Engineer, except for non-construction activities including mobilization, shop drawing and sample submittals, fabrication of materials, delivery of materials and equipment, and concrete curing.
4. In developing the project schedule, ensure that subcontractor work at all tiers, as well as the prime contractor's work, is included and coordinated in the project schedule.
5. Identification and listing in chronological order of those activities reasonably required to complete the Work, including:
 - a. Subcontract work.
 - b. Major equipment design, fabrication, factory testing, and delivery dates, including required lead times.
 - c. Move-in and other preliminary activities.
 - d. Equipment and equipment system test and startup activities.
 - e. Project closeout and cleanup.
 - f. Work sequences, constraints, and milestones.
6. Listings identified by specification section number.
7. Identification of the following:
 - a. Horizontal timeframe by year, month, and week.
 - b. Duration, early start, and completion for each activity and subactivity.
 - c. Critical activities and Project float.
 - d. Subschedules to define further critical portions of Work.
8. The project schedule as developed shall show the sequence and interdependence of activities required for complete performance of the work. Ensure all work sequences are logical and the project schedule shows a coordinated plan of the work.
9. Proposed duration assigned to each activity shall be the Contractor's best estimate of time required to complete the activity considering the scope and resources planned for the activity.
10. Resource loading of each activity shall list all personnel by labor category and equipment type and capacity proposed to complete the activity in the duration shown.
11. Consider seasonal weather conditions in planning and scheduling all work influenced by high or low ambient temperatures, wind and/or precipitation to ensure completion of all work within the contract time. Show anticipated weather conditions on project calendar.

B. Joint Review, Revision, and Acceptance:

1. Within seven (7) calendar days of receipt of the Contractor's proposed project schedule, the Engineer and Contractor shall meet for joint review, correction, or adjustment of the proposed project schedule. Any areas which, in the opinion of the Engineer, conflict with timely completion of the project shall be subject to revision by the Contractor.
2. In the event the Contractor fails to define any element of work, activity, or logic, and the Engineer review does not detect this omission or error, such omission or error, when discovered by the Contractor or Engineer, shall be corrected by the Contractor at the next monthly project schedule update and shall not affect the contract time.
3. Within seven (7) calendar days after the joint review between the Contractor and Engineer, the Contractor shall revise and resubmit the project schedule in accordance with agreements reached during the joint review.
4. Upon acceptance of the project schedule by the Engineer, the project schedule will be used to evaluate the Contractor's monthly applications for payment based upon information developed at the monthly project schedule update meeting.

1.5 PROJECT SCHEDULE UPDATES

- A. General: Update the project schedule on a weekly basis throughout the entire contract time and until project substantial completion. The status date of each schedule update shall be the 7th day preceding the progress payment request date.
- B. Procedure: The Contractor shall meet with the Engineer each month at a project schedule update meeting to review actual progress made through the status date of the project schedule update, including dates activities were started and/or completed and the percentage of work completed on each activity started and/or completed.
- C. Progress Payments: The monthly updating of the project schedule shall be an integral part of the process upon which progress payments will be made under this contract. If the Contractor fails to provide schedule updates or revisions, then a portion of his monthly payment may be retained until such corrections have been made.
- D. Include the following information in each project schedule update:
 1. Overall percent complete, projected and actual.
 2. Completion progress by listed activity and subactivity, to within five (5) working days prior to submittal.
 3. Changes in Work scope and activities modified since submittal.
 4. Delays in submittals or resubmittals, deliveries, or Work.
 5. Adjusted or modified sequences of Work.
 6. Other identifiable changes.
 7. Revised projections of progress and completion.
- E. Narrative Progress Report:
 1. Submitted with each monthly submission of progress schedule.
 2. Summary of Work completed during the past period between reports.
 3. Work planned during the next period.
 4. Explanation of differences between summary of Work completed and Work planned in previously submitted report.
 5. Current and anticipated delaying factors and estimated impact on other activities and completion milestones.
 6. Corrective action taken or proposed.

1.6 PROJECT SCHEDULE REVISIONS

- A. Required Revisions: If, as a result of the monthly schedule update, it appears the project schedule no longer represents the actual prosecution and progress of the work, the Engineer will request, and the Contractor shall submit, a revision to the project schedule. The

Contractor may also request reasonable revisions to the project schedule in the event the Contractor's planning for the work is revised. If the Contractor desires to make changes in the project schedule, the Contractor shall notify the Engineer in writing, stating the reason for the proposed revision. Accepted revisions will be incorporated into the project schedule at the next monthly schedule update.

- B. Procedure: If revision to the project schedule is contemplated, the Contractor or Engineer shall so advise the other in writing at least seven (7) calendar days prior to the next schedule update meeting, describing the revision and setting forth the reasons therefore. District-requested revisions to the project schedule will be presented in writing to the Contractor, who shall respond in writing within seven (7) calendar days.

1.7 TIME IMPACT ANALYSIS FOR CONTRACT MODIFICATIONS, CHANGES, DELAYS, AND CONTRACTOR REQUESTS

- A. Requirements: When contract modifications or changes are initiated, delays are experienced, or the Contractor desires to revise the project schedule, the Contractor shall submit to the Engineer a written time impact analysis illustrating the influence of each modification, change, delay, or Contractor request on the contract time.
- B. Time Extensions: Activity delays shall not automatically mean that an extension of the contract time is warranted or due the Contractor. It is possible that a modification, change, or delay will not affect existing critical path activities or cause non-critical activities to become critical. A modification, change, or delay may result in only absorbing a part of the available total float that may exist within an activity chain of the project schedule, thereby not causing any effect on the contract time. Time extensions will be granted in accordance with the terms of the contract.
- C. Float: Float is not for the exclusive use or benefit of either the Government or the Contractor. Extension of the contract time will be granted only to the extent the equitable time adjustments to the activity or activities affected by the modification, change, or delay exceeds the total (positive or zero) float available on a particular activity.
- D. Procedure: Each time impact analysis shall be submitted within the time period stated in a request for proposal, or the time period designated under the clauses entitled Changes or Default. In cases where the Contractor does not submit a written request for extension of time and a time impact analysis within the designated time, it is mutually agreed that the particular modification, change, delay, or Contractor request does not require an extension of the contract time. Upon acceptance, the time impact analysis shall be incorporated into the project schedule at the next monthly schedule update.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 PROJECT SCHEDULE SUBMISSIONS

- A. Provide the submissions as described below. The data, reports, and network diagrams required for each submission are contained in paragraph SUBMITTALS. If the Contractor fails or refuses to furnish the information and schedule updates as set forth herein, then the Contractor will be deemed not to have provided an estimate upon which a progress payment can be made.

- B. Review comments made by the Engineer on the schedule(s) does not relieve the Contractor from compliance with requirements of the Contract Documents.
- C. Preliminary Project Schedule Submission
 - 1. Within 14 calendar days after the Notice-to-Proceed is acknowledged submit the Preliminary Project Schedule defining the planned operations detailed for the first 90 calendar days for approval. The Preliminary Project Schedule may be summary in nature for the remaining performance period. It must be early start and late finish constrained and logically tied as specified. The Preliminary Project Schedule forms the basis for the Initial Project Schedule specified herein and must include all the required plan and program preparations, submissions and approvals identified in the contract (for example, Quality Control Plan, Safety Plan, and Waste Management Plan, etc.) as well as any Contractor design activities, planned submissions of all early procurement equipment packages, permitting activities, review activities, and other non-construction activities intended to occur within the first 90 calendar days.
 - 2. Engineer's acceptance of the associated package(s) and all other specified Program and Plan approvals must occur prior to any planned field construction activities.
- D. Initial Project Schedule Submission
 - 1. Within 7 calendar days after the Pre-Construction conference submit the Initial Project Schedule for Engineer's review and approval. The schedule shall be divided into SCHEDULE A: Base Bid Outside Wastewater Treatment Plant Site and SCHEDULE B: Base Bid Inside Wastewater Treatment Plant Site. The schedule must demonstrate a reasonable and realistic sequence of activities which represent all work through the entire contract performance period. Include in the detailed schedule, preconstruction and permitting activities, permit submissions and any required District actions and long lead procurement items. Also, include in the preliminary schedule the entire construction effort with as much detail as is known at the time but, as a minimum, include all construction start and completion milestones, and detailed construction activities. Include the remaining construction, including cost loading.
 - 2. No payment shall be made for work items not fully detailed in the Initial Project Schedule.
- E. Baseline Project Schedule Submission
 - 1. Acceptance of the Contractor's schedule by the Engineer will be based solely upon compliance with the requirements of the Contract Documents. By way of the Contractor assigning activity durations and proposing the sequence of the Work, the Contractor agrees to utilize sufficient and necessary management and other resources to perform work in accordance with the schedule. Upon submittal of final and accepted "Initial Project Schedule", the schedule shall be considered the "Baseline Project Schedule".
- F. Periodic (Monthly) Schedule Update Submissions
 - 1. Update the Project Schedule on a regular basis, monthly at a minimum. Provide a draft Periodic Schedule Update for review as prescribed in the paragraph PROJECT SCHEDULE UPDATES. These updates will enable the Engineer to assess the Contractor's progress. Update the schedule to include detailed construction activities as the work progresses. This may require submission of detailed schedule activities for any distinct construction that is started prior to submission of Contractor's final design(s) submission(s) if such activity is authorized.
 - a. Update information including Actual Start Dates (AS), Actual Finish Dates (AF), Remaining Durations (RD), and Percent Complete is subject to the approval of Engineer at the meeting.
 - b. AS and AF dates must match the date(s) reported on the Contractor's Quality Control Report for any activity start or finish.
 - c. Engineer reserves the right to require the Contractor adjusts, add to, or clarify any portion of the schedule which may later be discovered to be insufficient for the

monitoring of the Work or approval of partial payment requests. No additional compensation shall be allowed for such adjustments, additions, or clarifications.

G. Schedule Adjustments

1. The Engineer reserves the right to require that the Contractor adjust, add, or clarify any portion of the schedule which may later be discovered to be insufficient for monitoring of the Work or approval of partial payment requests. No additional compensation will be provided for such adjustments, additions, or clarifications.

3.2 PERIODIC SCHEDULE UPDATE

A. Periodic Schedule Update Meetings

1. Conduct periodic schedule update meetings for the purpose of reviewing the proposed Periodic Schedule Update, Schedule Reports, and Progress Payment as requested by the Engineer. Provide a computer with the scheduling software loaded or screen sharing capabilities which allows all meeting participants to view the proposed schedule during the meeting. The Contractor's authorized scheduler must organize, group, sort, filter, perform schedule revisions, as needed, and review functions as requested by the Engineer and/or Contractor. The meeting is a working interactive exchange, which allows Engineer and Contractor the opportunity to review the updated schedule on a real time and interactive basis. The meeting shall last no longer than one (1) hour. The Contractor's Project Manager and scheduler must attend the meeting with the District and Engineer. Superintendents, foremen and major subcontractors must attend the meeting as required to discuss the project schedule and work. Following the periodic schedule update meeting, make corrections to the draft submission. Include only those changes approved by the Engineer in the submission and invoice for payment.
2. Applications for payment submitted prior to or without conducting a monthly construction progress schedule review meeting will not be accepted and returned as un-reviewed.

B. Update Submission Following Progress Meeting

1. Submit the complete Periodic Schedule Update of the Project Schedule containing all approved progress, not later than four (4) workdays after the periodic schedule update meeting.

C. Schedule Revisions

1. Revision to the monthly schedule update, submittal activities, activity durations, their logical relationships, and the original baseline shall not be allowed. The purpose of the monthly schedule update is to determine the amount of Work completed since the previous month's schedule update as the basis for the application for payment only.
2. Proposed revision to the schedule shall be completed in coordination with the Owner and the RPR and provided as a proposed recovery schedule. Periodic Update Schedules submitted without accepted revisions will not be accepted and returned as un-reviewed.

3.3 REQUESTS FOR TIME EXTENSIONS

- A. Provide a justification of delay to the Engineer in accordance with the appropriate contract provisions and clauses for approval within fourteen (14) calendar days of a delay occurring. Also, prepare a time impact analysis for each contract change request (CCR) to justify time extensions. Failure to submit any such request for an extension in a timely manner shall constitute a waiver of any claim for extension.

B. Justification of Delay

1. Provide a description of the event(s) that caused the delay and/or impact to the work. As part of the description, identify all schedule activities impacted. Show that the event that caused the delay/impact was the responsibility of the District. Provide a time impact analysis that demonstrates the effects of the delay or impact on the project completion

date or interim completion date(s). Evaluate multiple impacts chronologically; each with its own justification of delay. With multiple impacts consider any concurrency of delay. A time extension and the schedule fragnet becomes part of the project schedule and all future schedule updates upon approval by the Engineer.

- C. Time Impact Analysis (Prospective Analysis)
 - 1. Prepare a time impact analysis for approval by the Engineer based on industry standard AACE 52R-06. Utilize a copy of the last approved progress schedule prior to the first day of the impact or delay for the time impact analysis. If the Engineer determines the period between the last approved schedule and the first day of impact is too great, prepare an interim updated schedule to perform the time impact analysis. Unless approved by the Owner, no other changes may be incorporated into the schedule being used to justify the time impact.
- D. Forensic Schedule Analysis (Retrospective Analysis)
 - 1. Prepare an analysis for approval by the Engineer based on industry standard AACE 29R-03.
- E. Fragmentary Network (Fragnet)
 - 1. Prepare a proposed fragnet for time impact analysis consisting of a sequence of new activities that are proposed to be added to the project schedule to demonstrate the influence of the delay or impact to the project's contractual dates. Clearly show how the proposed fragnet is to be tied into the project schedule including all predecessors and successors to the fragnet activities. The proposed fragnet must be approved by the Engineer prior to incorporation into the project schedule.
- F. Time Extension
 - 1. The Engineer must approve the Justification of Delay including the time impact analysis before a time extension will be granted. No time extension will be granted unless the delay consumes all available Project Float and extends the projected finish date ("End Project" milestone) beyond the Contract Completion Date. The time extension will be in calendar days.
 - 2. Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay will not be a cause for an extension to the performance period, completion date, or any interim milestone date.
- G. Impact to Early Completion Schedule
 - 1. No extended overhead shall be paid for delay prior to the original Contract Completion Date for an Early Completion IPS unless the Contractor actually performed work in accordance with that Early Completion Schedule. The Contractor must show that an early completion was achievable had it not been for the impact.

3.4 FAILURE TO ACHIEVE PROGRESS

- A. Should the progress fall behind the approved project schedule for reasons other than those that are excusable within the terms of the contract, the Engineer may require provision of a written recovery plan (recovery schedule) for approval. The plan must detail how progress will be made-up to include which activities will be accelerated by adding additional crews, longer work hours, extra workdays, etc.
- B. Artificially Improving Progress
 - 1. Artificially improving progress by means such as, but not limited to, revising the schedule logic, modifying or adding constraints, shortening activity durations, or changing calendars in the project schedule is prohibited. Indicate assumptions made and the basis for any logic, constraint, duration and calendar changes used in the creation of the recovery plan. Any additional resources, manpower, or daily and weekly work hour

changes proposed in the recovery plan must be evident at the work site and documented in the daily report along with a Schedule Narrative Report.

C. Failure to Perform

1. Failure to perform work and maintain progress in accordance with the supplemental recovery plan may result in corrective action directed by the Engineer pursuant to Standard General Conditions and other contract provisions as may be applicable.

D. Recovery Schedule

1. Should the Engineer find it necessary, submit a recovery schedule pursuant to Standard General Conditions, and other contract provisions as may be applicable. No additional compensation shall be provided for a recovery schedule, adjustments, additions, or clarifications.

3.5 OWNERSHIP OF FLOAT

- A. Except for the provision given in the paragraph IMPACT TO EARLY COMPLETION SCHEDULE, float available in the schedule, at any time, may not be considered for the exclusive use of either the District or the Contractor including activity and/or project float. Activity float is the number of workdays that an activity can be delayed without causing a delay to the "End Project" finish milestone. Project float (if applicable) is the number of workdays between the projected early finish and the contract completion date milestone.

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SECTION 01 33 00

SUBMITTALS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section specifies the general methods and requirements of submissions applicable to the following work-related submittals: Shop Drawings, Product Data, Samples, and Construction or Submittal Schedules. Detailed submittal requirements will be specified in the technical specification section.

1.2 SHOP DRAWINGS, PRODUCT DATA, SAMPLES

- A. Shop Drawings.
1. Shop drawings, as specified in individual work Sections include, but are not necessarily limited to: custom-prepared data such as fabrication and erection/installation (working) drawings of concrete reinforcement, piping layout, scheduled information, special wiring diagrams, coordination drawings, individual system or equipment inspection and test reports including performance curves and certifications as applicable to the work.
 2. All shop and working drawings shall be prepared on standard size, 22-inch by 34-inch sheets, except those which are made by changing existing standard shop or working drawings.
 3. All shop drawings submitted by subcontractors for approval shall be sent directly to the Contractor for checking. The Contractor shall be responsible for their submission at the proper time so as to prevent delays in delivery of materials.
 4. The Contractor shall check all subcontractors' shop drawings regarding measurements, size of members, materials, and details to satisfy himself/herself that they conform to the intent of the Drawings and Specifications. Shop drawings found to be inaccurate or otherwise in error shall be returned to the subcontractors for correction before submission thereof.
 5. All details on shop drawings submitted for approval shall show clearly the relation of the various parts of main members and lines of the structure, and where correct fabrication of the work depends upon field measurements; such measurements shall be made and noted on the Drawings before being submitted for approval.
- B. Product Data: Product data as specified in individual Sections, includes, but is not necessarily limited to, standard prepared data for manufactured products (sometimes referred to as catalog data), such as the manufacturer's product specifications and installation instructions, availability, roughing-in diagrams and templates, catalog cuts, product photographs, standard wiring diagrams, printed performance curves and operational-range diagrams, production or quality control inspection and test reports and certifications and recommended spare-parts listing, and product warranties, as applicable to the Work. Product data shall be submitted electronically to the maximum extent possible.
1. Include a brief description of where product is proposed for use. Reference systems, drawings and specifications with submittal.
- C. Samples: Samples specified in individual Sections, includes, but is not necessarily limited to, physical examples of the work such as sections of manufactured or fabricated work, and units of work to be used by the Engineer for independent inspection and testing, as applicable to the Work.

1.3 EQUIPMENT, MATERIALS AND COMPONENTS

- A. All equipment, materials and components furnished by the Contractor shall be stock models for which parts are readily available and shall be products which shall have performed satisfactorily in an installation independent of the manufacturer's facilities for a consecutive period of not less than two (2) years as of the date of the bid opening.
- B. Any item which the Contractor proposes to furnish as equal to any item specified shall be submitted for approval following the instructions below.

1.4 REQUIRED SUBMITTALS

- A. Construction Schedule. The Contractor shall furnish the Engineer his/her proposed work schedule within 15 days after award of contract. The Contractor shall also advise the Engineer of revisions of the schedule as modifications may become necessary, or as may be required after commencement of work. Such outlines and revisions shall be in sufficient detail to enable the Engineer to judge as to the adequacy of the Contractor's operations and to anticipate such conditions as may tend to impair or retard the progress and completion of the work.
- B. Payment Schedule. The Contractor shall furnish the Engineer a detailed payment schedule within 15 days of award of contract. This schedule shall be based upon the Contract Bidding Schedule but with sufficient additional detail to allow accurate calculation of the Monthly Progress Payment. Lump sum bid items shall be broken down into their component parts, i.e., mobilization, excavation, arsenic treatment system, etc. in accordance with Section 01 20 00 Price and Payment Procedures.
- C. Submittals are required on the items as listed individually in each section of the Technical Specifications (Divisions 2 through 44). The description of submittal data required is contained in the individual section.
- D. As-built drawings: One (1) complete set of (22" x 34") blueline prints of the Contract Drawings will be furnished to the Contractor for use in preparing as-built drawings. The Contractor shall keep this set of prints on the job site and accurately record (redline) all changes to contract drawings including Contract Modifications, as indicated in Section 01 72 00 Record Documents. Submit as-built redline prints to the Engineer at the completion of the job.
- E. The Contractor shall furnish to the Engineer three (3) complete bound sets of operation and maintenance instructions for those items as listed individually in each section of the Technical Specifications (Divisions 2 through 44). Each set shall contain manufacturer's specifications, operation and performance and dimensional data. Sets shall be neatly segregated, indexed and labeled. See also Section 01 73 00 Operations and Maintenance Data.

1.5 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall review shop drawings, product data and samples, including those by Subcontractors, prior to submission to determine and verify the following:
 - 1. Field measurements.
 - 2. Field construction criteria.
 - 3. Catalog numbers and similar data.
 - 4. Conformance with the Specifications.
- B. If a shop drawing shows any deviation from the requirements of the Contract Documents, the Contractor shall provide a description of the deviations with the reason and justification in a letter attached to the submittal.

- C. The review and approval of shop drawings, samples or product data by the Engineer shall not relieve the Contractor from his responsibility with regard to the fulfillment of the Contract.
- D. No portion of the work requiring a shop drawing, sample, or product data shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased or on-site construction accomplished which does not conform to approved shop drawings and data shall be at the Contractor's risk. The District will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.
- E. Project work, material, fabrication, and installation shall conform with approved shop drawings, applicable samples, and product data.

1.6 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule.
- B. Deliver submittals electronically in PDF format.
- C. A single submittal shall be provided by the Contractor for all items contained within a single specification. Submit all product data, shop drawings, laboratory test results, material source information, and certificates of compliance listed in each specification section under a single submittal cover for review. Incomplete submittals will not be reviewed and will be returned as "Revise and Resubmit."
- D. Number of submittals required. It is the intent of the District to maximize the use of electronic submittals. Submit one electronic copy to the Engineer. If an electronic submittal is not practical submit per the following:
 - 1. Shop Drawings: Unless otherwise stated in the respective Specifications Sections, submit five hard copies.
 - 2. Product Data: Unless otherwise stated in the respective Specifications Sections, submit five hard copies.
 - 3. Samples: Submit five samples unless stated otherwise in the respective Specification Sections.
- E. Submittals shall contain:
 - 1. Cover sheet that includes:
 - a. The date of submission and the dates of any previous submissions.
 - b. The Project title and number.
 - c. Contractor identification.
 - d. The names of:
 - 1) Contractor.
 - 2) Supplier.
 - 3) Manufacturer.
 - e. Identification of the product, with the specification section number, page, and paragraph(s).
 - 2. Field dimensions, clearly identified as such.
 - 3. Relation to adjacent or critical features of the Work or materials.
 - 4. Applicable standards, such as ASTM numbers.
 - 5. Identification of deviations from Contract Documents.
 - 6. Identification of revisions on resubmittals.
- F. Processing Time
 - 1. All submittals and Requests for Information (RFI) shall be made sufficiently in advance of construction to provide 14 calendar days for review by the Engineer.

2. Time for review shall commence on Engineer's receipt of submittal.
3. Resubmittals will be subject to same review time.
4. No adjustment of Contract Times or Price will be allowed as a result of delays in progress of Work caused by rejection and subsequent resubmittals.

G. Resubmittals: Clearly identify each correction or change made.

H. Incomplete Submittals:

1. A single submittal shall be provided by the Contractor for all items contained within a single specification. Incomplete submittals will not be reviewed and will be returned as "Revise and Resubmit."
2. Engineer will return entire submittal for Contractor's revision if preliminary review deems it incomplete.
3. When any of the following are missing, submittal will be deemed incomplete:
 - a. Contractor's review stamp; completed and signed.
 - b. "Transmittal of Contractor's Submittal;" completed and signed.

I. Submittals not required by Contract Documents:

1. Will not be reviewed and will be returned stamped "Not Subject to Review."
2. Engineer will keep one copy and return submittal to Contractor.

1.7 REVIEW OF SHOP DRAWINGS, PRODUCT DATA, WORKING DRAWINGS AND SAMPLES

- A. The Engineer's review is for general conformance with the design concepts presented in the Contract Documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Contract Drawings and Specifications or from departures there from. The Contractor remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.
- B. The review of shop drawings, data, and samples will be general. They shall not be construed:
 1. As permitting any departure from the Contract requirements:
 2. As relieving the Contractor of responsibility for any errors, including details, dimensions, and materials:
 3. As approving departures from details furnished by the Engineer, except as otherwise provided herein.
- C. If the shop drawings, data or samples submitted describe variations and show a departure from the Contract requirements which the Engineer finds to be in the interest of the District and to be so minor as not to involve a change in Contract Price or time for performance, the Engineer may return the reviewed drawings without noting an exception.
- D. One electronic copy of shop drawings or product data will be returned to the Contractor. Samples will not be returned. If the Contractor wishes extra copies to be returned, he shall submit additional copies.
- E. Submittals will be returned to the Contractor under one of the action codes indicated and defined on the transmittal form furnished by the Engineer.
- F. Re-submittals will be handled in the same manner as first submittals. On re-submittals the Contractor shall direct specific attention, in writing, on the letter of transmittal and on re-submitted shop drawings by use of revision triangles or other similar methods, to revisions other than the corrections requested by the Engineer on previous submissions. Any such revisions which are not clearly identified shall be made at the risk of the Contractor. The

Contractor shall make corrections to any work done because of a revision that is not in accordance with the Contract Documents.

- G. Partial submittals may not be reviewed. The Engineer will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the Contractor, and will be considered "Rejected" until re-submitted. The Engineer may at his option provide a list or mark the submittal directing the Contractor to the areas that are incomplete.
- H. If the Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, the Contractor shall give written notice thereof to the Engineer at least five (5) working days prior to release for manufacture.
- I. When the shop drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.

1.8 DISTRIBUTION

- A. Distribute reproductions of approved shop drawings and copies of approved product data and samples, where required, to the job site file and elsewhere as directed by the Engineer.

1.9 GENERAL PROCEDURES FOR SUBMITTALS

- A. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work sections of the Specifications, so that the installation will not be delayed by processing times including re-submittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. No extension of time will be authorized because of poorly sequenced activities. No extension of time will be authorized because of the Contractor's failure to transmit submittals sufficiently in advance of the Work.
- B. All submittals shall be made utilizing an approved submittal cover form which shall be used as the document for approving or disapproving the material. Written approval must be obtained from the Engineer before items requiring submittal are installed. Submittals not in accordance with the plans and specifications shall be accompanied by a written statement indicating in detail all parts which deviate from the plans and specifications.
- C. All submittals shall be made to the Engineer by the Contractor only. Submittals received by the Engineer without the Contractor's signature shall be returned to the Contractor without action.
- D. Literature, shop drawings, etc., fully describing the items which the Contractor proposes to install shall be submitted in the form of one electronic copy. Material or finish samples shall be submitted in three (3) sets. Items submitted shall be plainly marked to indicate which options, models etc. are proposed.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

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SECTION 01 40 00

QUALITY CONTROL

PART 1 GENERAL

1.1 PERFORMANCE OF WORK BY CONTRACTOR

- A. The Contractor's procedure and methods of construction may, in general, be of his/her own choosing, provided they follow best general practice and are calculated to secure results which will satisfy the requirements of these specifications.
- B. The Contractor shall furnish the Engineer all reasonable facilities for obtaining such information as he may desire respecting the character of the materials and the progress of the work. The Contractor shall furnish information to include the number of persons employed, their pay, the time they worked, and other elements of cost at the request of the Engineer or the District.

1.2 RELATED SECTION:

- A. Refer to Contract General Conditions for additional requirements.

1.3 AUTHORITY OF THE ENGINEER

- A. The authority of the Engineer for technical contract administration and inspection of the work is limited to the following functions:
 - 1. Inspect and accept or reject work and materials including exceptions to material submittals and shop drawings.-
 - 2. Assure compliance with all technical contract terms and conditions.
 - 3. Clarify specifications and drawings where clarification does not involve contract cost or time. Any disagreements with the Contractor over clarification of specifications and drawings are to be immediately referred to the District.
 - 4. Verify, prepare, and recommend payment estimates on progress payments; forward to the District for approval.
 - 5. Conduct "Labor Standards Interviews" in accordance with instructions from the District. All known or suspected violations of the Labor Standards Provisions shall be reported immediately to the District.
 - 6. Enforce safety requirements in accordance with the Federal and State Regulations and the Technical Specifications.
- B. The Engineer is not authorized to take the following actions, all of which remain the sole responsibility of the District.
 - 1. Make changes to the contract provisions, period of performance, or change any contract terms or conditions.
 - 2. Make decisions concerning any claims and disputes under this contract.
- C. Close liaison will be maintained by the Engineer, the District and the Contractor. The Engineer shall notify the District immediately of any problems encountered, including but not restricted to maintaining completion schedules.

1.4 AUTHORITY OF THE INSPECTOR

- A. An Inspector employed by the District will assist the Engineer in making inspections and measurements and will enforce strict compliance with the terms of the contract.

- B. The Inspector shall have free access to the job site at all times while construction is in progress, and the Contractor shall furnish such information and assistance as may be necessary.
- C. The Inspector shall, on a daily basis, record the work being accomplished, the trades working, materials delivered and/or installed, reasons for delays, and other pertinent information.
- D. The Inspector may reject unsuitable materials or work not performed in accordance with the terms of the contract until the situation has been referred to and resolved by the Engineer and/or District.
- E. The Inspector shall observe that all construction is performed in conformance with the contract, health, and safety requirements.
- F. The Inspector shall conduct wage rate interviews and report suspected labor standard violations to the District.
- G. The Inspector shall check and verify the Contractor's progress payment requests, if progress payments have been included in the contract.
- H. No decisions or instructions of an Inspector will, at any time, relieve the Contractor from the responsibility of complying fully with all the requirements of the contract. In cases of difference arising between an Inspector and the Contractor or his agent, appeal shall be taken to the Engineer.
- I. Inspectors are not authorized to waive or alter in any respect any of the terms or requirements of the contract, to make additional requirements, to grant extensions of time or delays, or to waive forfeitures. The Contractor shall not be entitled to payment for any work improperly performed with or without an Inspector's approval.

1.4 INSPECTION AND TESTING

- A. Contract Description.
 - 1. Where the Contract Documents require work to be field tested or approved, it shall be tested in the presence of the Engineer or its authorized representative. The Engineer shall have the right to witness all on-site tests performed by the Contractor and any shop tests. The results of any tests performed by the Contractor shall be made available for the information of the Engineer. Inspections, tests or favorable reviews by the Engineer or others shall not relieve the Contractor from its obligation to perform the work in accordance with the requirements of the Contract Documents or for its sole responsibility for the quality of workmanship and materials.
 - 2. Except as specifically required under the technical specifications for testing and inspection, all tests for materials furnished by the Contractor will be done in accordance with commonly recognized standards of national organizations. Where tests are to be performed by an independent laboratory or agency, the Contractor shall furnish such samples of all materials as required by the Engineer without charge. The sample or samples of materials to be tested shall be selected by such laboratory or agency, or the Engineer, and not by the Contractor. No material for which the Contract Documents require the submittal and approval of tests, certificates of compliance or other documentation shall be incorporated in the Work until such submittal has been made and approved.
 - 3. The Contractor shall provide safe access for the Engineer and inspectors to adequately inspect the quality of work and the conformance with the Contract Documents. The Contractor shall furnish the Engineer the necessary labor and facilities for such things as excavation in the compacted fill to the depths required to take samples. The Contractor

shall provide adequate lighting, ventilation, ladders and other protective facilities as may be necessary for the safe performance of inspections.

4. Upon completion of the Work the Engineer will conduct a final inspection as provided for in Section 01 70 00, "Project Closeout." Records shall be available at all reasonable hours for inspection by other local or State agencies to ascertain compliance with laws and regulations.

B. Notice

1. The Contractor shall notify the Engineer in writing at least 72 hours before any field testing or special inspections, including concrete and compaction testing, are required to be performed by the independent laboratory. Any offsite test will require more intense planning and scheduling.
2. Whenever the Contractor varies the period during which work is carried on each day, the Contractor shall give due notice to the Engineer so that proper inspection may be provided. Any work done in the absence of the Engineer shall be considered to be rejected. It will be the responsibility of the Contractor to demonstrate to the satisfaction of the Engineer that the work meets all conditions of the specification and if such conditions are not met to remove the work.
3. The Contractor shall give the Engineer written notification at least 30 days prior to the shipment of materials and equipment to be tested and/or inspected at the point of origin. Satisfactory tests and inspections at the point of origin shall not be construed as a final acceptance of the materials and equipment nor shall such tests and inspections preclude retesting or re-inspection at the site of the Work.

C. Testing

1. The Contractor shall be responsible for, and shall pay for, all source quality control and off-site tests of materials required including all source and mix design tests for the approval of soil and concrete materials.
2. The District will perform the soils and concrete confirmation tests detailed in the Technical Specifications during the performance of the Work. The District will retain the services of a qualified testing agency to perform soil and asphalt compaction testing and work identified as requiring special inspections and testing as defined by the CBC 2022.
3. The Contractor shall be responsible for the costs associated with the re-test of any failed test. The cost of the re-test of any failed test will be deducted from the bid price.
4. The Engineer shall have the authority to require additional tests or inspections due to the manner in which the Contractor executes its work. Examples of such additional tests and inspections include; tests of materials substituted for previously accepted materials, or substituted for specified materials, or retests made necessary by failure of material to comply with the requirements of the Specifications. The Contractor shall be responsible for the costs of any additional tests or inspections.
5. The Contractor shall submit information and certifications for any independent testing laboratory or agency to the Engineer for review and approval of the labs or agency.

D. Work Covered Prior to Inspection and/or Testing

1. Work requiring inspection and/or testing shall not be concealed or buried prior to the acceptance of such inspection or testing. Work covered without the favorable review or consent of the Engineer shall, if required by the Engineer, be uncovered for inspection and/or testing at the Contractor's expense.

E. Work Covered With Prior Inspection and/or Testing

1. If the Engineer considers it necessary or advisable that covered work which was favorably inspected and tested be uncovered for re-inspection and/or retesting, the Contractor, at the Engineer's request, will uncover, expose or otherwise make available for observation, inspection or testing as the Engineer may require, that portion of the work in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that such work is defective, the Contractor will bear all expenses of such

uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction. If, however, such work is not found to be defective the Contractor will be allowed an increase in the Contract price or an extension of the Contract time, or both, directly attributable to such uncovering, exposure, observation, testing and reconstruction, and a Change Order shall be issued for such additional work.

F. Coordination of State of California and other Inspections

1. The Contractor is completely responsible for scheduling all State, County, and any other agency inspections such as Pacific Gas and Electric Company in accordance with the State, County, and agency requirements. The Contractor shall notify the Engineer of all work component inspection notices and schedules. Failure of the Contractor to properly coordinate and schedule these inspections shall not be cause for time extensions.

PART 2 PRODUCTS

2.1 TEST WATER

- A. The Contractor shall coordinate with the District for the use of water available at the project site and shall pay all costs associated with the use of the water. The Contractor shall properly dispose of the water, which is required for testing of piping and structures, including dechlorination. The Contractor shall dispose of all testing water in the sanitary sewer without damage to property, and in accordance with applicable regulations.

PART 3 EXECUTION

3.1 STATEMENT OF SPECIAL INSPECTIONS

- A. The Statement of Special Inspections is provided on the structural drawings in accordance with the requirements of the California Building Code.
- B. The Statement of Special Inspections summarizes the Special Inspections and tests required. Special Inspectors will be provided by the District, and will refer to the approved Drawings and specifications for detailed special inspection requirements. Any additional tests and inspections required by the approved Drawings and specifications shall also be performed.
- C. The Special Inspections identified are in addition to those required by other sections of the building code. Special Inspection is not a substitute for inspection by the Engineer.
- D. The Engineer will keep records of all inspections and will furnish inspection reports to the Contractor. Discovered discrepancies shall be brought to the immediate attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the District and the registered design professional in responsible charge. The Special Inspection program does not relieve the Contractor of his or her responsibilities.
- E. Job site safety and means and methods of construction are solely the responsibility of the Contractor.
- F. The Contractor is required to coordinate for all inspections. The Contractor shall notify the Engineer and the Special Inspector a minimum of 72 hours prior to all Special Inspections and other inspections and tests that are required. The Contractor shall notify the Engineer and the Special Inspector a minimum of 72 hours prior to any concrete to be poured.

- G. Inspectors and testing agencies shall be engaged by the District. Any conflict of interest must be disclosed to the Engineer prior to commencing work.
- H. Special inspected work that is installed or covered without the approval of the Engineer is subject to removal or exposure at the expense of the Contractor.
- I. Continuous inspection is always required during the performance of the work unless otherwise specified. When work in more than one category of work requiring special inspection is to be performed simultaneously, or the geographic location of the work is such that it cannot be continuously observed, it is the Contractor's responsibility to employ a sufficient number of inspectors to assure that all the work is inspected and in accordance with the provisions of the building code.

3.2 CONTRACTOR STATEMENT OF RESPONSIBILITY

- A. Each Contractor responsible for the construction or fabrication of a system or component designated above as part of the main wind force or main seismic force resisting systems above must submit a Statement of Responsibility.

END OF SECTION

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SECTION 01 43 33

MANUFACTURERS' FIELD SERVICES

PART 1 GENERAL

1.1 DEFINITIONS

- A. Person-Day: One person for 8 hours not including travel to site within regular Contractor working hours.

1.2 SUBMITTALS:

- A. Informational Submittals:
 - 1. Training Schedule: Submit, in accordance with requirements of this Specification, not less than 45 days prior to start of equipment installation and revise as necessary for acceptance.
 - 2. Lesson Plan: Submit, in accordance with requirements of this Specification, proposed lesson plan not less than 45 days prior to scheduled training and revise as necessary for acceptance.
 - 3. Training Session Recordings: Furnish District with two (2) complete sets of recordings fully indexed and cataloged with printed label stating session and date recorded.

1.3 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

- A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified in the individual specification section.
- B. Representative subject to acceptance by Engineer. No substitute representatives will be allowed unless prior written approval by such has been given.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

- A. Furnish manufacturers' services, when required by an individual specification section, to meet the requirements of this section.
- B. Where time is necessary in excess of that stated in the Specifications for manufacturers' services, or when a minimum time is not specified, time required to perform specified services shall be considered incidental.
- C. Schedule manufacturer' services to avoid conflict with other onsite testing or other manufacturers' onsite services.
- D. Determine, before scheduling services, that conditions necessary to allow successful testing have been met.

- E. Only those days of service approved by Engineer will be credited to fulfill specified minimum services.
- F. When specified in individual Specification sections, manufacturers' onsite services shall include:
 - 1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation, or application procedures.
 - 2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
 - 3. Providing, on a daily basis, copies of manufacturers' representatives' field notes and data to Engineer.
 - 4. Revisiting the site as required to correct problems and until installation and operation are acceptable to Engineer.
 - 5. Resolution of assembly or installation problems attributable to or associated with respective manufacturer's products and systems.
 - 6. Assistance during functional and performance testing, commissioning and facility startup and evaluation.
 - 7. Training of District personnel in the operation and maintenance of respective product as required.

3.2 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

- A. When so specified, a "Manufacturer's Certificate of Proper Installation" form, a copy of which is attached to this section, shall be completed and signed by equipment manufacturer's representative.
- B. Such form shall certify signing party is a duly authorized representative of manufacturer, is empowered by manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to ensure equipment is complete and operational.

3.3 TRAINING

- A. General:
 - 1. Furnish manufacturers' representatives for detailed classroom and hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.
 - 2. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with District, and familiar with operation and maintenance manual information specified in Section 01 73 00 – Operation and Maintenance Data.
 - 3. Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.
 - 4. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.
- B. Training Schedule:
 - 1. List specified equipment and systems that require training services and show:
 - a. Respective manufacturer.
 - b. Estimated dates for installation completion.
 - c. Estimated training dates.
 - 2. Allow for multiple sessions when several shifts are involved.

3. Adjust schedule to ensure training of appropriate personnel as deemed necessary by District, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.
 4. Coordinate with Section 01 32 16 – Construction Progress Schedule.
- C. Lesson Plan: When manufacturer or vendor training of District personnel is specified, prepare a lesson plan for each required course containing the following minimum information:
1. Title and objectives.
 2. Recommended attendees (such as operators).
 3. Course description, outline of course content, and estimated class duration
 4. Format (such as, lecture, self-study, demonstration, hands-on).
 5. Instruction materials and equipment requirements.
 6. Resumes of instructors providing training.
- D. Pre-Startup Training:
1. Coordinate training sessions with District's operating personnel and manufacturers' representatives, and with submission of operation and maintenance manuals in accordance with Section 01 73 00 – Operation and Maintenance Data.
 2. Complete at least 14 calendar days prior to beginning of facility startup.
- E. Post-startup Training: If required in Specifications, furnish and coordinate training of District's operating personnel by respective manufacturer's representatives.
- 3.4 Supplement
- A. The supplement listed below, following "End of Section," is part of this Specification.
1. Manufacturer's Certificate of Proper Installation

END OF SECTION

Manufacturer's Certificate of Proper Installation

Owner: _____ Eqpt Serial No: _____
Eqpt Tag No: _____ Eqpt/System: _____
Project No: _____ Spec. Section: _____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- ☐ Installed in accordance with Manufacturer's recommendations.
- ☐ Inspected, checked, and adjusted.
- ☐ Serviced with proper initial lubricants.
- ☐ Electrical and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ Functional tests.
- ☐ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments: _____

I, the undersigned manufacturer's representative, hereby certify that I am: i) a duly authorized representative of the manufacturer; ii) empowered by the manufacturer to inspect, approve, and operate their equipment; and iii) authorized to make recommendations required to ensure equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20 ____

Manufacturer: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

SECTION 01 50 00

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SUBMITTALS SECTION INCLUDES

- A. Meet requirements of Section 01 33 00, "Submittals," as applicable. Make submittals required below before starting Work at the site or in accordance with accepted schedule of submittals submissions.
- B. Administrative Submittals: Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies.
- C. Traffic Control Plan: Submit vehicular and pedestrian traffic control plan as described in this section.

1.2 RELATED SECTION:

- A. Refer to Contract General Conditions for additional requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. State of California, Department of Transportation (Caltrans) Specifications and Standards:
 - 1. Standard Specifications:
 - a. Section 7 Legal Relations and Responsibility
 - b. Section 12 Construction Area Traffic Control Devices
 - 2. Standard Plans:
 - a. Temporary Traffic Control Systems
 - 3. California Manual on Uniform Traffic Control Devices, Current Edition (California MUTCD)
- B. Mendocino County Department of Transportation
 - 1. Standard Specifications:
 - a. Section 1-1.05 Traffic Control
 - 2. Standard Plans;
 - a. MenDot Std. No. T21 Traffic Control System for Construction Zones Details
 - b. MenDot Std. No. T22A Traffic Control Requirements
 - c. MenDot Std. No. T22B Traffic Control Requirements (Cont.)
- C. The Contractor must conduct their operations to cause the least possible obstruction and inconvenience to public traffic. Unless otherwise approved by the Engineer, all traffic must be permitted to pass through the Work.
- D. Due to the need to accommodate and minimize inconvenience to the public, unless expressly specified or approved in writing by the Engineer, no road closures will be permitted. Public vehicular and pedestrian traffic must be allowed to travel through the Work area with an absolute minimum of interruption or impedance unless otherwise provided for in the Technical Specifications or approved in writing by the Engineer. The Contractor must make provisions for the safe passage of pedestrians around the area of Work at all times.
- E. Residents affected by construction must be provided passage and access through the Work area to the maximum extent possible.

- F. The Contractor must provide multiple, advance written notices of closures to all affected property owners in a form approved by the Engineer.
- G. Except as otherwise approved by the County, the stockpiling or storing of material in County streets or right of way shall be prohibited. Where this is unavoidable, all such materials must be piled or stored in a manner that will not obstruct sidewalks, driveways, or pedestrian crossings. Gutters and drainage channels must be kept clear and unobstructed at all times. All such materials shall be stored and handled in a manner that protects County streets, sidewalks, or other facilities from damage.
- H. Where approved in advance by the Engineer, the Contractor must construct and maintain detours for the use of public traffic at his or her own expense. Failure or refusal of the Contractor to construct and maintain detours so approved at the proper time will be a material breach of the Contract subject to any and all remedies available pursuant to the Contract Documents and at law and equity. Such remedies include, but are not limited to, termination pursuant to the Contract General Conditions.
- I. Throughout performance of the Work, the Contractor must construct and adequately maintain suitable and safe crossings over trenches and such detours as are necessary to care for the public and private traffic at all times including Saturdays, Sundays and holidays.
- J. The Contractor will be responsible for keeping all emergency services, including the police and fire departments, informed of obstructions to or detours around any public or private roads caused by reasons of his or her operations.
- K. The Contractor must comply with the California Manual on Uniform Traffic Control Devices (MUTCD) at all times.
- L. The fact that rain or other causes, either within or beyond the control of the Contractor, may force suspension or delay of the Work, shall in no way relieve the Contractor of his or her responsibility of maintaining traffic through the Project and providing local access as specified in this section. The Contractor must, at all times, keep on the job such materials, force and equipment as may be necessary to keep roads, streets and driveways within the Project open to traffic and in good repair and shall expedite the passage of such traffic, using such force and equipment as may be necessary.

1.4 MOBILIZATION

- A. Mobilization shall include, but not be limited to, these principal items:
 - 1. Moving Contractor's field office and equipment required for first month operations onto site.
 - 2. Installing temporary construction power, wiring, and lighting facilities.
 - 3. Providing on-site communication facilities, including telephones.
 - 4. Providing onsite sanitary facilities and potable water facilities as specified and as required by Laws and Regulations, and governing agencies.
 - 5. Insurance and bonds.
 - 6. Posting OSHA required notices and establishing safety programs and procedures.
 - 7. Having Contractor's superintendent at the site full time.
 - 8. Submitting of initially acceptable schedules as required.
- B. Obtaining required permits.

1.5 ACCESS TO SITE

- A. Access to the work from existing roads. The District assumes no responsibility for the condition or maintenance of any road or structure thereon that may be used by the Contractor in performing the work under these specifications or in traveling to and from the site of the work. No payment will be made to the Contractor by the District for any work done in improving, repairing, or maintaining any road or structure thereon for use in the performance of the work under these specifications. Roads subject to interference by the Work shall be kept open.

1.6 PROTECTION OF PROPERTY

- A. The Contractor shall not enter upon private property for any purpose without first obtaining written permission from the owner or his duly authorized representative, shall be responsible for the preservation of all public and private property along and adjacent to work contemplated under the contract, and shall use every precaution necessary to prevent damage or injury thereto. He/she shall exercise due care in preventing, shall be responsible for damages to structures of all kinds, whether owned by the District or privately, and shall protect from disturbance or damage all land monuments.

1.7 PROTECTION OF ENVIRONMENT

- A. All contract operations shall be conducted in compliance with all federal, state and local environmental laws and regulations. This condition applies to, but is not limited to, laws and regulations governing noise levels, air and water quality standards, and cultural resources.
- B. If the Contractor fails or refuses to promptly comply with the requirements of subparagraph A. above, the Engineer or his/her authorized representative, shall notify the Contractor of any noncompliance and indicate to the Contractor the action to be taken. The Contractor shall, after receipt of such notice, immediately correct the conditions to which attention has been directed. Such notice, either oral or written, when served on the Contractor or his representative(s) at the site of the work, shall be deemed sufficient.
- C. In the event the Contractor fails or refuses to promptly comply with the compliance directive issued under subparagraph above, the Engineer with the concurrence of the Contracting Officer may issue an order to suspend all or any part of the work.
- D. When satisfactory corrective action is taken, an order to resume work will be issued. The Contractor shall not be entitled to any extension of time, nor to any claim for damage or to excess costs by reason of either the directive or the suspension order.

1.8 ADDITIONAL SAFETY REQUIREMENT

- A. Roll-over protection and seat belts required by 29 CFR 1926 shall include equipment regardless of year of manufacture.
- B. Submit a written and detailed Fire Safety and Prevention Plan outlining the prevention measures and emergency procedures that will be implemented at the project site during demolition. The Fire Safety and Prevention Plan shall be prepared in accordance with §3221 of the California Code of Regulations, and shall include following elements:
 - 1. Potential fire hazards and their proper handling and storage procedures, potential ignition sources (such as welding, smoking and others) and their control procedures, and the type of fire protection equipment or systems which can control a fire involving them;
 - 2. Names or regular job titles of those responsible for maintenance of equipment and systems installed to prevent or control ignitions or fires; and
 - 3. Names or regular job titles of those responsible for the control of accumulation of flammable or combustible waste materials.

- C. Housekeeping. The Contractor shall control accumulations of flammable and combustible waste materials and residues so that they do not contribute to a fire emergency. The housekeeping procedures shall be included in the written fire prevention plan.
- D. Training.
 - 1. The Contractor shall apprise employees of the fire hazards of the materials and processes to which they are exposed.
 - 2. The Contractor shall review with each employee upon initial assignment those parts of the fire prevention plan which the employee must know to protect the employee in the event of an emergency. The written plan shall be kept at the job site and made available for employee review.
- E. Maintenance. The Contractor shall regularly and properly maintain, according to established procedures, equipment and systems installed at the project site to prevent accidental ignition of combustible materials.

1.7 CONTRACTOR'S USE OF PREMISES

- A. Availability of lands:
 - 1. All work is to be performed on District lands or such other lands which are designated for the use of the Contractor. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by the District, unless otherwise provided in the Contract Documents. Nothing contained in the Contract Documents shall be interpreted as giving the Contractor exclusive occupancy of the lands or rights of way provided.
- B. Use of premises: The Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the project site and approved staging areas. The Contractor shall assume full responsibility for any damage to any such land or area.
- C. Lands furnished by the District upon which Contractor shall perform the Work are as shown on the Drawings.
- D. Coordinate with the District on location(s) for Contractor's temporary facilities and laydown of materials and equipment. In the absence of available laydown area for materials and equipment on District-owned lands, Contractor shall make his/her own arrangements for temporary facilities and laydown of materials and equipment.
- E. Contractor's employees shall park their vehicles in District approved parking areas only.
- F. Contractor's employees shall not use existing District buildings or landscaped areas for break or lunch times. Contractor's employees shall be responsible for cleaning up any litter from break or lunch time.

1.8 TEMPORARY TRAFFIC CONTROL PLAN

- A. The Contractor shall provide all materials, equipment, and labor necessary to furnish, place, and maintain all temporary traffic control systems, including construction and maintenance area traffic control devices and flaggers as required to access the project site and perform the Work in accordance with this Section, and all other appurtenant work, complete in place, as shown on the Drawings and as specified herein.
- B. The Contractor shall submit for review by the Engineer, Work Zone Traffic Control Plans on 11" x 17" format which contains only information related to the site-specific work zone traffic

control. Separate Traffic Control Plans shall be prepared for work in the Mendocino County right-of-way and California Department of Transportation right-of-way.

- C. Approval for work within the Mendocino County right-of-way will require approval of the Mendocino County Department of Transportation. An encroachment permit for work within the Mendocino County right-of-way is required.
- D. Approval for work within the State right-of-way will require approval of the California Department of Transportation District 1 Encroachment Permits office. An encroachment permit for work within the State right-of-way is required.
- E. The Work Zone Traffic Control Plans shall show which California MUTCD and/or Mendocino County Standard typical applications, if any, are to be used for each work operation in addition to site specific traffic control. If the Contractor proposed to use the current edition of California MUTCD in specific work operations, they shall submit in writing for consideration which Typical Application Diagram will be used for each work operation. The Work Zone Traffic Control Plan shall be specific to the proposed method(s) construction and shall include:
 - 1. Specific details for construction staging, including the location and limits of the work zone.
 - 2. Locations of all excavations.
 - 3. Plans for protection of the public from construction-related hazards.
 - 4. Lane closures and traffic routing including consideration of construction-related trucking routes.
 - 5. A trucking route for approval by the Engineer. The route must minimize traffic on residential streets that are not part of the project.
 - 6. A pedestrian routing plan for approval by the Engineer prepared in accordance with the California MUTCD. The routing plan must demonstrate how pedestrians will be safely routed around the project site during construction.
 - 7. Lane closure markings, barricade locations, and sign locations showing the necessary signing, methods of delineation and channelization and reference to the appropriate Caltrans standards and California MUTCD details for all affected roads.
 - 8. Dimensions of lanes affected by traffic control that will be open to traffic.
 - 9. Dimensions and locations of signs and cone tapers.
 - 10. Identification of side streets and driveways affected by construction and
 - 11. Time periods of lane closures and detours.
- F. The Work Zone Traffic Control Plan shall contain a title block which contains the Contractor's name, address, phone number, project superintendent's name, contract name, dates and hours traffic control will be in effect, and a space for review acknowledgment.
- G. The Work Zone Traffic Control Plan shall be submitted to the Engineer and other affected agencies for review at least two weeks prior to implementation in order to determine the Contractor's compliance with the requirements of this section.
- H. No work except for installation of project identification signs will be allowed to commence prior to approval of the Work Zone Traffic Control Plan.
- I. A "Letter of Responsibility," on company letterhead, indicating the names and telephone numbers of at least three different persons who shall be available to be contacted in case of emergency at any time during the life of the contract. Said persons must have decision-making authority within the company.

1.9 PROTECTION OF WORK AND PROPERTY

- A. Reference General Conditions and this Section.

- B. Comply with all OSHA and other applicable safety rules.
- C. Keep Owner informed of all accidents or near accidents on the site and related claims.
- D. Use of Explosives: No blasting or use of explosives will be allowed on the site.
- E. During the performance of the Work, Contractor is responsible for adapting its means, methods, techniques, sequences, and procedures of construction to allow the District to maintain operation as described in Section 01 10 00, "Summary Of Work," at the existing level of facility production and consistent with applicable permit requirements, and Laws and Regulations. In performing such Work and in cooperating with the District to maintain operations, it may be necessary for Contractor to plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items that will be included within the Contract Price.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 TEMPORARY UTILITIES

- A. Power:
 - 1. Electrical appurtenances required for providing temporary electric power services for the Contractor shall be provided by the Contractor and approved by Pacific Gas and Electric Company.
 - 2. Cost of electric power used in performance and acceptance testing will be borne by Contractor.
 - 3. The Contractor shall provide its own diesel or gasoline engine driven air compressor system and power generator when required for its pneumatic tools or equipment, if any.
- B. Lighting: Provide temporary lighting at least to meet all applicable safety requirements to allow erection, application or installation of materials and equipment, and observation or inspection of the Work. Cost of temporary lighting required for performing the Work will be borne by the Contractor.
- C. Heating, Cooling, and Ventilating:
 - 1. Provide as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for the installation of materials, and to protect materials, equipment, and finishes from damage due to temperature or humidity.
 - 2. Provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
 - 3. Pay all costs of installation, maintenance, operation, removal, and fuel consumed.
 - 4. Provide portable unit heaters, complete with controls, oil or gas-fired, and suitably vented to outside as required for protection of health and property.
 - 5. Natural gas is not available at the site.
- D. Water:
 - 1. Contractor will pay for all water use related to the Work. The Contractor shall provide temporary connections, piping and valving. The Contractor shall not make connection to any potable water system without first obtaining permission from the District and water system owner.

2. Contractor shall provide temporary facilities and piping required to bring water to the point of use, and remove them when no longer needed. The District or owner may install a metering device or implement another method of measurement. The Contractor will pay for water used based on meter readings, water truck loads, or other measurement method.
 3. Contractor shall provide and bear costs of necessary water required for testing equipment, tanks or vaults, and piping prior to Substantial Completion.
- E. Minimum Safety Equipment:
1. Contractor to provide and maintain adequate safety equipment onsite for activities involved, including but not limited to, air monitors, confined space entry equipment when required, adequate first aid supplies, etc. Contractor to submit list for District review.
- F. Sanitary and Personnel Facilities:
1. Provide and maintain facilities for Contractor's employees, Subcontractors, and all other onsite employees. Service, clean, and maintain facilities and enclosures.
 2. Use of the District's existing sanitary facilities by construction personnel will not be allowed.
 3. Locate sanitary facilities where they will not create a public nuisance or interfere with the work and at the direction of the Engineer or Engineer, relocate sanitary facilities.
 4. Make Contractor's facilities available to the District Construction Inspector.
- G. Communication:
1. The Contractor shall make arrangements to obtain and pay for its own communication equipment such as telephone, cellular phone, and facsimile equipment.
 2. Contractor to pay all costs of installation and monthly bills.
 3. No incoming telephone calls allowed to District telephone system.
- H. Fire Protection: Furnish and maintain on the site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of the National Fire Prevention Standard for Safeguarding Building Construction Operations (NFPA No. 241).

3.2 PROTECTION OF WORK AND PROPERTY

- A. General:
1. Contractor shall at no time interfere with or limit the public's access to and parking for the recreational path and trails at the site except as approved by the Engineer.
 2. Perform Work within rights-of-way and easements in a systematic manner that minimizes inconvenience to property owners and the public.
 3. No residence or business shall be cut off from vehicular traffic unless special arrangements have been made.
 4. Maintain in continuous service all existing oil and gas pipelines, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and all other utilities encountered along the line of Work, unless other arrangements satisfactory to owners of said utilities have been made.
 5. Where completion of Work requires temporary or permanent removal and/or relocation of an existing utility, coordinate all activities with owner of said utility and perform all work to their satisfaction.
 6. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.
 7. Keep fire hydrants and water or sewer control valves free from obstruction and available for use at all times.
 8. In areas where Contractor's operations are adjacent to or near a utility such as gas, telephone, television, electric power, water, sewer, or irrigation system and such

- operations may cause damage or inconvenience, suspend operations until arrangements necessary for protection thereof have been made by Contractor.
9. Notify property owners and utility companies which may be affected by the construction operation at least 7 calendar days in advance. Before exposing a utility, obtain utility owner's permission. Should service of utility be interrupted due to Contractor's operation, notify proper authority immediately. Cooperate with said authority in restoring service as promptly as possible and bear all costs incurred.
 10. Do not impair operation of existing sewer or storm drain systems. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, storm drains, or other sewer structures. Maintain original site drainage wherever possible.
- B. Site Security: Provide and maintain additional temporary security fences as necessary to protect the Work and Contractor's equipment and stored material. Contractor shall be solely responsible for any vandalism, theft, or damage to the work and Contractor's equipment and stored material.
- C. Barricades and Lights:
1. Provide barricades, as necessary, to prevent unauthorized entry to construction areas inside and outside of fenced area, and as required to ensure public safety and the safety of Contractor's employees, other employer's employees, and any others who may be affected by the Work.
 2. Provide to protect existing facilities and adjacent properties from potential damage.
 3. Locate to enable access by facility operators and property owners.
 4. Protect streets, roads, highways, and other public thoroughfares that are closed to traffic by effective barricades with acceptable warning signs that comply with the requirements of the manual on Uniform Traffic Control Devices, current edition.
- D. Signs and Equipment:
1. Conform to requirements of the Contract Documents.
 2. Barricades: Provide in sufficient quantity to safeguard public and Work.
 3. Traffic Cones: Provide to delineate traffic lanes to guide and separate traffic movements.
 4. Provide barricades and lighting at obstructions, such as material piles and equipment.
 5. Illuminate barricades and obstructions with warning lights from sunset to sunrise.
 6. Alert the general public of construction hazards, which would include surface irregularities, unramped walkways, grade changes, and trenches or excavations in roadways and in other public access areas.
- E. Trees and Plantings:
1. Protect from damage and preserve trees, shrubs, and other plants outside the limits of the Work and within the limits of the Work unless designated on the Drawings to be removed.
 - a. Where practical, tunnel beneath trees when on or near the line of trench.
 - b. Employ hand excavation as necessary to prevent tree injury.
 - c. Do not stockpile materials or permit traffic within drip lines of trees.
 - d. Provide and maintain temporary barricades around trees.
 - e. Water vegetation as necessary to maintain health.
 - f. Cover temporarily exposed roots with wet burlap, and keep the burlap moist until soil is replaced around the roots.
 - g. No trees, except those specifically shown on Drawings to be removed, shall be removed without written approval of the Engineer.
 - h. Dispose of removed trees in a legal manner off the site.
 2. In the event of damage to bark, trunks, limbs, or roots of plants that are not designated for removal, treat damage by corrective pruning, bark tracing, application of a heavy coating of tree paint, and other accepted horticultural and tree surgery practices.
 3. Replace each plant that dies as a result of construction activities.

- F. Existing Structures: Where Contractor contemplates removal of small structures such as mailboxes, signposts, and culverts that interfere with Contractor's operations, obtain approval of the Engineer. Replace those removed in a condition equal to or better than original.
- G. Finished Construction: Protect finished floors and concrete floors exposed as well as those covered with composition tile or other applied surfacing.
- H. Waterways: Keep ditches, culverts, and natural drainages continuously free of construction materials and debris.
- I. Dewatering: Construct, maintain, and operate cofferdams, channels, flume drains, sumps, pumps, or other temporary diversion and protection works. Furnish materials required, install, maintain, and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from the various parts of the Work. Maintain the foundations and parts of the Work free from water.

3.3 TEMPORARY CONTROLS

- A. Air Pollution Control: Comply with requirements of the Federal Clean Air Act and all governing local requirements.
- B. Noise Control: Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.
- C. Water Pollution Control: Comply with the NPDES General Permit and all requirements of the State of California, the County of Mendocino, and the Contract Documents.
- D. Erosion, Sediment, Runoff, and Flood Control
 - 1. Provide, maintain, and operate temporary facilities to control erosion and sediment releases, prevent runoff of contaminated or sediment laden water, and to protect Work and existing facilities from flooding during construction period.
 - 2. Comply with the NPDES General Permit for Storm Water Discharges associated with Construction Activity.

3.4 STORAGE YARDS AND BUILDINGS

- A. Temporary Storage Yards: Onsite storage of materials shall be limited to the staging areas indicated on the Drawings. Contractor shall obtain permission from the District prior to using any other location for temporary storage or stockpiling.
- B. Temporary Storage Buildings:
 - 1. No storage buildings will be allowed.
 - 2. No storage of combustible materials shall be permitted onsite other than what is being used or consumed that day.

3.5 ACCESS ROADS AND DETOURS

- A. No road detours are anticipated for the Work.
- B. Maintain drainage ways. Install and maintain culverts to allow water to flow beneath access roads. Provide corrosion-resistant culvert pipe of adequate strength to resist construction loads.
- C. Provide gravel, crushed rock, or other stabilization material to permit access by all motor vehicles at all times.

- D. Maintain road grade and crown to eliminate potholes, rutting, and other irregularities that restrict access.
- E. Coordinate with the Engineer for lane closures and other operations affecting traffic and access. Provide at least 72 hours' notice to the Engineer of operations that will alter access to the site.
- F. Upon completion of construction, leave roads and fences in same or better as pre-construction, and suitable for future use by the District.

3.6 PARKING AREAS

- A. Due to site constraints, Contractor shall provide parking facilities for personnel working on the Project in Contractor's parking area or other approved area. No employee or equipment parking will be permitted on the District's existing paved areas without prior approval. Any additional parking spaces required shall be the responsibility of the Contractor.

3.7 VEHICULAR TRAFFIC

- A. Refer to Section 7-1.03 "Public Convenience and Section "7-1.04, "Public Safety" of the State Standard Specifications.
- B. Full costs for "Maintaining Traffic," including "flagging Costs", shall be considered as included in the various items of work and no additional compensation will be made.
- C. Streets shall be open to through vehicular traffic during non-working hours. All public traffic shall be permitted to pass through the work with as little inconvenience and delay as possible.
- D. Comply with Laws and Regulations regarding closing or restricting the use of public streets or highways. No public or private road shall be closed, except by written permission of the Engineer. Assure the least possible obstruction to traffic and normal commercial pursuits.
- E. Prior to any anticipated road closure or detour, a traffic control plan and pedestrian traffic control plan prepared by a California licensed Civil or Traffic Engineer shall be submitted to the Engineer.
- F. No work shall commence until traffic control signing has been approved by the Engineer.
- G. The Contractor shall provide all materials, equipment, and labor necessary to furnish, place, and maintain all temporary traffic control systems and pedestrian control systems, including construction and maintenance area traffic control devices and flaggers as required to perform the Work.
- H. Conduct Work to interfere as little as possible with public travel, whether vehicular or pedestrian.
 - 1. Whenever it is necessary to cross, close, or obstruct roads, driveways, and walks, whether public or private, provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of public and private travel.
 - 2. Road Closures: Maintain satisfactory means of exit for persons residing or having occasion to transact business along the route of the Work. If it is necessary to close off roadway or alley providing sole vehicular access to property for periods greater than 2 hours, provide written notice to the Engineer so affected 3 days prior to such closure. In such cases, closings of up to 4 hours may be allowed. Closures of up to 10 hours may be allowed if a week's written notice is given and undue hardship does not result.

Notification signs to the public including "No Parking" signs shall be posted at least 48 hours prior to Work in affected area.

3. In making street crossings, do not block more than one-half the street at a time. Whenever possible, widen the shoulder on the opposite side to facilitate traffic flow. Provide temporary surfacing on shoulders as necessary.
- I. Whenever the Contractor's operations create a condition hazardous to the public, furnish, erect, and maintain such fences, barricades, lights, signs and other devices as are necessary to prevent accidents or damage or injury to the public.
- J. Maintain top of backfilled trenches before they are paved, to allow normal vehicular traffic to pass over. Provide temporary access for driveways where required. Cleanup operations shall follow immediately behind backfilling.
- K. When flaggers and guards are required by regulation or when deemed necessary for safety, furnish them with approved orange wearing apparel and other regulation traffic control devices complying with the provisions of the California MUTCD and State of California Department of Transportation Standard Specifications and Standard Plans.
- L. Coordination: Coordinate traffic routing with that of others working in the same or adjacent areas.
- M. Under no circumstances shall access to businesses or residences be held up more than 30 minutes at any one time. The Contractor may coordinate with property and business owners to schedule work so that longer delays do not adversely affect residents or business owners to their satisfaction. In addition, Contractor shall give personal notice to all affected property owners as specified in paragraph M, hereinbefore. Before closing any street to through traffic, Contractor shall obtain prior approval from the Engineer seven (7) days in advance of closure. Contractor shall at all times provide access to public facilities such as schools, etc. and make provisions for passage of emergency vehicles.
- N. Should the Contractor appear to be neglectful or negligent in furnishing warning and productive measures as above specified, the Engineer may direct attention to the existence of hazard, and the necessary warning and protective measures shall be furnished and installed by the Contractor at his expense, without cost to the District. Should the Engineer point out any inadequacy of warning and protective measures, such action on the part of the Engineer shall not relieve the Contractor from responsibility for public safety nor abrogate his obligation to furnish and pay for these devices
- O. The Contractor shall keep the Mendocino Volunteer Fire Department informed regarding the closure or restriction of any traveled way. At a minimum, the Contractor shall call the Fire Department at (707) 937-0131, daily to report any traveled way closure. This requirement applies immediately upon closure for that day and again immediately after removal of the closure. For closures over multiple days, the daily notification still applies. This requirement does not apply for single lane closures on multiple lane local streets.

3.8 CLEANING DURING CONSTRUCTION

- A. General:
 1. Rubbish shall not be allowed to accumulate on the site and the Contractor shall collect and remove, from time to time, such rubbish and debris incident to the execution of the contract as, in the opinion of the Engineer, may be undesirable or disfiguring on the premises. The Contractor may not burn any material on the site. Wet down exterior surfaces prior to sweeping to prevent blowing of dust and debris.

2. Provide approved containers for collection and disposal of waste materials, debris, and rubbish. At least at weekly intervals, dispose of such waste materials, debris, and rubbish offsite.
3. At least weekly, brush-sweep the entry drive and roadways, and all other streets and walkways affected by Work and where adjacent to Work. There will be times when sweeping will be required daily. Remove all mud and debris tracked onto roadway as soon as possible.
4. Do not allow material to fall out of trucks onto any roadway when hauling away cleared and grubbed vegetation, particularly, the branches and thorns of Kiave trees to be removed.

3.9 REMOVAL OF TEMPORARY FACILITIES AND UTILITIES

- A. At such times or times any temporary construction facilities and utilities are no longer required for the Work, Contractor shall notify the Engineer of his intent and schedule for removal of the temporary facilities and utilities, and obtain the Engineer's approval before removing the same. As approved, Contractor shall remove the temporary facilities and utilities from the site as his property and leave the site in such condition as specified, as directed by the Engineer, and/or as shown on the Plans.
- B. After completion of the project, all temporary utility services shall be disconnected or removed and all affected improvements shall be restored to their original condition by the Contractor at no cost to the District.
- C. The condition of the site shall be left in a condition that will restore original drainage, evenly graded, seeded or planted as necessary, and left with an appearance equal to, or better than original.

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.
- E. Product substitution procedures.

1.2 RELATED SECTION:

- A. Refer to Contract General Conditions for additional requirements.

1.3 PRODUCTS

- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- C. Furnish interchangeable components from same manufacturer for components being replaced.

1.4 PRODUCT DELIVERY REQUIREMENTS

- A. Schedule delivery of products or equipment as required to allow timely installation and to avoid prolonged storage.
- B. Transport and handle products in accordance with manufacturer's instructions.
- C. Deliver products or equipment in manufacturer's original unbroken cartons or other containers designed and constructed to protect the contents from physical or environmental damage.
- D. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- F. Clearly and fully mark and identify as to manufacturer, item and installation location.

1.5 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products in accordance with manufacturers' instructions. Provide manufacturer's instructions for storage and handling.
- B. Store with seals and labels intact and legible.
- C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- D. Store pumps, motors, electrical equipment, and other equipment having antifriction or sleeve bearings in weather-tight warehouses.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- G. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- H. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- I. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- J. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.6 STORAGE FACILITIES

- A. Temporary Storage Building:
 - 1. Provide a weather-proof temporary storage building or other secure facility specifically for the purpose of providing for protection of products and equipment.
 - 2. Equip building with lockable doors and lighting, and provide electrical service for equipment space heaters and heating or ventilation as necessary to provide storage environments acceptable to specified manufacturers.
 - 3. Provide method of storage of products and equipment off the ground.

1.7 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.
- D. Contractor shall verify listed equipment models and manufacturers comply to the stated performance requirements of the equipment. No additional cost to the District will be incurred

if the stated models do not meet the performance requirements. The Contractor is responsible for providing equipment that meets the performance requirements.

- E. Design documentation is based on the first named manufacturer. If the Contractor elects to supply an "as equal" manufacturer or product for consideration, first submit the product substitution as described below.

1.8 PRODUCT SUBSTITUTION PROCEDURES

- A. Engineer will consider requests for Substitutions only within 60 days after date of Owner-Contractor Agreement.
- B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse Owner for review or redesign services associated with re-approval by authorities having jurisdiction.
- E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- F. Substitution Submittal Procedure:
 - 1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 - 2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
 - 3. Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

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SECTION 01 70 00

PROJECT CLOSEOUT

PART 1 GENERAL

1.1 FINAL CLEANUP

- A. The Contractor shall promptly remove all rubbish, debris, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. The Contractor may not burn any material on the site. Final acceptance of the Work by the District will be withheld until the Contractor has satisfactorily complied with the foregoing requirements for final cleanup of the project site.

1.2 CLOSEOUT TIMETABLE

- A. The Contractor shall establish dates for equipment testing, acceptance periods, (as required under the Contract). Such dates shall be established not less than two weeks prior to beginning any of the foregoing items, to allow the District, the Engineer, and their authorized representatives and consultants sufficient time to schedule attendance at such activities.
- B. All temporary buildings, including field offices, storage buildings, and sheds shall be removed from the project site seven (7) days after completion of the Work. All temporary services such as water, power, utilities, service contracts, pager contracts, telephones, and other temporary services shall remain in service for seven (7) days following approval of substantial completion of the Work by the District and shall be discontinued within seven (7) days after.

1.3 CLOSEOUT PROCEDURES

- A. Prerequisites to Substantial Completion: Complete following items before requesting Certification of Substantial Completion, either for entire Work or for portions of Work:
 - 1. Submit maintenance manuals, Project record documents, digital images of construction photographs, and other similar final record data in compliance with this section.
 - 2. Complete facility startup, testing, adjusting, balancing of systems and equipment, demonstrations, and instructions to District's operating and maintenance personnel as specified in compliance with this section.
 - 3. Conduct inspection to establish basis for request that Work is substantially complete. Create comprehensive list (initial punch list) indicating items to be completed or corrected, value of incomplete or nonconforming Work, reason for being incomplete, and date of anticipated completion for each item. Include copy of list with request for Certificate of Substantial Completion.
 - 4. Obtain and submit releases enabling District's full, unrestricted use of Project and access to services and utilities. Include certificate of occupancy, operating certificates, and similar releases from authorities having jurisdiction and utility companies.
 - 5. Deliver tools, spare parts, extra stocks of material, and similar physical items to District.
 - 6. Make final change-over of locks eliminating construction master-key system and transmit keys directly to District. Advise District's personnel of change-over in security provisions.
 - 7. Discontinue or change over and remove temporary facilities and services from Project Site, along with construction tools, mockups, and similar elements.
 - 8. Perform final cleaning according to this section.

1.4 SUBSTANTIAL COMPLETION INSPECTION

- A. The Contractor shall notify the Engineer at least ten (10) working days prior to the anticipated date of completion of all work specified in the contract. Upon completion of the work, the Engineer shall proceed with substantial completion inspection and shall complete such inspection as promptly as practicable. The time required for such inspection and the making of any corrections as a result thereof shall be included in the contract performance time.
- B. Substantial Completion Inspection:
 - 1. When Contractor considers Work to be substantially complete, submit to Engineer:
 - a. Written certificate that Work, or designated portion, is substantially complete
 - b. List of items to be completed or corrected (initial punch list)
 - 2. Within seven (7) calendar days after receipt of request for Substantial Completion, Engineer will make inspection to determine whether Work or designated portion is substantially complete.
 - 3. Should Engineer determine that Work is not substantially complete:
 - a. Engineer will promptly notify Contractor in writing, stating reasons for its opinion.
 - b. Contractor shall remedy deficiencies in Work and send second written request for Substantial Completion to Engineer.
 - c. Engineer will re-inspect Work.
 - d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer's inspection.
 - 4. When Engineer finds that Work is substantially complete, Engineer will:
 - a. Prepare Certificate of Substantial Completion on AIA G704 - Certificate of Substantial Completion EJCDC C-625 - Certificate of Substantial Completion accompanied by Contractor's list of items to be completed or corrected as verified and amended by Engineer and District (final punch list).
 - b. Submit Certificate to District and Contractor for their written acceptance of responsibilities assigned to them in Certificate.
 - 5. After Work is substantially complete, Contractor shall:
 - a. Allow District occupancy of Project under provisions stated in Certificate of Substantial Completion.
 - b. Complete Work listed for completion or correction within time period stipulated.
 - 6. District will occupy all portions of Work as specified in Section 01 10 00– Summary of Work.
- C. Prerequisites for Final Completion: Complete following items before requesting final acceptance and final payment.
 - 1. When Contractor considers Work to be complete, submit written certification that:
 - a. Contract Documents have been reviewed.
 - b. Work has been examined for compliance with Contract Documents.
 - c. Work has been completed according to Contract Documents.
 - d. Work is completed and ready for final inspection.
 - 2. Submittals: Submit the following:
 - a. Final punch list indicating all items have been completed or corrected.
 - b. Final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
 - c. Specified warranties, workmanship/maintenance bonds, maintenance agreements, and other similar documents.
 - d. Accounting statement for final changes to Contract Sum.
 - e. Contractor's affidavit of payment of debts and claims on AIA G706 - Contractor's Affidavit of Payment of Debts and Claims.
 - f. Contractor affidavit of release of liens on AIA G706A - Contractor's Affidavit of Release of Liens.

- g. Consent of surety to final payment on AIA G707 - Consent of Surety to Final Payment Form.
- 3. Perform final cleaning for Contractor-soiled areas according to this section.

D. Final Completion Inspection:

- 1. Within seven (7) calendar days after receipt of request for final inspection, Engineer will make inspection to determine whether Work or designated portion is complete.
- 2. Should Engineer consider Work to be incomplete or defective:
 - a. Engineer will promptly notify Contractor in writing, listing incomplete or defective Work.
 - b. Contractor shall remedy stated deficiencies and send second written request to Engineer that Work is complete.
 - c. Engineer will re-inspect Work.
 - d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer's inspection.

1.5 STARTING OF SYSTEMS

- A. Coordinate schedule for startup of various equipment and systems.
- B. Notify Engineer seven (7) calendar days prior to startup of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of manufacturer's representative or Contractors' personnel according to manufacturer's instructions.
- G. When specified in individual Specification sections, require manufacturer to provide authorized representative who will be present at Site to inspect, check, and approve equipment or system installation prior to startup and will supervise placing equipment or system in operation.
- H. Submit a written report according to Section 01 33 00-Submittal Procedures that equipment or system has been properly installed and is functioning correctly.

1.6 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to District personnel two (2) weeks prior to date of final inspection.
- B. Demonstrate Project equipment and instruct in classroom environment located at the project site and instructed by qualified manufacturer's representative who is knowledgeable about the Project.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with District personnel in detail to explain all aspects of operation and maintenance.
- D. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed time at designated location.

- E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- F. Required instruction time for each item of equipment and system is specified in individual Specification sections.

1.7 PROJECT RECORD DOCUMENTS

- A. Maintain on Site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, product data, and Samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by District.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record, at each product section, description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates used.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction as follows:
 - 1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
 - 2. Include locations of concealed elements of the Work.
 - 3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
 - 4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
 - 5. Identify and locate existing buried or concealed items encountered during Project.
 - 6. Measured depths of foundations in relation to finish main floor datum.
 - 7. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 8. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 9. Field changes of dimension and detail.
 - 10. Details not on original Drawings.
- G. Submit marked-up paper copy documents to Engineer before Substantial Completion, with claim for final Application for Payment.
- H. Submit PDF electronic files of marked-up documents to Engineer before Substantial Completion.

1.8 OPERATION AND MAINTENANCE DATA

- A. Submit in PDF composite electronic indexed file.
- B. Submit data available hard copy only bound in 8½ x 11-inch, three D side ring binders with durable plastic covers.
- C. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of Project, and subject matter of binder when multiple binders are required.
- D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- F. Contents: Prepare table of contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions arranged by system and subdivided by Specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Include the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents
 - g. Safety precautions to be taken when operating and maintaining or working near equipment
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Shop Drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Photocopies of warranties and bonds.

1.9 FINAL SUBMITTALS

- A. The Contractor, prior to requesting its final progress payment, shall submit the following items to the Engineer:
 - 1. Written guarantees or warranties.
 - a. Obtain warranties and bonds executed in duplicate by responsible Subcontractors, suppliers, and manufacturers within 10 days after completion of applicable item of Work.
 - b. Execute and assemble transferable warranty documents and bonds from Subcontractors, suppliers, and manufacturers.
 - 2. Certificates of compliance.
 - 3. Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification sections.
 - 4. Completed final Record Drawings.
 - 5. Certificates of inspection and acceptance by local governing agencies having jurisdiction.

1.10 COMPLETION OF THE WORK

- A. The date of substantial completion of the Project shall be the date when the construction is sufficiently completed, in accordance with the Contract Documents, as modified by any change orders agreed to by the parties, so that the District can occupy or utilize the project for the use for which it was intended, and the District has accepted the Project.

1.11 REMAINING PUNCH LIST ITEMS

- A. Upon attaining substantial completion and upon acceptance of the Work by the District, by agreement between the parties some small remaining punch list items may remain to be completed by the Contractor.
- B. Failure of the Contractor to complete or correct all such outstanding punch list work to the satisfaction of the Engineer shall constitute a waiver by the Contractor of all rights to any and all claims it may have to all monies withheld by the District under the Contract to cover the value of such uncompleted or uncorrected items.

1.12 MAINTENANCE, CORRECTION AND REPAIR PERIOD

- A. The Contractor shall comply with the correction and repair requirements contained in the General Conditions.
- B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing constructed by the Contractor which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless the Contractor shall have obtained a statement in writing from the affected private owner or public agency releasing the District from further responsibility and liability in connection with such repair or resurfacing.
- C. The Contractor shall make all repairs and replacements promptly upon receipt of written order from the District. If the Contractor fails to make such repairs or replacements promptly, the District reserves the right to do the work or to have the work done by others and the Contractor and its Surety shall be liable to the District for the cost thereof.

1.13 ACCEPTANCE AND FINAL PAYMENT

- A. Final acceptance is the allowance of final estimates by the Contracting Officer. The Engineer shall certify to the Contracting Officer that the contract is complete and include with the certification the amount of the final payment due the Contractor. All progress or partial payments made prior to the final payment are subject to correction in the final estimate and payment.

1.14 RELEASE OF CLAIMS

- A. After completion of work, and prior to final payment, the Contractor shall furnish to the Contracting Officer a release of claims Form DI-137, properly executed by the Contractor, releasing claims against the United States arising out of the contract, other than claims specifically excepted from the operation of the release.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that existing Site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual Specification sections.
- D. Verify that utility services are available with correct characteristics and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance according to manufacturer's instructions.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer-required or -recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

3.3 EXECUTION

- A. Comply with manufacturer's installation instructions, performing each step in sequence. Maintain one set of manufacturer's installation instructions at Project Site during installation and until completion of construction.
- B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.
- D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
 - 1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.
 - 2. Physically separate products in place, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
 - 3. Exposed Joints: Provide uniform joint width and arrange to obtain best visual effect. Refer questionable visual-effect choices to Engineer for final decision.
- E. Allow for expansion of materials and building movement.
- F. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with entire Project.
 - 1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.
 - 2. Coordinate enclosure of Work with required inspections and tests to minimize necessity of uncovering Work for those purposes.

- G. Mounting Heights: Where not indicated, mount individual units of Work at industry recognized standard mounting heights for the application indicated.
 - 1. Refer questionable mounting heights choices to Engineer for final decision.
 - 2. Elements Identified as Accessible to Handicapped: Comply with applicable codes and regulations.
- H. Adjust operating products and equipment to ensure smooth and unhindered operation.
- I. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by manufacturer.

3.4 CUTTING AND PATCHING

- A. Employ skilled and experienced installers to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements affecting:
 - 1. Structural integrity of element.
 - 2. Integrity of weather-exposed or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of element.
 - 4. Visual qualities of sight-exposed elements.
 - 5. Work of District or separate contractor.
- C. Execute cutting, fitting, and patching, including excavation and fill to complete Work and to:
 - 1. Fit the several parts together, to integrate with other Work.
 - 2. Uncover Work to install or correct ill-timed Work.
 - 3. Remove and replace defective and nonconforming Work.
 - 4. Remove samples of installed Work for testing.
 - 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute Work by methods to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.
- E. Cut masonry and concrete materials using masonry saw or core drill.
- F. Restore Work with new products according to requirements of Contract Documents.
- G. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.
- H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
- J. Identify hazardous substances or conditions exposed during the Work to Engineer for decision or remedy.

3.5 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual Specification sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.

- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

3.6 FINAL CLEANING

- A. District will provide final cleaning after final acceptance.

END OF SECTION

SECTION 01 72 00

RECORD DOCUMENTS

PART 1 GENERAL

1.1 SUBMITTALS

- A. Quality Control Submittals: Written procedures for maintaining and markup of record documents. Contract description.
- B. Contract Closeout Submittal: Record Documents in accordance with the requirements of this section. Submit prior to application for final payment.

1.2 RELATED SECTIONS

- A. Section 01 33 00 - Submittals

1.3 QUALITY ASSURANCE

- A. Furnish a qualified and experienced person, whose duty and responsibility shall be to maintain record documents.
- B. Accuracy of Records:
 - 1. Coordinate changes within record documents, making neat, legible and accurate entries on each page of Specifications and each sheet of Drawings and other documents where such entry is required to show change.
 - 2. Purpose of project record documents is to provide factual information regarding aspects of Work, both concealed and visible, to enable future modification of Work to proceed without lengthy and expensive site measurement, investigation, and examination.
- C. Make entries within 24 hours after receipt of information that a change in Work has occurred.
- D. Prior to submitting each request for progress payment, request Engineer's review and approval of current status of record documents. Failures to properly maintain, update, and/ or submit record documents may result in return of Contractor's Application for Progress Payment by Engineer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Maintain record documents completely protected from deterioration, loss, and damage until completion of Work.
- B. In event of loss of recorded data, use means necessary to again secure data to Engineer's acceptance. Such means shall include, if necessary in Engineer's opinion, removal and reconstruction of covering materials, at no additional cost to the District.

PART 2 PRODUCTS

2.1 RECORD DOCUMENTS

- A. Promptly following the Notice to Proceed, Engineer will provide 1 complete hardcopy set of full-size drawings to the Contractor for use in preparing Record Drawings.

PART 3 EXECUTION

3.1 MAINTENANCE OF RECORD DOCUMENTS

- A. General:
 - 1. Label or stamp each record document with title, "Record Documents," in neat large, printed letters.
 - 2. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.
- B. Preservation
 - 1. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
 - 2. Make documents and Samples available at all times for observation by Engineer.
- C. Making Entries on Drawings
 - 1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
Color Coding:
 - a. Green when showing information deleted from Drawings.
 - b. Red when showing information added to Drawings.
 - c. Blue and circled in blue to show notes.
 - 2. Date entries.
 - 3. Call attention to entry by "cloud" drawn around area or areas affected.
 - 4. Legibly mark to record actual changes made during construction, including, but not limited to:
 - a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
 - b. Horizontal and vertical locations of existing and new underground facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements of permanent surface improvements.
 - c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
 - d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
 - e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, Written Amendment, and Engineer's written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.
 - 5. Dimensions on Schematic Layouts: Show on record drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
 - a. Clearly identify the item.
 - b. Show, by symbol or note, vertical location of item ("under slab," "in ceiling plenum," "exposed," and the like).
 - c. Make identification so descriptive that it may be related reliably to Specifications.
- D. Make entries in other pertinent documents as accepted by Engineer.

END OF SECTION

SECTION 01 73 00

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 OPERATION AND MAINTENANCE

- A. The Operation and Maintenance Manual Data for each piece of equipment must be submitted and favorably reviewed by the Engineer prior to final acceptance. Three (3) copies of the favorably reviewed Operation and Maintenance Manual shall be provided.
- B. The manual shall be bound in a 3-ring binder with rigid covers, marked to indicate the specific equipment furnished for this project, and shall utilize tab sheets to organize the information. Operation and maintenance manual shall include:
 - 1. Cover Page: Equipment Name, equipment tag number, project name, Owner's name, and other data as appropriate.
 - 2. Laminated Table of Contents: General description of information provided within each tab section.
 - 3. Lubrication Information: Required lubricants and lubrication schedules.
 - 4. Control Diagrams: Internal and connection wiring, including logic diagrams, wiring diagrams for control panels, ladder logic for computer based systems, and connections between existing systems and new additions, and adjustments such as calibrations and set points for relays, and control or alarm contact settings.
 - 5. Start-up Procedures: Recommendations for installation, adjustment, calibration, and troubleshooting.
 - 6. Operating Procedures:
 - a. Step-by-step procedures for starting, operating, and stopping equipment under specified modes of operation.
 - b. Include safety precautions and emergency operating shutdown instructions.
 - 7. Preventative Maintenance Procedures: Recommended steps and schedules for maintaining equipment.
 - 8. Overhaul Instructions: Directions for disassembly, inspection, repair and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.
 - 9. Parts List: Generic title and identification number of each component part of equipment; include bearing manufacturer, model and ball or roller pass frequencies for every bearing.
 - 10. Spare Parts List: Recommended number of parts to be stored at the site and special storage precautions.
 - 11. Drawings: Exploded view or plan and section views with detailed callouts.
 - 12. Provide electrical and instrumentation schematic record drawings.
 - 13. Source (Factory) Quality Control Test Results: Provide copies of factory test reports as specified in the Technical Specifications.
 - 14. Field Quality Control Test Results: After field testing is completed, insert field test reports as specified in the Technical Specifications.
 - 15. Equipment Summary Form: Completed form in the format attached below. Insert Equipment Summary Form after the tab sheet of each equipment section. The manufacturer's standard form will not be acceptable. Manual submitted without equipment summary form fully completed, including equipment identification number, will be rejected and returned.

Equipment Summary Form

1. Equipment Item: _____
Is it a packaged unit, i.e. pump, motor, shaft? Yes _____ No _____
If yes, please detail. _____

2. How many: _____
3. Cost: _____
4. Manufacturer: _____
Address: _____
Phone #: _____ Fax: _____
Email: _____ Website: _____
5. Equipment Identification Numbers:
Serial Number: _____
Model: _____
Part #: _____
6. Location of Equipment: _____
7. Weight of Individual Components (Over 100 Pounds): _____

8. Nameplate Data:
Horsepower: _____ RPM: _____
Amperage: _____ Size: _____
Voltage: _____ Frame Size: _____

Service Factor (S.F.): _____ Seal Size: _____
Speed: _____ Seal Type: _____
Enclosure Type: _____ Bearings: _____
GPM: _____ Impeller Size: _____
Maximum Capacity @ _____ ft TDH Other: _____
Design Point Capacity @ _____ ft TDH
9. Manufacturer's Local Representative:
Name: _____
Address: _____
Telephone Number: _____
Email: _____ Website: _____

10. Maintenance Requirements (including schedules):

TASK	SCHEDULE

11. Lubricant List:

12. Spare Parts (with accurate part #'s):

12. Comments:

13. General Info:

Year Installed: _____

Project Name & Number: _____

Design Engineer: _____

14. Warranty:

Start Date: _____

Expiration Date: _____

Prorated: _____

END OF SECTION

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SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Recycling nonhazardous construction waste.
 - 2. Disposing of nonhazardous demolition and construction waste.
- B. Related Sections:
 - 1. Section 02 41 10 - Demolition, Salvage and Abandonment: for disposition of waste resulting from site demolition activities.
 - 2. Section 31 11 00 - Site Clearing and Grubbing: for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS

- A. Construction Waste:
 - 1. Site-clearing and demolition waste.
 - 2. Soils.
 - 3. Concrete and asphalt.
 - 4. Lumber.
 - 5. Wood sheet materials.
 - 6. Metals.
 - 7. Piping and fittings.
 - 8. Electrical conduit.
 - 9. Packaging: Regardless of salvage/recycle goal indicated in paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

- a. Paper.
 - b. Cardboard.
 - c. Boxes.
 - d. Plastic sheet and film.
 - e. Polystyrene packaging.
 - f. Wood crates.
 - g. Plastic pails.
 - h. HI-5 beverage containers.
10. A minimum of 50% of the non-hazardous waste generated at the site shall be diverted to an off-site recycle, diversion, or salvage facility.

1.4 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for the Notice to Proceed.

1.5 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Report: Concurrent with final Application for Payment, submit report. Include the following information:
 1. Material category.
 2. Generation point of waste.
 3. Total quantity of waste in tons.
 4. Quantity of waste salvaged, both estimated and actual in tons.
 5. Quantity of waste recycled, both estimated and actual in tons.
 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

1.7 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements of this Section. Indicate quantities by weight or volume but use same units of measure throughout waste management plan.

- B. Include the location and owner contact information of all disposal sites including which materials are to be disposed at each site. Provide written confirmation of acceptance by disposal site owner(s) of waste materials.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
 - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - 2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect them from the weather.
5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.3 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 2. Polystyrene Packaging: Separate and bag materials.
 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Site-Clearing Wastes:
 1. No burning of brush or any other materials will be allowed on the site.
 2. Any and all organic material that has been cleared and grubbed must be stockpiled and composted such that seeds of invasive species by the heat of composting over a period of six to nine months. Composted material shall be used as organic mulch in accordance with Division 32 Section "Plants".
- C. Wood Materials:
 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

3.4 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.
- D. Washing out of concrete trucks shall be limited to temporary concrete washout areas indicated on the Drawings.

END OF SECTION

SECTION 02 01 00

SITE CONDITIONS

PART 1 GENERAL

1.1 DESCRIPTION

- A. General: All information obtained by the Engineer regarding site conditions, subsurface information, groundwater elevations, existing construction of site facilities, and existing underground utilities and similar data are shown on the Drawings, or are available for review in the Geotechnical Investigation Report (Soils Report). See Section 02 32 00, "Geotechnical Investigation Data" for Soils Report(s) prepared for the project.
- B. Investigations conducted by a geotechnical Engineer of subsurface conditions were made for the purpose of study and design, and neither the District's Representative nor the District assume any responsibility whatever with respect to the sufficiency or accuracy of borings, or of the Log of Test Borings, or of other investigations that have been made, or of the interpretations made thereof, and there is no warranty or guarantee, either expressed or implied, that the conditions indicated by such investigations are representative of those existing throughout such area, or any part thereof, or that unlooked for developments may not occur.
- C. This Geotechnical Investigation is not part of the Contract Documents but the technical data contained therein upon which Bidder is entitled to rely are incorporated therein by reference. Such technical data is boring method, location and logs; and laboratory test methods and results.
- D. Any logs of test borings or topographic maps showing a record of the data obtained by the District's Representative's investigations of surface and subsurface conditions that are made available or bound herewith shall be considered a part of the Contract Documents. Said logs represent the opinion of the District's Representative as to the character of the materials encountered by them in their investigations.
- E. Information derived from inspection of logs of test borings, of topographic maps, or from plans showing locations of utilities and structures will not in any way relieve the Contractor from any risk, or from properly examining the site and making such additional investigations as he may elect, or from properly fulfilling all the terms of the Contract Documents.
- F. Related Work described elsewhere:
 - 1. Section 02 01 10 - Existing Utilities and Underground Structures
 - 2. Section 02 32 00 - Geotechnical Investigation Data
 - 3. Section 31 00 00 - Earthwork

1.2 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall satisfy himself as to the nature and location of the Work, the general and local conditions, particularly those bearing upon availability of transportation, disposal, handling and storage of materials, availability of labor, water, sanitary sewer, electric power, communications, roads, and uncertainties of weather, river stages, or similar physical conditions at the site, the conformation and conditions of the ground, the character of equipment facilities needed preliminary to and during the prosecution of the Work and all other matters which can in any way affect the Work or the cost thereof under this Contract.

- B. The Contractor shall further satisfy himself as to the character, quality, and quantity of surface and subsurface materials to be encountered by inspecting the site as well as, any exploratory work performed by the District's Representative, and information presented by the plans and specifications made as part of this Contract. Any failure by the Contractor to acquaint himself with all available information will not relieve him from responsibility for properly estimating the difficulty or cost of successfully performing the Work.
- C. The Contractor shall anticipate underground obstructions such as utility lines, foundations, groundwater, stumps, varying soil conditions, and debris. No extra payment will be allowed for the removal, replacement, repair, or possible increased cost caused by underground obstructions indicated in the Contract Documents. Any such lines or obstructions indicated on the Drawings show only the approximate location and must be verified in the field by the Contractor.
- D. The Contractor shall note that portions of the existing road surfaces are not in structural sections and that heavy truck and equipment operations may cause road surface damage in excess of normal usage. If damage does occur due to construction activity, the Engineer shall be notified immediately before proceeding with the Work, or causing more damage to occur. Damage caused to the existing asphalt road surface by Contractor's operations shall be repaired per Mendocino County standards and State of California, Department of Transportation (Caltrans) Specifications and Standards Section 39 Asphalt Concrete.

1.3 ADDITIONAL INFORMATION

- A. Prior to bidding, bidders may make their own subsurface investigations subject to time schedules and arrangements approved in advance by the District. Before any subsurface test holes are excavated, obtain clearance from District.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 02 01 10

EXISTING UTILITIES AND UNDERGROUND STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes: Contractor is responsible for locating and protecting existing utilities, facilities and underground structures. Responsibilities shall include but are not limited to those defined in this section.
- B. Refer to Drawings for the approximate locations of utilities and underground structures.

1.2 GENERAL

- A. The Contractor shall protect all existing utilities and improvements not designated for removal, and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, all in accordance with requirements of the Contract Documents.
- B. The approximate locations of known existing utilities are shown in the Drawings. The Contractor shall verify the location of existing utilities at least 2 working days but no more than 14 calendar days prior to the beginning excavation by notifying Underground Services Alert (USA) at (800) 642-2444 or 811. The Contractor shall notify the Engineer of any utilities not shown in the Drawings or substantially different from the Drawings. The Contractor shall make exploratory excavations of all utilities including those not shown in the Drawings that may interfere with the Work. All such exploratory excavations shall be performed as soon as practicable after award of the Contract and, in any event, a sufficient time in advance of construction to avoid possible delays to the Contractor's Work.
- C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility.

1.3 CALIFORNIA ADMINISTRATIVE CODE

- A. Section 1540(a)1 of Construction Safety Orders (Title 8) California Administrative Code, Section 1540 states:
 - 1. (1) "Prior to opening and excavation, effort shall be made to determine whether underground installations; i.e., sewer, water, fuel, electric lines, etc., will be encountered and, if so, where such underground installations are located. When the excavation approaches the approximate location of such an installation, the exact location shall be determined by careful probing or hand digging; and, when it is uncovered, adequate protection shall be provided for the existing installation. All known owners of underground facilities in the area concerned shall be advised of proposed Work at least 48 hours prior to the start of actual excavation."
- B. The District and Engineer have determined the approximate location of public utilities and underground structures as well as existing mapping permits. However, in accordance with California's Administrative Code, Section 1540, the Contractor shall make the effort to determine the exact location of underground installations.

1.4 PUBLIC UTILITIES AND AGENCIES AFFECTED

- A. General, For underground utility location call Underground Service Alert (USA) at (800) 642-2444 or 811.
- B. Electrical, Pacific Gas & Electric Company has jurisdiction over electrical power - Call: (707) 468-3954 a minimum of 48 hours prior to any excavation within 10 feet of existing electrical lines. It should be noted that where a structure is known to receive service and does not have overhead service, then underground service shall be assumed to exist. For underground utility location call Underground Service Alert (USA) at (800) 227-2600.
- C. Telephone Service, AT&T - Call: (415) 499-4900. It should be noted that where service to a structure is known to receive service and does not have overhead service, then underground service shall be assumed to exist. For assistance with location of underground telephone facilities, call U.S.A. at (800) 227-2600.
- D. Communications, Comcast - Call: (925) 424-0278.
- E. Water Service, Mendocino Unified School District - Call: (707) 937-1603.
- F. Sanitary Sewer Service, Mendocino City Community Services District - Call: (707) 937-5790.
- G. Street Lighting Service west of SR 1, Mendocino City Community Services District - Call: (707) 937-5790.
- H. Storm Drainage, County of Mendocino - Call: (707) 463-4363.

1.5 PROTECTION OF STREET OR ROADWAY MARKERS

- A. The Contractor shall not destroy, remove, or otherwise disturb any existing survey markers, street monuments, or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or the permanent markers points that will be disturbed by the construction operations have been properly referenced. All survey markers or points disturbed by the Contractor shall be accurately replaced after all street or roadway resurfacing has been completed.

1.6 RESTORATION OF PAVEMENT

- A. General. All paved areas, including asphalt concrete berms cut or damaged during construction, shall be replaced with similar materials and of a thickness equal to the existing plus 1 inch or 6 inches, whichever is greater, except where specific resurfacing requirements have been called for in the Contract Documents. Restoration of paved areas shall be in accordance with the requirements of Mendocino County standards and State of California, Department of Transportation (Caltrans) Specifications and Standards Section 39 Asphalt Concrete. All pavements that are subject to partial removal shall be neatly sawcut in straight lines.
- B. Temporary Resurfacing. The Contractor shall place temporary surfacing promptly after backfilling and shall maintain such surfacing until final restoration of improvements.
- C. Permanent Resurfacing. Damaged edges of pavement along excavations and elsewhere shall be repaired in accordance with County of Mendocino Department of Transportation requirements. Damaged pavement edges shall be trimmed back by saw cutting in straight line to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. All pavement restoration and other facilities restoration shall be constructed to

finish grades compatible with adjacent undisturbed pavement and other facilities (i.e., valve lids, manhole covers, etc). The Contractor shall replace damaged pavement striping in kind.

- D. Restoration of Sidewalks. Wherever sidewalks have been removed for purposes of construction, the Contractor shall place suitable temporary sidewalks promptly after backfilling and shall maintain them in satisfactory condition until the final restoration has been made.

1.7 EXISTING UTILITIES AND IMPROVEMENTS

- A. General. The Contractor shall protect all existing underground utilities and other improvements that may be impaired during construction operations. It shall be the Contractor's responsibility to ascertain the actual location of all existing utilities and other improvements that will be encountered in its construction operations, and to see that such utilities or other improvements are adequately protected from damage due to such operations. The Contractor shall take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.
- B. Utilities to be moved. In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of the Contractor, be notified by the District to move such property. Time of relocation of the utility by the utility company is not a responsibility of the District. When utility lines that are to be removed are encountered within the area of operations, the Contractor shall notify the Engineer immediately and confirm the necessary measures to be taken to prevent interruption of service.
- C. Where the proper completion of the Work requires the temporary or permanent removal and/or relocation of an existing utility or other improvement that is indicated, the Contractor shall remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the Engineer and the District of the facility. In all cases of such temporary removal or relocation, restoration to former location shall be accomplished by the Contractor in a manner that will restore or replace the utility or improvement as nearly as possible to its former location and to equal or better condition as found prior to removal.
- D. District's Right of Access. The right is reserved to the District and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the Work of this Contract.
- E. Underground Utilities Indicated. Existing utility lines that are indicated or the locations of which are made known to the Contractor prior to excavation and that are to be retained, and all utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling, and if damaged, shall be immediately repaired or replaced by the Contractor to the satisfaction of the Engineer.
- F. Underground Utilities not Indicated. In the event that the Contractor damages any existing utility lines that are not indicated or the locations of which are not made known to the Contractor prior to excavation, the Contractor shall notify the Engineer immediately and a written report there-of shall be made by the Contractor to the District.
- G. All costs of locating, repairing damage not due to failure of the Contractor to exercise reasonable care, and removing or relocating such utility facilities not shown in the Contract documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the Work which was interrupted or idled during such Work will be paid for as extra Work.

- H. Approval of Repairs. All repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the utility or improvement District before being concealed by backfill or other Work. Contractor to schedule with District for all inspections.
- I. Maintain In Service. All power and telephone or the communication cable ducts, gas and water mains, irrigation lines, sanitary sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of Work shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the Engineer are made with the District of said pipelines, duct, main, irrigation lines, sanitary sewer, storm drain, pole, or wire or cable. The Contractor shall be responsible for and shall repair all damage due to its operations, and the provisions of this section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

1.8 TREES WITHIN STREET RIGHTS-OF-WAYS AND PROJECT LIMITS

- A. General. The Contractor shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the District. All existing trees and shrubs that are damaged during construction shall be trimmed or replaced by the Contractor or a certified tree company under permit from the District. Tree trimming and replacement shall be accomplished in accordance with the following paragraphs.
- B. Trimming. Symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. All limbs over 1-1/2 inches in diameter shall be coated with an asphaltic emulsion material.
- C. Replacement. The Contractor shall immediately notify the District if any tree is damaged by the Contractor's operations. If, in the opinion of the District, the damage is such that replacement is necessary, the Contractor shall replace the tree at its own expense. The tree shall be of a like size and variety as the tree damaged, or, if of a smaller size, the Contractor shall pay to the District of said tree a compensatory payment acceptable to the tree District, subject to the approval of the jurisdictional agency or District. The size of the trees shall be not less than 1-inch diameter nor less than 6 feet in height.

1.9 NOTIFICATION BY THE CONTRACTOR

- A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sanitary sewer, storm drain, gas, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway; the Contractor shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than three (3) days nor more than seven (7) days prior to excavation so that a representative of said owners of agencies can be present during such Work if they so desire. The Contractor shall also notify USA at (800) 227-2600 or 811 at least 2 working days, but no more than 14 calendar days, prior to such excavation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 CONTRACTOR RESPONSIBILITY

- A. The Contractor shall anticipate work along existing water, sanitary sewer, electrical, gas, communication, drainage and telephone services. It may be expected that there will be variation in location from that as shown on the Drawings to the actual location. Contractor responsible for verifying actual location in the field after pre-marking by the various utilities affected.
- B. No extra payment will be allowed for the removal, replacement, repair, or possible increased cost caused by inadvertent or planned interception and breaking of underground obstructions which may exist.
- C. The various utilities indicated on the Drawings show only the approximate location and must be verified in the field by the Contractor. The various utility agencies will cooperate with the Contractor to endeavor to familiarize him with all known underground utilities and obstructions, but this will not relieve the Contractor from full responsibility in anticipating and locating their actual location.
- D. The Contractor, in conjunction with the affected utility company(s), shall pothole and establish the horizontal and vertical location of all existing utilities shown on the Drawings and marked in the field. This may be done on an area-by-area basis but shall be accomplished at least five working days in advance of the date of construction within such area. Any discrepancies (horizontal and/or vertical) between the location of a utility found by the potholing operation and that shown on the Drawings shall be brought to the Engineer's attention immediately. The actual location shall be noted on the Contractor's as-built drawings. Potholing shall be required at the connection to existing facilities prior to the shop drawing submittals.
- E. Contractor shall provide all relevant information in writing to the Engineer immediately upon discovery of any conflict. Any delay in notification to the Engineer may delay direction and/or corrective action and a delay claim due to this reason shall not be considered by the District. The Contractor shall not proceed with any work that is in conflict until direction is provided by the Engineer and shall redirect crews to other contract work. All the information required to be obtained per this Section and any other information not noted but relative to the project shall be provided to the Engineer on a set of Plans when the investigative effort is complete.
- F. Contractor shall remove, relocate or mitigate utility conflicts, man-made buried objects or other unforeseen items as directed by the Engineer.

3.2 PRIOR INVESTIGATION

- A. Prior to bidding, each bidder shall make his own subsurface investigations, talk to the various utilities affected to secure, for his own information, the knowledge of each utility with the precise location of their facilities so that he may take into account in his bid the difference in location from that believed to exist to that which may actually prove to be the precise location.

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SECTION 02 32 00

GEOTECHNICAL INVESTIGATION DATA

PART 1 GENERAL

1.1 TANK SITE INVESTIGATIONS

- A. A soil and subsurface investigation was conducted for the recycled water storage tank, and the results and recommendations are contained in the following reports:
 - 1. Title: Limited Geotechnical Investigation, Proposed MCCSD Recycled Water Tank Project, Mendocino, California.
Date: January 14, 2026.
Author: SHN Consulting Engineers and Geologists, Inc.
Technical Data: Geotechnical boring logs and laboratory test results.
- B. An electronic copy of this information may be made available for review at the office of the District or Engineer. A copy of the soils boring logs is included with the drawings.
- C. Hard copy reproductions of information will NOT be available or made at the office of the Engineer.
- D. This report of explorations and tests of subsurface conditions at the site has been utilized by the Engineer in preparation of the Contract Documents. Bidder may rely upon the accuracy of the "technical" data contained in such reports but not upon nontechnical data, interpretations or opinions contained therein or for the completeness thereof for the purposes of bidding or construction.
- E. This Geotechnical Investigation is not part of the Contract Documents but the technical data contained therein upon which Bidder is entitled to rely are incorporated therein by reference. Such technical data is boring method, location and logs; and laboratory test methods and results.
- F. Before submitting a Bid, each Bidder will, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests and studies and obtain any additional information and data, which pertain to the physical conditions, surface or subsurface, at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing of the Work and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price and other terms and conditions of the Contract Documents.

1.2 HDD CROSSING INVESTIGATION

- A. A soil and subsurface investigation was conducted for the trenchless pipeline crossing under State Route 1, and the results and recommendations are contained in the following report:
 - 1. Title: Final Geotechnical Investigation and Geologic Hazards Report, MUSD Recycled Water System HDD Crossing, Mendocino, California.
Date: September 29, 2021.
Author: Crawford and Associates, Inc.
Technical Data: Geotechnical boring logs and laboratory test results.
- B. An electronic copy of this information may be made available for review at the office of the District or Engineer. A copy of the soils boring logs is included with the drawings.

- C. Hard copy reproductions of information will NOT be available or made at the office of the Engineer.
- D. This report of explorations and tests of subsurface conditions at the site has been utilized by the Engineer in preparation of the Contract Documents. Bidder may rely upon the accuracy of the "technical" data contained in such reports but not upon nontechnical data, interpretations or opinions contained therein or for the completeness thereof for the purposes of bidding or construction.
- E. This Geotechnical Investigation is not part of the Contract Documents but the technical data contained therein upon which Bidder is entitled to rely are incorporated therein by reference. Such technical data is boring method, location and logs; and laboratory test methods and results.
- F. Before submitting a Bid, each Bidder will, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests and studies and obtain any additional information and data, which pertain to the physical conditions, surface or subsurface, at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing of the Work and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price and other terms and conditions of the Contract Documents.

1.3 WASTEWATER TREATMENT PLANT INVESTIGATION

- A. A soil and subsurface investigation was conducted for the wastewater treatment plant facility improvements, and the results and recommendations are contained in the following reports:
 - 1. Title: Wastewater Collection, Treatment and Disposal Facilities, MCCSD, Mendocino, California.
Date: November 6, 1973.
Author: James M. Montgomery Consulting Engineers, Inc.
Technical Data: Geologic cross sections, pits and borings (Sheets G-5 through G-10).
 - 2. Title: Geotechnical Recommendations, Proposed Wastewater Treatment Facilities Improvements and Recycled Water System Expansion, MCCSD, Mendocino, California.
Date: January 24, 2018.
Author: SHN Consulting Engineers & Geologists, Inc.
Technical Data: Subsurface Conditions.
 - 3. Title: Updated Geotechnical Recommendations, Proposed Wastewater Treatment Facilities Improvements and Recycled Water System Expansion, MCCSD, Mendocino, California.
Date: March 3, 2025.
Author: SHN Consulting Engineers & Geologists, Inc.
Technical Data: None.
 - 4. Title: Supplemental Geotechnical Recommendations, Proposed Wastewater Treatment Facilities Improvements and Recycled Water System Expansion, MCCSD, Mendocino, California.
Date: June 2, 2025.
Author: SHN Consulting Engineers & Geologists, Inc.
Technical Data: None.
- B. An electronic copy of this information may be made available for review at the office of the District or Engineer. A copy of the soils boring logs is included with the drawings.
- C. Hard copy reproductions of information will NOT be available or made at the office of the Engineer.

- D. This report of explorations and tests of subsurface conditions at the site has been utilized by the Engineer in preparation of the Contract Documents. Bidder may rely upon the accuracy of the "technical" data contained in such reports but not upon nontechnical data, interpretations or opinions contained therein or for the completeness thereof for the purposes of bidding or construction.
- E. This Geotechnical Investigation is part of the Contract Documents but the technical data contained therein upon which Bidder is entitled to rely are incorporated therein by reference. Such technical data is boring method, location and logs; and laboratory test methods and results.
- F. Before submitting a Bid, each Bidder will, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests and studies and obtain any additional information and data, which pertain to the physical conditions, surface or subsurface, at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing of the Work and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price and other terms and conditions of the Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

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SECTION 02 41 10

DEMOLITION, SALVAGE, AND ABANDONMENT

PART 1 GENERAL

1.1 DESCRIPTION

- A. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor as required for the demolition, abandonment, or removal of pavements and structures and utility removals and abandonments, as indicated on the Drawings and as specified herein.
- B. The Work of this Section shall include, but shall not be limited to the following items:
 - 1. Demolition of asphalt pavement, concrete structures, pavement, underground piping, and other features as required to install utilities, structures, concrete pavement and asphalt pavement.
 - 2. Abandonment or removal of existing pipe and other utilities as indicated on the Drawings and specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02 01 00 - Site Conditions
- B. Section 02 01 10 - Existing Utilities and Underground Structures
- C. Section 02 32 00 - Geotechnical Investigation Data
- D. Section 31 00 00 - Earthwork
- E. Section 31 11 00 - Site Clearing and Grubbing

1.3 DEMOLITION/ABANDONMENT COORDINATION

- A. The Contractor shall anticipate and coordinate construction demolition and improvement as shown on the Drawings and described in the Construction Documents.
- B. The Contractor shall carefully coordinate the extent of the Work in areas where existing utilities shall be reconnected to new facilities and where existing facilities shall remain operational.
- C. While Work is being performed, the Contractor shall provide adequate access for normal operations, including access, routine operation and maintenance. The Contractor shall erect and maintain fences, warning signs, barricades, and other devices as required for the protection of the Contractor's and District's employees and the public around pipelines, structures and excavations. The Contractor shall remove all such protection when the demolition/abandonment operations are completed, or as Work progresses, or when directed by the Engineer or District.
- D. The Contractor shall coordinate all Work with the Engineer and District.
- E. The Contractor shall be responsible for scheduling and coordinating any required shut down and/or relocations as necessary for performance of the work.

1.4 POTENTIALLY HAZARDOUS WASTE

- A. The existing abandoned Mendocino Unified School District water main located in various streets within the County of Mendocino right-of-way may be made of asbestos-cement pipe (ACP). Portions of the Mendocino City Community Services District existing sewer main located in various streets within the County of Mendocino right-of-way may be made of ACP. The Contractor is advised that asbestos cement pipe (ACP) will likely be encountered on the project and must be cut, handled, and disposed of according to the Contractor's State Licensing Law and all other applicable laws and regulations.
- B. When approved by the District, Contractor shall impact, excavate, demolish, recycle, and/or properly dispose of material containing lead under the rules and regulations of the following agencies:
 - 1. US Department of Transportation (US DOT)
 - 2. US Environmental Protection Agency (US EPA)
 - 3. California Environmental Protection Agency (Cal/EPA)
 - 4. California Department of Public Health (CDPH)
 - 5. California Department of Toxic Substances Control (DTSC)
 - 6. California Department of Industrial Relations, Division of Occupational Safety and Health (Cal/OSHA)
 - 7. California Department of Resources Recycling and Recovery (CalRecycle)
 - 8. California Air Resources Board (CARB)
- C. Work at the project site is understood to meet the Cal/OSHA definition of construction work [1532.1(a)] and includes the planned impaction of presumed lead based paint and/or known lead containing surface coatings, thus, is subject to regulation by governmental agencies and standards, including those listed below:
 - 1. Code of Federal Regulations (CFR)
 - 2. 29 CFR 1926, Construction Standards
 - 3. 40 CFR Parts 261, 265, and 268, Hazardous Waste Management
 - 4. 40 CFR Part 745, Lead: Identification of Dangerous Levels of Lead
 - 5. 40 CFR Part 745, Subpart E Lead Renovation, Repair and Painting Program
 - 6. 49 CFR Parts 172, 173, 178, 179, Hazardous Material Transportation
 - 7. California Code of Regulations (CCR)
 - 8. 8 CCR Division 1, Chapter 4, Construction Safety Orders
 - 9. 8CCR1532.1, Lead in Construction
 - 10. 8 CCR 1537, Welding, Cutting, and Heating of Coated Metals
 - 11. 8 CCR 1531, Respiratory Protection
 - 12. 17 CCR Division 1, Chapter 8, Accreditation/Certification, and Work Practices in Lead-Related Construction
 - 13. 22 CCR Division 4.5, Environmental Health Standards for Management of Hazardous Waste
- D. Contractor shall prevent visible dust migration during demolition, excavation, transportation, placement, and handling of material containing lead and asbestos. Contractor shall use wet methods (water) when impacting lead containing coatings to suppress airborne lead dust.
- E. Employee exposure to material containing any detectable quantity of lead will trigger compliance with applicable lead regulations, including 8 CCR 1532.1. Individuals engaged in lead-related construction work activities should attend lead hazard training appropriate to their assignments. All training for other lead-related construction activities should be in accordance with the Cal/OSHA and CDPH worker training provisions, including 8 CCR 1532.1(l).
- F. Contractor shall designate, in writing, one or more individuals as lead Supervisor(s). Supervisor(s) shall be capable of identifying existing and predictable lead hazards in the surroundings or working conditions and who has authorization to take prompt corrective

measures to eliminate them. Supervisors shall be trained, as required by 8 CCR 1532.1, and, when required, be certified consistent with section 8 CCR 1532.1(l)(3).

- G. Contractor is responsible for all sampling, characterization, removal, handling and disposal of contaminated materials that are not determined to be hazardous waste by the Engineer under 22 California Code of Regulations Division 4.5, including trucking, disposal site fees, and additional testing if required by disposal sites. You shall comply with all disposal regulations, such as City, County, and/or State permits and licenses, as may be required.
- H. Handle, store, and dispose of hazardous waste under 22 California Code of Regulations Division 4.5. Dispose of hazardous waste within 90 days of the start of generation. Store hazardous waste in sealed, covered containers labeled with the contents and accumulation start date under 22 CA Code of Regulations, Division 4.5. Labels must comply with the provisions of 22 CA Code of Regulations, Division 4.5 § 66262.31 and § 66262.32. Use a hazardous waste manifest and a transporter registered with the Department of Toxic Substances Control (DTSC) and in compliance with the California Highway Patrol Biennial Inspection of Terminals Program to transport hazardous waste to an appropriately permitted hazardous waste management facility.
- I. In general, the Contractor shall maintain awareness of potential signs of contamination throughout the project limits and shall notify the District immediately upon discovery of any potential contamination.
- J. The Contractor shall provide 40-hour OSHA-HAZWOPER certified workers when performing any work around potentially contaminated areas and provide a field Site Safety Officer that is also an 8-hour OSHA-HAZWOPER Supervisor trained to directly oversee the contaminated materials removal and handling operation. All workers in this circumstance must have their initial and annual renewal refresher training, medical clearance and personal protective equipment in accordance with 8CCR Section 5192.
- K. Waste streams shall be tested by the Contractor using appropriate US EPA and CalEPA testing protocols for the purpose of hazardous waste characterization. It is the Contractor's sole responsibility to ensure the waste produced by the Contractor's work is properly characterized and disposed of. Waste shall be packaged, stored, handled, transported and disposed of appropriately for each category of waste generated based on the testing results and regulatory protocol. The cost of all waste characterization, waste profiling, transportation and disposal will be the responsibility of the Contractor.
- L. Prior to disposal of any excess material from the work site, submit to the Engineer written authorization for such disposal and entry permission signed by the approved disposal site. You shall disclose in landfill applications the existing conditions and the written disposal and entry permission shall include acknowledgement of such disclosure.

1.5 MATERIAL SALVAGE

1.6 SUBMITTALS

- A. Demolition and Abandonment Plan: The Contractor shall prepare and submit a Utility and Building Demolition and Abandonment Plan to the Engineer for review at least 14 days prior to start of demolition. The procedures shall provide for safe conduct of the Work, careful deactivation, removal and disposition of materials and equipment, protection of property which are to remain undisturbed, coordination with existing facilities to remain in service, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operation.

1.7 REPAIR OF DAMAGE

- A. Any damage to existing street improvements, utility poles, building elements to remain, other existing utilities and facilities to remain, and private property, as caused by the Contractor's operations shall be repaired at the Contractor's expense to the satisfaction of the Engineer.
- B. Damaged items shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of Work of this Contract.

1.8 PROTECTION OF EXISTING FACILITIES

- A. Before beginning any cutting, trenching, demolition or abandonment Work, the Contractor shall carefully inspect the existing facilities to determine the extent of the Work. The Contractor shall take all necessary precautions to prevent damage to existing facilities which are to remain in place and in operation. The Contractor shall be responsible for any damages to existing facilities, which are caused by the operations of the Contractor. Damages to such facilities shall be repaired or replaced to existing condition at no additional cost to the District and to the satisfaction of the Engineer. The Contractor shall carefully coordinate the Work of this Section with all other Work and shall provide shoring, bracing, and supports, as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition Work performed under any part of this Contract. The Contractor shall remove all temporary protection when the Work is complete or when so authorized by the Engineer.
- B. The Contractor shall carefully consider all bearing loads and capacities for placement of equipment and material.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 DEMOLITION AND ABANDONMENT OF FACILITIES

- A. Demolition shall be accomplished in accordance with applicable codes and regulations. Blasting shall not be permitted.
- B. Disposal of all materials shall be performed in compliance with all applicable local, state and federal codes, regulations, and requirements. Structures to be abandoned shall be cleaned prior to abandonment.
- C. The Drawings used in this Contract to indicate demolition, abandonment and salvage are based on Record Drawings and the best available information on the existing facilities. The structures and utilities may differ slightly. Prior to the submittal of bids, the Contractor shall conduct a comprehensive survey of the facilities to verify the scope of Work, the extent of utilities, and the physical sequencing constraints.
- D. The Contract Drawings define the minimum portion of the structures to be removed. Unless otherwise shown on the Drawings, the Contractor may make rough cuts or breaks that exceed the limits of demolition shown.

- E. All debris, materials, piping, and miscellaneous waste products from the demolition process shall be removed safely from the project site as soon as possible. They shall be disposed of in accordance with applicable federal, state, and local regulations. The Contractor is responsible for determining and complying with these regulations and shall bear all costs associated with disposal of these items.
- F. All equipment, materials, and piping within the limits of the demolition shall become the property of the Contractor, unless noted otherwise on the Drawings, and shall be removed from the site.
- G. No toxic or hazardous materials are anticipated for demolition or removal. If these or questionable substances are found during the demolition process, report the condition immediately to the Engineer in writing.

3.2 UTILITIES

- A. The existing known utilities at the project site include potable water underground electrical and overhead power.. Existing utilities shall be maintained as specified in Section 02 01 10, "Existing Utilities and Underground Structures."
- B. The Contractor shall be responsible for coordinating all utility service shut-downs with the District or District's Representative before demolition is started.
- C. Where utility lines that are abandoned or are designated for abandonment are exposed by demolition excavation, they shall be removed.
- D. Sewer lines and other piping to be plugged and abandoned shall be done so in accordance with the Plans and these Specifications.
- E. All utilities designated to remain in service shall remain in service for the duration of the work.
- F. Salvage utility facilities for reuse where designated on the Drawings. Store in a safe and protected location until reinstalled. The Contractor shall be responsible for any damages to these facilities. Damages to such facilities shall be repaired or replaced with new at no additional cost to the District and to the satisfaction of the Engineer.

3.3 POTENTIALLY HAZARDOUS WASTE

3.4 PAVING DEMOLITION

- A. Asphalt concrete and armor coats shall be saw cut with a suitable tool before excavation. For all roads and paved areas, saw cutting shall be required. Breaking of asphalt, concrete, or armor coats with jack hammers or excavation equipment will not be permitted.
- B. All edges of asphalt concrete or armor coats shall be cut four (4) inches vertically, with a neat, square edge.
- C. In all cases, existing asphalt paving or armor coating shall be saw cut out after construction and just prior to final paving to a point twelve (12) inches or more wider than each side of the trench line in accordance with County of Mendocino Department of Transportation requirements. Saw cuts shall be parallel or perpendicular to centerline of the trench. Any strip of existing pavement with a width of four (4) feet or less shall be removed and replaced with new pavement.

- D. The Contractor shall dispose of all Portland cement concrete and asphalt concrete generated from removal or demolition activities on the project at a recycler for these materials. The Contractor shall provide receipts verifying delivery and approximate quantity (TONS) of the material delivered to the material recycler.

3.5 PROTECTED AREAS

- A. The existing structures not designated for removal, along with its associated utilities and landscaping, shall remain in place, in service and accessible to employees. The Contractor shall exercise caution when working near these structures. Any damage to structures, surrounding landscaping, or paved areas shall be repaired or replaced to original pre-contract conditions at the Contractor's sole expense. The Contractor is responsible for providing any temporary access as required for this facility.
- B. All other areas of the site not within the limits of demolition and grading shown on the Drawings shall be left undisturbed. Any damage to these areas during the demolition or construction process shall be repaired or replaced to original pre-contract conditions at the Contractor's sole expense. Disturbed areas, not within the demolition and grading limits shown on the Drawings, shall be reseeded.

3.6 BACKFILLING

- A. The Contractor shall backfill all demolition areas to final grade with appropriate fill material as shown on the Drawings and described in these Specifications.
- B. Backfill material shall meet the applicable requirements of Section 31 00 00, "Earthwork." In all areas not immediately backfilled to ground level, the Contractor shall erect safety barriers around the excavation.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formwork.
 - 2. Reinforcement.
 - 3. Accessories.
 - 4. Cast-in place concrete.
 - 5. Finishing and curing.

1.2 SYSTEM DESCRIPTION

- A. Design, engineer and construct formwork, shoring and bracing in accordance with ACI 301 to conform to design and applicable code requirements to achieve concrete shape, line and dimension.

1.3 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 – Specifications for Structural Concrete
 - 2. ACI 302.1R – Guide to Concrete Floor and Slab Construction
 - 3. ACI 305.1 – Standard Specification for Hot Weather Concreting
 - 4. ACI 306.1 – Standard Specification for Cold Weather Concreting
 - 5. ACI 318 – Building Code Requirements for Structural Concrete
 - 6. ACI 347 – Guide to Formwork for Concrete
- B. ASTM International:
 - 1. ASTM C31/C31M – Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - 2. ASTM C33 – Standard Specification for Concrete Aggregates
 - 3. ASTM C39/C39M – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - 4. ASTM C94/C94M – Standard Specification for Ready-Mix Concrete
 - 5. ASTM C143/C143M – Standard Test Method for Slump of Hydraulic Cement Concrete
 - 6. ASTM C150 – Standard Specification for Portland Cement
 - 7. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete
 - 8. ASTM C173/C173M – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
 - 9. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete
 - 10. ASTM C494/C494M – Standard Specification for Chemical Admixtures for Concrete
 - 11. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
 - 12. ASTM C1017/C1017M – Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
 - 13. ASTM C1064/C1064M – Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
 - 14. ASTM C1077 – Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

15. ASTM C1107/C1107M – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
16. ASTM E1155 – Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers

C. AWS D1.4/D4.1M – Structural Welding Code – Steel Reinforcing Bars

1.4 SUBMITTALS

- A. Shop Drawings: Signed and sealed by professional Civil or Structural Engineer licensed in the State of California.
 1. Indicate pertinent dimensioning, form materials, arrangement of joints and ties, location of bracing and temporary supports, schedule of erection and stripping.
 2. Indicate reinforcement sizes, spacing, locations, quantities, grade, bending and cutting schedules, and supporting and spacing devices.
 3. Indicate slabs-on-grade.
 4. Indicate penetrations and embedded objects.
- B. Product Data:
 1. Cementitious materials: type, manufacturing location, shipping locations, and certificates showing compliance with ASTM C150.
 2. Coarse and fine aggregates: types, pit or quarry locations, producers' names, and gradations.
 3. Admixtures: types, brand names, producers, manufacturer's technical data sheets, and certification data.
 4. Ready-mix plant certification or ASTM C94 certification documentation.
 5. Attachment accessories.
 6. Joint devices and filler materials.
- C. Design Data:
 1. Submit concrete mix designs for each concrete strength. Identify mix ingredients and proportions, including admixtures. Submit separate mix designs when admixtures require hot and cold weather concrete work or air entrained concrete work.
 2. Submit certified laboratory compression test results for each concrete strength.
- D. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.6 QUALITY ASSURANCE

- A. Construct and erect concrete formwork in accordance with ACI 301.
- B. Perform concrete reinforcing work in accordance with ACI 301.
- C. Perform cast-in-place concrete work in accordance with ACI 301.
- D. Conform to ACI 305 when concreting during hot weather.
- E. Conform to ACI 306.1 when concreting during cold weather.

- F. Perform Work in accordance with State of California standards.
- G. Maintain one copy of each document on site.
- H. Design Work under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of California.

1.7 COORDINATION

- A. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 FORM MATERIALS AND ACCESSORIES

- A. Form Materials: At discretion of Contractor. New material to be used.
- B. Form Release Agent: Colorless mineral oil not capable of staining concrete or impairing natural bonding characteristics of coating intended for use on concrete.

2.2 REINFORCEMENT MATERIALS

- A. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade, deformed billet bars, uncoated.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for support of reinforcing; plastic tipped or non-corroding for supports in slabs forming finished ceilings or where supports are exposed to weather.
- C. Fabricate concrete reinforcement in accordance with ACI 318.
- D. Weld reinforcement in accordance with AWS D1.4.

2.3 CONCRETE MATERIALS

- A. Cement:
 - 1. ASTM C150, Type II/V Portland type.
 - 2. The concrete must contain at least 675 pounds of cementitious material per cubic yard.
 - 3. The cementitious material must be composed of one of the following, by weight:
 - a. 25 percent natural pozzolan or fly ash with a CaO content of up to 10 percent and 75 percent Portland cement.
 - b. 20 percent natural pozzolan or fly ash with a CaO content of up to 10 percent, 5 percent silica fume, and 75 percent Portland cement.
 - c. 12 percent silica fume, metakaolin, or UFFA, and 88 percent Portland cement.
 - d. 50 percent GGBFS and 50 percent Portland cement.
- B. Normal Weight Aggregates: ASTM C33.
 - 1. Coarse aggregate maximum size: 1 inch in accordance with ACI 318.
- C. Water: ACI 318; potable, clean, and without deleterious amounts of chloride ions.

2.4 ADMIXTURES:

- A. Air Entrainment Admixture: ASTM C260, containing no chlorides or other corrosion causing chemicals.
- B. Chemical: ASTM C494/C494M Type A – Water Reducing, Type D – Water Reducing and Retarding, containing no chlorides or other corrosion causing chemicals.
- C. Fly Ash: ASTM C617 Class F.
- D. Plasticizing: ASTM C1017/C1017M Type I, plasticizing and Type II, plasticizing and retarding.

2.5 ACCESSORIES

- A. Epoxy Bonding Compound: ASTM C881. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces. Provide Class A if placement temperature is below 40 degrees F; Class B if placement temperature is between 40 and 60 degrees F; or Class C if placement temperature is above 60 degrees F.
- B. Vapor Barrier: ASTM E1745 10 mil thick; type recommended for below grade application, Stego Wrap brand or equal. Furnish joint tape recommended by manufacturer.
- C. Polysulphide Sealant: ASTM C920-87, Type M, grade NS, Class 121/2 Min.
 - 1. Primer: in accordance with manufactures recommendations.
 - 2. Prepare surfaces, primer, and install in accordance with manufactures recommendations for intended application.
- D. Evaporation Retardant:
 - 1. Provide to retard rapid evaporation of water from fresh exposed concrete.
 - 2. Fluorescent color tint which shall disappear completely upon drying is optional.
 - 3. Manufacturers:
 - a. Master Builders Co., Cleveland, OH, Confilm or Confilm LL-898.
 - b. Evelid Chemical Co., Cleveland, OH, Eucobar.
 - c. Or approved equal.
- E. Non-Shrink Grout: ASTM C1107/C1107M; Grade A; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 3,000 psi in 72 hours and 7,000 psi in 28 days.

2.6 JOINT DEVICES AND FILLER MATERIALS

- A. Joint Filler: ASTM D1751; Asphalt impregnated fiberboard or felt, 1/4 inch thick; tongue and groove profile.
- B. Joint Sealant: ASTM C920 unless otherwise noted; suitable for materials to which applied.
 - 1. Horizontal Joints: Grade P, use T.
 - 2. Vertical Joints: Grade NS.

2.7 HYDROPHILIC RUBBER WATER STOPS

- A. The waterstop shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.

- B. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.
- C. Performance Requirements as follows:

Chloroprene Rubber

Property	Test Method	Required Limits
Tensile Strength	ASTM D412	1300 PSI min.
Ultimate Elongation	ASTM D412	400% min.
Hardness (Shore A)	ASTM D2240	50 +/- 5
Tear Resistance	ASTM D624	100 lb/inch min.

Modified Chloroprene (Hydrophilic Rubber)

Property	Test Method	Required Limits
Tensile Strength	ASTM D412	350 PSI min.
Ultimate Elongation	ASTM D412	600% min.
Hardness (Shore A)	ASTM D2240	52 +/- 5
Tear Resistance	ASTM D624	50 lb/inch min.
Expansion Ratio	Volumetric Change – Distilled Water @ 70°F	3 to 1 min.

- D. Manufacturer:
- SIKA HYDROTITE DS profile, or approved equivalent.
- E. Accessories
- Waterstop Adhesive for Smooth Surfaces: SIKA HYDROTITE ADHESIVE, or approved equivalent, to secure waterstop to smooth, dry concrete.
 - Waterstop Epoxy Gel: SIKA GREENSTREAK EPOXY 7300 two component epoxy gel, or approved equivalent, to secure SIKA HYDROTITE to rough, wet (or dry) concrete.
 - Waterstop Adhesive for Rough Surfaces: LEAKMASTER single component hydrophilic sealant, or approved equivalent, to secure SIKA HYDROTITE to rough, dry concrete.
 - Provide cyanoacrylate adhesive (i.e., Super Glue) for all waterstop splices.

2.8 CONCRETE MIX

- A. Mix and deliver concrete in accordance with ASTM C94/C94M, Option A.
- B. Select proportions for concrete in accordance with ACI 301.
- C. Furnish concrete of the following strength:

Parameter	All concrete shown on structural drawings	Miscellaneous concrete not shown on structural drawings
Compressive Strength (measured at 28 days)	4,000 psi	3,000 psi
Maximum Water-Cement Ratio	0.45 by weight	0.59 by weight
Maximum Aggregate Size	1.0 inch	1.0 inch
Slump	1 inch minimum to 4 inches maximum, as measured at point of placement	1 inch minimum to 4 inches maximum, as measured at point of placement
Air Content	6% plus or minus 2%	6% plus or minus 2%

Parameter	All concrete shown on structural drawings	Miscellaneous concrete not shown on structural drawings
Fly Ash Content	25% maximum, 15% minimum of total weight of cementitious materials	25% maximum, 15% minimum of total weight of cementitious materials

- D. Employ an independent commercial testing laboratory complying with ASTM C1077 and favorably reviewed by the Engineer to design all concrete mixes and carry out all necessary testing. Concrete mix design proportions shall be established on the basis of field experience and trial mixtures with the materials to be employed in accordance with ACI 318 Section 26.4.
1. When the testing laboratory has mix designs meeting the specifications that are available from prior projects, submit material and mixture proportions with supporting test results and test record statistics to demonstrate compliance with the requirements of this Section and ACI 318 Section 26.4. Include calculations for f'_{cr} based on source quality test records.
 2. If new mix designs are required, prepare a range of trial batches for each design and submit the mixes that demonstrate satisfactory test results in accordance with ACI 318 Section 26.4.
 - a. Allow for the variability of concrete strength from test to test by increasing the required average compressive strength over the specified strength as specified in ACI 318 Section 26.4.
- E. Select admixture proportions for normal weight concrete in accordance with ACI 301.
1. Use of admixtures will not relax weather placement requirements.
 - a. Use accelerating admixtures in cold weather only when approved by the Engineer.
 - b. Use set retarding admixtures during hot weather only when approved by the Engineer.
 2. Do not use calcium chloride nor admixtures containing calcium chloride.
 3. Add air entraining agent to concrete mix for concrete work exposed to exterior.
 4. Do not exceed the water-cementitious material ratios. Vary the water-reducing admixtures to accomplish an increase in slump or workability time.

2.9 SLURRY CEMENT BACKFILL

- A. Standard Specifications, Section 19-3.02E.

2.10 FLOWABLE FILL (CONTROLLED LOW STRENGTH MATERIAL, CLSM)

- A. Placement Requirements:
1. Pump or gravity feed. Fill from upstream end until material flows to downstream end.
 2. Maximum run length approximately 500 feet.
- B. Compressive Strength:
1. Minimum: 75 psi.
 2. Maximum: 150 psi.
- C. Density:
1. Minimum wet density: 90 lb/ft³.
- D. Placement Characteristics:
1. Self-leveling, non-shrink, minimal bleed water (<2% per ASTM C940).
- E. Mix Components:
1. Portland Cement: ASTM C150

2. Aggregates: ASTM C33
3. Fly Ash: ASTM C618
4. Water: Potable
5. Admixtures: ASTM C494 (optional for flowability)

PART 3 EXECUTION

3.1 FORMWORK ERECTION

- A. Erect formwork, shoring and bracing to achieve design requirements. Use new materials for all formwork.
- B. Camber slabs and framing to achieve ACI 301 tolerances.
- C. Provide bracing to ensure stability of formwork.
- D. Form external corners of equipment pad with 3/4-inch chamfer.
- E. Apply form release agent to formwork prior to placing form accessories and reinforcement.
- F. Clean forms as erection proceeds, to remove foreign matter.

3.2 INSERTS, EMBEDDED COMPONENTS, AND OPENINGS

- A. Provide formed openings where required for work to be embedded in and passing through concrete members.
- B. Coordinate work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
- C. Install concrete accessories straight, level, and plumb.
- D. Install Vapor Retarder in accordance with ASTM 1643.
- E. Place formed construction joint device in pattern pouring sequence.

3.3 REINFORCEMENT PLACEMENT

- A. Place reinforcement, supported and secured against displacement.
- B. Ensure reinforcing is clean, free of loose scale, dirt, or other foreign coatings.
- C. Space reinforcement bars with minimum clear spacing in accordance with ACI 318.
- D. Weld reinforcement in accordance with AWD D1.4.
 1. Do not weld crossing reinforcement bars for assembly except as permitted by the Engineer.
- E. Maintain concrete cover around reinforcement in accordance with ACI 318.

3.4 EXAMINATION

- A. Verify requirements for concrete cover over reinforcement.

- B. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete

3.5 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Remove laitance, coatings, and unsound materials.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- C. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- D. Remove water from areas receiving concrete before concrete is placed.

3.6 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301.
- B. Notify testing laboratory minimum 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, and anchor bolts are not disturbed during concrete placement.
- D. Install vapor retarder under interior slabs on grade in accordance with ASTM E1643. Lap joints minimum 6 inches and seal watertight in accordance with manufacturer's recommendations.
- E. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight in accordance with manufacturer's recommendations.
- F. Separate slabs on grade from vertical surfaces with 1/4 inch thick joint filler.
- G. Deposit concrete at final position. Prevent segregation of mix.
- H. Place concrete in continuous operation for each panel or section determined by predetermined joints.
- I. Do not interrupt successive placement: do not permit cold joints to occur.
- J. Consolidate concrete.
- K. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- L. Saw cut joints within 12 hours after placing. Saw cut joints as soon as concrete surface is firm enough not to be torn or damaged by blade and before random shrinkage cracks can form. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness.
- M. Screed slabs on grade level, maintaining surface flatness of maximum 1/4 inch in 10 ft.

3.7 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Remove formwork progressively and in accordance with code requirements.

3.8 CONCRETE FINISHING

- A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1.
- B. Steel trowel surfaces which are indicated to be exposed.
- C. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains as indicated on drawings.

3.9 CURING AND PROTECTION

- A. Cure slab surfaces in accordance with ACI 301.
- B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
 - 1. Protect concrete footings from freezing for minimum 5 days.
- C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete for not less than 7 days.

3.10 HYDROPHILIC RUBBER WATER STOPS

- A. Cut coil ends square (or at proper angle for mitered corners) with shears or sharp blade to fit splices together without overlaps. The hydrophilic rubber water stop profile should be cut to a length just slightly less than the circumference of the pipe to be sealed. This will allow for a snug fit of the profile once the installation is complete. Ends should be cut square with a sharp knife or shears.
- B. Splices shall be sealed using cyanoacrylate adhesive (super glue).
- C. Apply Watertest Adhesive for Smooth Surfaces to the pipe surface, smooth cored concrete and to the watertest.
- D. Apply Watertest Adhesive for Rough Surfaces to rough concrete.
- E. Seal any exposed open ends of hydrophilic rubber water stop using Watertest Adhesive for Rough Surfaces.
- F. Follow approved manufacturer recommendations and installation instructions.

3.11 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed by Owner's testing laboratory in accordance with ACI 301 and under provisions of General Conditions.
- B. Provide free access to Work and cooperate with appointed firm.

- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- D. Concrete Inspections:
 - 1. Continuous Placement Inspection: Inspect for proper installation procedures.
 - 2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.
- E. Strength Test Samples:
 - 1. Sampling Procedures: ASTM C172.
 - 2. Cylinder Molding and Curing Procedures: ASTM C31/C31M, cylinder specimens, field cured.
 - 3. Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, or not less than once for each 50 cubic yards of concrete, or not less than once for each 2,000 square feet of surface area for slabs or walls. Additional samples for seven-day compressive strength tests shall be taken for each class of concrete at the beginning of the concrete work or whenever the mix or aggregate is changed (CBC sec 1905A.1.15).
 - 4. When volume of concrete for any class of concrete would provide less than 5 sets of cylinders, take samples from five randomly selected batches, or from every batch when less than 5 batches are used.
 - 5. Make one additional cylinder during cold weather concreting, and field cure.
- F. Field Testing:
 - 1. Slump Test Method: ASTM C143/C143M.
 - 2. Air Content Test Method: ASTM C173/C173M.
 - 3. Temperature Test Method: ASTM C1064/C1064M.
 - 4. Measure slump and temperature for each compressive strength concrete sample.
 - 5. Measure air content in air entrained concrete for each compressive strength concrete sample.
- G. Cylinder Compressive Strength Testing:
 - 1. Test Method: ASTM C39/C39M.
 - 2. Test Acceptance: In accordance with ACI 318.
 - 3. Testing laboratory will transport cylinders from site, cure, test, and provide report.
 - 4. Test results from cured test cylinders shall be evaluated separately for each specified concrete mixture.
 - 5. Test one cylinder at 7 days.
 - 6. Test two cylinders at 28 days.
 - 7. Retain one for testing when requested by Engineer.
 - 8. Dispose remaining cylinders when testing is not required.
- H. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken
- I. Reinforcement Inspection:
 - 1. Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover, and splicing.

3.12 PATCHING

- A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

- C. Patch imperfections in accordance with ACI 301.

3.13 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.
- B. Repair or replacement of defective concrete will be determined by Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

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SECTION 05 05 19

POST-INSTALLED ANCHORS

PART 1 GENERAL

1.1 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
1. American Concrete Institute (ACI):
 - a. 318: Building Code Requirements for Structural Concrete
 - b. 355.2: Qualification of Post-Installed Mechanical Anchors in Concrete
 - c. 355.4: Qualification of Post-Installed Adhesive Anchors in Concrete
 2. American Iron and Steel Institute (AISI): Stainless Steel Types
 3. American National Standards Institute (ANSI)
 4. ASTM International (ASTM):
 - a. A193/A193M: Specification for Alloy-Steel and Stainless Steel Bolting
 - b. Materials for High-Temperature Service
 - c. A194/A194M: Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
 - d. A380: Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
 - e. A563: Specification for Carbon and Alloy Steel Nuts
 - f. A967: Specification for Chemical Passivation Treatments for
 - g. Stainless Steel Parts
 - h. F436: Specification for Hardened Steel Washers
 - i. F468: Specification for Nonferrous Bolts, Hex Cap Screws, and
 - j. Studs for General Use
 - k. F568M: Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners
 - l. F593: Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
 - m. F594: Specification for Stainless Steel Nuts
 - n. F1554: Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
 5. International Code Council Evaluation Service (ICC-ES):
 - a. Evaluation Reports for Concrete and Masonry Anchors.
 - b. AC01: Acceptance Criteria for Expansion Anchors in Masonry Elements
 - c. AC106: Acceptance Criteria for Pre drilled Fasteners (Screw Anchors) in Masonry Elements
 - d. AC 193: Acceptance Criteria for Mechanical Anchors in Concrete Elements
 - e. AC 308: Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements
 - f. AC70: Acceptance Criteria for Fasteners Power-driven into Concrete, Steel and Masonry Elements
 6. International Association of Plumbing and Mechanical Officials (IAPMO): Evaluation Reports for Concrete and Masonry anchors
 7. Specialty Steel Industry of North America (SSINA):
 - a. Specifications for Stainless Steel
 - b. Design Guidelines for the Selection and Use of Stainless Steel
 - c. Stainless Steel Fabrication
 - d. Stainless Steel Fasteners

1.2 DEFINITIONS

- A. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.
- B. Exterior Area: Location not protected from the weather by a building or other enclosed structure.
- C. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, and where wall or roof slab is not common to a water-holding or earth-retaining structure.
- D. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.
- E. Submerged: Location at or below top of wall of open water-holding structure, such as, a basin or channel, or wall, ceiling or floor surface inside a covered water-holding structure, or exterior below grade wall or roof surface of water- holding structure, open or covered

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Specific instructions for concrete anchor installation, including drilled hole size, preparation, placement, procedures, and instructions for safe handling of anchoring systems
- B. Informational Submittals:
 - 1. Concrete and Masonry Anchors:
 - a. Manufacturer's product description and installation instructions
 - b. Current ICC-ES report for each type of post-installed anchor to be used
 - c. Adhesive Anchor Installer Certification
 - 2. Passivation method for stainless steel members
 - 3. Hot-Dip Galvanizing: Certificate of compliance signed by galvanizer, with description of material processed and ASTM standard used for coating

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installers of adhesive anchors horizontally or upwardly inclined to support sustained tension loads shall be certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Installer Certification Program or equivalent.
 - 2. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package stainless steel items in a manner to provide protection from carbon impregnation.
- B. Protect hot-dip galvanized finishes from damage due to metal banding and rough handling.

PART 2 PRODUCTS

2.1 GENERAL

- A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Stainless Steel	
Threaded Rods	F593, AISI Type 316, Condition CW
Item	ASTM Reference
Nuts*	F594, AISI Type 316, Condition CW
Carbon Steel	
Threaded Rods	F1554, Grade 36 or F568M Class 5.8 A193/A193M, Grade B7
Flat and Beveled Washers (Hardened)	F436
Nuts*	A194/A194M, Grade 2H
* Nuts of other grades and styles having specified proof load stresses greater than the specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod.	

- B. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, and zinc-plated steel material types as indicated in Fastener Schedule at end of this section.

2.2 POST-INSTALLED CONCRETE ANCHORS

- A. General:

1. AISI Type 316 stainless, hot-dip galvanized, or zinc-plated steel, as shown in Fastener Schedule at end of this section.
2. Post-installed anchor systems used in concrete shall be approved by ICC Evaluation Services Report or equivalent for use in cracked concrete and for short and long-term loads including wind and earthquake. Mechanical anchors shall comply with the requirements of ICC-ES AC 193 or ACI 355.2.
3. Adhesive anchors shall comply with the requirements of ICC-ES AC 308 or ACI 355.4.

- B. Torque-Controlled Expansion Anchors (Wedge Anchors):

1. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; Kwik-Bolt –TZ (KB-TZ) Anchors (ESR- 1917)
 - b. Powers Fasteners, Brewster, NY; Power-Stud +SD1, +SD2, +SD4, or +SD6 Anchors (ESR-2502 and ESR-2818)
 - c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 Anchors (ESR-3037)

- C. Undercut Anchors:

1. Manufacturers and Products:
 - a. USP Structural Connectors, Burnsville, MN; DUC Undercut Anchor (ESR-1970)
 - b. Hilti, Inc., Tulsa, OK; HDA Undercut Anchor (ESR-1546)
 - c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; TORQ-CUT Self- Undercutting Anchor (ESR-2705)
 - d. Powers Fasteners, Brewster, NY; Atomic+ Undercut Anchor (ESR-3067)

- D. Self-Tapping Concrete Screw Anchors:

1. Manufacturers and Products:
 - a. Powers Fasteners, Brewster, NY; Wedge-Bolt+ (ESR-2526)
 - b. Powers Fasteners, Brewster, NY; Vertigo+ Rod Hanger Screw Anchor (ESR-2989)
 - c. Powers Fasteners, Brewster, NY; Snake+ Flush Mount Screw Anchor (ESR-2272)
 - d. Hilti, Inc., Tulsa, OK; HUS-EZ Screw Anchor (ESR-3027)
 - e. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Titen HD Screw Anchor (ESR-2713)

- E. Adhesive Anchors:
 - 1. Threaded Rod:
 - a. Diameter as shown on Drawings
 - b. Length as required, to provide minimum depth of embedment
 - c. Clean and free of grease, oil, or other deleterious material
 - 2. Adhesive:
 - a. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments
 - b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions
 - 3. Packaging and Storage:
 - a. Disposable, self-contained system capable of dispensing both components in the proper mixing ratio and fitting into a manually or pneumatically operated caulking gun
 - b. Store adhesive on pallets or shelving in a covered storage area Package Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions
 - c. Dispose of When:
 - 1) Shelf life expired
 - 2) Stored other than in accordance with manufacturer's instructions
 - 4. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System, HIT RE 500 SD or HIT-HY 200 (ESR-2322 and ESR-3187)
 - b. Simpson Strong-Tie Co., Inc., Pleasanton, CA; AT-XP Adhesive Anchors (ESR-2508 and IAPMO ER-263)
 - c. Powers Fasteners, Brewster NY, Pure 110+ Epoxy adhesive anchor system (ESR-3298)
- F. Adhesive Threaded Inserts:
 - 1. Stainless steel, internally threaded inserts
 - 2. Manufacturer and Product: Hilti, Inc., Tulsa, OK; HIS-RN Insert with HIT-RE 500-SD or HIT-HY 200 adhesive

2.3 POST-INSTALLED MASONRY ANCHORS

- A. General:
 - 1. AISI Type 316 stainless, hot-dip galvanized, or zinc-plated steel, as shown in Fastener Schedule at end of this section
 - 2. Current ICC Evaluation Report indicating acceptance for anchors at structural applications in masonry
- B. Manufacturers and Products:
 - 1. Hilti, Inc., Tulsa, OK; Kwik-Bolt-3 (KB-3) (ESR-1385), for grout-filled masonry, HIT-HY 70 (ESR-2682) for grout filled CMU, hollow CMU, or unreinforced masonry
 - 2. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 (IAPMO ER 240) for grout filled CMU, Titen-HD (ESR-1056) for grout filled or hollow CMU, AT-XP (IAPMO ER-281) for grout filled CMU
 - 3. Powers Fasteners, Brewster NY; Power-Stud+ SD1 (ESR-2966) for grout-filled masonry, Wedgebolt+ (ESR-1678) for grout-filled masonry

PART 3 EXECUTION

3.1 CONCRETE AND MASONRY ANCHORS

- A. Begin installation only after concrete or masonry to receive anchors has attained design strength.
- B. Install in accordance with manufacturer's instructions. Provide minimum embedment, edge distance, and spacing as follows, unless indicated otherwise by anchor manufacturer's instructions or shown otherwise on Drawings:

Anchor Type	Min. Embedment (bolt diameters)	Min. Edge Distance (bolt diameters)	Min. Spacing (bolt diameters)
Expansion	9	6	12
Undercut	9	12	16
Adhesive	9	9	13.5

- C. Use only drill type, and bit type and diameter recommended by anchor manufacturer.
- D. Clean hole of debris and dust according to manufacturer's requirements.
- E. When embedded steel or rebar is encountered in the drill path, slant drill to clear obstruction. If drill must be slanted more than indicated in the manufacturer's installation instructions to clear obstruction, notify Engineer for direction on how to proceed.
- F. Adhesive Anchors:
- Do not install adhesive anchors when temperature of concrete or masonry is below 40°F or above 100°F.
 - Do not install prior to concrete attaining an age of 21 days unless otherwise approved by adhesive manufacturer and Engineer.
 - Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry where required by manufacturer's instructions.
 - For hollow-unit masonry, install screen tube in accordance with manufacturer's instructions.
 - Do not disturb anchor during recommended curing time.
 - Do not exceed maximum torque as specified in manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

- A. Concrete and Masonry Anchors: Special inspection and testing shall be provided by Owner where indicated on Drawings.

3.3 MANUFACTURER'S SERVICES

- A. Adhesive Anchors: Conduct site training of installation personnel for proper installation, handling, and storage of adhesive anchor system. Notify Engineer of time and place for sessions.

3.4 FASTENER SCHEDULE

- A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Post-Installed Anchors for Metal Components to Cast-in-Place Concrete (e.g., Ladders, Handrail Posts, Electrical Panels, and Equipment)		

Service Use and Location	Product	Remarks
Interior Dry Areas	Anchor material type to match material being anchored (for example, stainless steel anchors to	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an
Service Use and Location	Product	Remarks
	anchor stainless steel equipment, zinc plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment).	overhead application
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel adhesive anchors	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application
2. Anchors in Grout-Filled Concrete Masonry Units		
Interior Dry Areas	Anchor material type to match material being anchored (for example, stainless steel anchors to anchor stainless steel equipment, zinc plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment).	
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel adhesive anchors	
3. Anchors in Hollow Concrete Masonry Units		
Interior Dry Areas	Anchor material type to match material being anchored (for example, stainless steel anchors to anchor stainless steel equipment, zinc plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment).	Adhesive anchors shall be installed with screen tubes.
Exterior, Interior Wet, and Corrosive Areas	Stainless steel adhesive anchors	Adhesive anchors shall be installed with screen tubes.
4. All Others		
All service uses and locations	Stainless steel anchors	

- B. Antiseizing Lubricant: Use on all stainless steel threads.
- C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120°F.

END OF SECTION

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SECTION 05 53 00

GRATING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Grating for installation over the exterior portions of the new chlorine contact basin and tank as shown on the Drawings.
- B. The Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install aluminum grating.

1.2 QUALITY ASSURANCE

- A. Grating shall comply with applicable provisions and recommendations of the following:
 - 1. ASTM B221, Aluminum Alloy, Extruded Bars, Rods, Wire, Shapes and Tubing
 - 2. NAAM Metal Bar Grating Manual designated ANSI/NAAMM AGB 531 and AGB 532 (current edition)
 - 3. ASTM A569 Hot Rolled Carbon Steel Sheet and Strip
 - 4. ASTM A510 Carbon Steel Rods and Course Round Wire
 - 5. ASTM E 84 Surface Burning Characteristics of Building Materials
- B. The Contractor shall take field measurements prior to preparation of Shop Drawings and fabrication where required, to ensure proper fitting of the work.

1.3 SUBMITTALS

- A. Submittals shall conform to the requirements of Section 01 33 00–Submittal Procedures.
- B. Shop Drawings:
 - 1. Grating: Show dimensions, weight, size, location of pipe penetrations, standard installation details, and location of connections to adjacent grating, supports, and other work.
 - 2. Grating Anchorage: Show details of anchorage to supports to prevent displacement from impact.
- C. Product Data for grating, grating clips, anchors, accessories, and other manufactured products specified herein.
- D. Manufacturer's specifications including coatings, surface treatment, and finishes.

PART 2 PRODUCT

2.1 GENERAL

- A. GRATING MATERIALS
 - 1. Aluminum: Provide alloy and temper as designated below:
 - a. Bearing Bars and Banding: ASTM B221 alloy 6061-T6 or 6063-T6
 - b. Swaged Crossbar Rods: ASTM B221 alloy 6061 or 6063, or ASTM B210 alloy 3003
 - c. Finish: Clear anodic coating, chemically etched medium matte, with Architectural Class 1, 0.7 mils or thicker.

- B. METAL BAR GRATING
 - 1. Uniform load
 - a. Light Duty (Type A): 100 psf uniformly distributed load
 - b. Medium Duty (Type B): 500 psf uniformly distributed load
- C. Maximum Clear Span Deflection: ¼-inch
- D. Bearing Bar Spacing
 - 1. Light Duty: 1-3/16-inch maximum center to center.
 - 2. Medium Duty: 15/16-inch maximum center to center.
- E. Cross Bar Spacing: 4-inches maximum center to center. For aluminum I-bar grating with depths greater than 2-inches, provide cross bars at 2-inches maximum center to center.
- F. Grating depths shall be designed to produce no more than ¼-inch deflection under uniform load for the given clear span shown on the Drawings.
- G. Grating Materials: Aluminum, pressure-locked rectangular bar grating fabricated by pressing crossbars between rectangular bearing bars or I-bar grating fabricated by swaging crossbars between extruded I-shaped bearing bars.
- H. Surface: Slip resistance, consisting of an applied abrasive finish of aluminum oxide aggregate or striated.
- I. Manufacturer
 - 1. Ohio Gratings, Inc.
 - 2. McNichols Steel Grating
 - 3. Harsco Industrial IKG
 - 4. Approved equal.
 - 5. Substitution: Section 01 33 00–Submittal Procedures

2.2 ACCESSORIES

- A. Grating Clamps
 - 1. Use flanged beam and bolted angle frame supports.
 - 2. Must be removable from above grating walkway surface.
 - 3. Provide hat bracket, recessed bolt, and bottom clamp of same material as grating.
 - 4. Manufactures and Products:
 - a. Direct Metals Company, LLC; Grating Clamp
 - b. Grating Fasteners, Inc; G-Clip
 - c. Or Approved Equal
- B. Anchor Stud and Saddle Clip
 - 1. Use at embedded angle frame supports with stud anchor and nut recessed below top of grating surface.
 - 2. Removable from above grating walkway surface. Provide Type 316 stainless steel welded threaded stud anchor, nut, washer, and saddle clip.
 - 3. Manufactures and Products:
 - a. Welded Stud Anchor
 - 1) Neson Stud Welding, Inc
 - 2) Stud Welding Associates, Inc
 - 3) Or Approved Equal
 - b. Saddle Clip
 - 1) Direct Metals Company, LLC; Saddle Clip
 - 2) Grating Fasteners, Inc; Saddle Clip
 - 3) Struct-Fast, Inc; Gratefast
 - 4) Or Approved Equal

2.3 FABRICATION

A. General

1. All manufacturing, fabrication, welding, and tolerances shall comply with the NAAMM Metal Bar Grating Manual designated ANSI/NAAMM MBG 531 or MGB 532 (current edition).
2. Contractor shall field-measure areas to receive grating. Verify dimensions of new fabricated supports and fabricate to dimensions required for specified clearances.
3. Conceal fastening where practical.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Provide all ends of grating sections with banding bars of the same height and material as the bearing bars.
6. Do not notch bearing bars at supports to maintain elevation.
7. Provide aluminum saddle clips and grating clamps as required for grating hold down.
8. A single grating section shall not be less than 1.5-feet or greater than 3-feet in width, or weigh more than 150 pounds.
9. Supports:
 - a. Same material except that supports which are to be embedded in concrete shall be type 316 stainless steel, unless part of an extruded aluminum system.
 - b. Coordinate dimensions and fabrication with grating to be supported.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prior to grating installation, Contractor shall inspect supports for correct size, layout, and alignment. Any inconsistency between Contract Drawings and supporting structure deemed detrimental to grating placement shall be reported in writing to the Architect or Owner's agent prior to grating placement.
- B. Electrolytic Protection
 1. Where aluminum surfaces contact dissimilar metals, surfaces shall be kept from direct contact by painting the dissimilar metal with one coat of bituminous paint or other approved insulating materials.
 2. Where aluminum surfaces contact dissimilar materials (such as, concrete, masonry, or lime mortar), exposed aluminum surfaces shall be painted with one (1) coat of bituminous paint or other approved installing material.
 3. Allow paint to dry before installation of material.

3.2 INSTALLATION

- A. Install grating in accordance with shop drawings and standard installation clearances as recommended by the NAAMM Metal Bar Grating Manual.
- B. Install supports such that grating sections have a solid bearing on both ends, and that grating sections will not rock or wobble under design loads.
- C. Install grating supports plumb and level as applicable.
- D. Install sections of welded frames with anchors to straight plane without offsets.
- E. Field locate and install fasteners to fit grating layout.
- F. Anchor grating securely to supports using minimum of four fasteners, clips, and bolts in accordance with the grating section.

- G. Each grating sections shall be easily removable and replaceable.
- H. Protect painted surfaces during installation.
- I. Repair damaged coatings as specified in Section 09 90 00—Painting and Coating.
- J. Cutting, Fitting, and Placement
 - 1. Perform all cutting and filling required for installation. Grating shall be placed such that cross bars align.
 - 2. Cutting and banding shall permit removal of the grating without disturbing penetrating items.
 - 3. Wherever grating is pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a rectangular band bar of the same height and material as bearing bars.
 - 4. All rectangular cutouts are to be made to the next bearing bar beyond the penetration with a clearance not to exceed bearing bar spacing.
 - 5. Use standard panel widths wherever possible.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and field application of paints, stains, and other coatings.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
 - 2. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
 - 3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. California Department of Health Services:
 - 1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.
- C. Green Seal:
 - 1. GC-03-2nd Edition, January 7, 1997 - Anti-Corrosive Paints.
 - 2. GS-11-1st Edition, May 20, 1993 - Product Specific Environmental Requirements.
- D. Painting and Decorating Contractors of America:
 - 1. PDCA - Architectural Painting Specification Manual.
- E. South Coast Air Quality Management District:
 - 1. SCAQMD Rule 1113-January 1, 2004 - Architectural Coatings.
- F. SSPC: The Society for Protective Coatings:
 - 1. SSPC - Steel Structures Painting Manual.

1.3 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this section.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittals: Submittal procedures.
- B. Product Data: Submit data on finishing products.
- C. Samples:
 - 1. Submit two 8.5"x11" painted samples, illustrating selected colors for each color and system selected

- D. Manufacturer's Installation Instructions: Submit special surface preparation procedures, substrate conditions requiring special attention.

1.5 SUSTAINABLE DESIGN SUBMITTALS

- A. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
 - 1. Materials Resources Certificates:
 - a. Certify source for regional materials and distance from Project site.
 - 2. Indoor Air Quality Certificates:
 - a. Certify volatile organic compound content for each interior paint and coating.
 - b. Certify volatile organic compound content for each flooring system.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with 2019 California Building Code (CBC).

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing work of this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, VOC content, warning labels, contents by volume or major constituents, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.
- B. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

- D. Provide lighting level of 80 ft candle measured mid-height at substrate surface.

1.11 SEQUENCING

- A. Sequence application to the following:
 - 1. Do not apply finish coats until paintable sealant is applied.
 - 2. Back prime wood trim before installation of trim.

1.12 WARRANTY

- A. Furnish five year manufacturer warranty for paints and coatings.

1.13 EXTRA MATERIALS

- A. Supply 1 gallons of each color, and type; store where directed.
- B. Label each container with color, type, and location, in addition to manufacturer's label.

PART 2 PRODUCTS

2.1 PAINTS AND COATINGS

- A. Manufacturers:
 - 1. Tnemec.
 - 2. Ameron Protective Coatings Div.
 - 3. ICI Devco.
 - 4. Carboline Protective Coatings.
 - 5. Sherwin Williams.
 - 6. Dampney Compant, Inc.
 - 7. Or approved Equal.
- B. Furnish materials in accordance with 2022 California Building Code (CBC).

2.2 SUSTAINABILITY CHARACTERISTICS

- A. Materials and Resources Characteristics:
 - 1. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project site.
- B. Indoor Environmental Quality Characteristics:
 - 1. Flat and Non-Flat Paints: Maximum volatile organic compound content in accordance with GS-11.
 - 2. Anti-Corrosive Paints: Maximum volatile organic compound content in accordance with GC-03.
 - 3. Primers, and Shellacs: Maximum volatile organic compound content in accordance with SCAQMD Rule 1113.
 - 4. Concrete Floor Finishes: Maximum volatile organic compound content in accordance with SCAQMD Rule 1113, including sealers and stains.

2.3 COMPONENTS

- A. Coatings: Ready mixed, except field catalyzed coatings. Prepare coatings:
 - 1. To soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.

2. For good flow and brushing properties.
 3. Capable of drying or curing free of streaks or sags.
- B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve finishes specified; commercial quality.
- C. Patching Materials: Latex filler.
- D. Fastener Head Cover Materials: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify surfaces and substrate conditions are ready to receive Work as instructed by product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application.
- C. Test shop applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
1. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
 2. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
 3. Concrete Floors: 8 percent.

3.2 PREPARATION

- A. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Surfaces: Correct defects and clean surfaces capable of affecting work of this section.
- C. Marks: Seal with shellac those which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- F. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials. Apply compatible sealer or primer.
- G. Concrete Floors: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- H. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

- I. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- J. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- K. Exterior Siding to Receive Paint Finish: Remove dust, grit, and foreign matter. Fill nail holes with tinted exterior paintable caulking compound after prime coat has been applied.
- L. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.
- M. Metal Doors Scheduled for Painting: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

- A. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- B. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.
- C. Sand wood and metal surfaces lightly between coats to achieve required finish.
- D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- E. Where clear finishes are required, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.
- F. Prime concealed surfaces of interior and exterior woodwork with primer paint.

3.4 FIELD QUALITY CONTROL

- A. Inspect and test questionable coated areas.

3.5 CLEANING

- A. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.
- B. Steel – Existing
 - 1. Remove all contaminants from steel surfaces to be prepared and coated in accordance with SSPC-SP1 “solvent cleaning” by high pressure detergent wash followed by thorough rinsing with clean potable water. Allow all precleaned surfaces to dry prior to surface preparation.

3.6 SCHEDULE - EXTERIOR SURFACES

- A. Steel – Existing:

1. Power tool clean to bare metal in accordance with SSPC-SP11 to create a minimum 1 mil anchor profile.
 2. Prime and intermediate coat with Carbomastic 15 (high solids, two component epoxy mastic), applied at 5-7 mils dry film thickness per coat.
 3. Finish coat shall be Carbothane 134 VOC (high solids; two component aliphatic polyurethane), applied at 2-5 mils dry film thickness.
- B. Steel - Shop Primed:
1. Touch-up with zinc rich primer.
 2. Two coats of Series 1074 Endura-Shield (Aliphatic Acrylic Polyurethane Enamel).
- C. PVC:
1. Two coats of Series 1074 Endura-Shield (Aliphatic Acrylic Polyurethane Enamel).
- D. Ductile Iron Pipe (above-grade and in vaults):
1. Factory-applied fusion bonded epoxy
 2. Two coats of Series 1074 Endura-Shield (Aliphatic Acrylic Polyurethane Enamel).

3.7 SCHEDULE - INTERIOR SURFACES

- A. Steel - Primed:
1. Touch-up with zinc rich primer, Series 90-97 Tneme-Zinc (Zinc-Rich Urethane)
 2. Two coats of Series N69 Epoxoline (Polyamidoamine Epoxy).
- B. Concrete Masonry Unit:
1. Two coats of Series N69 Epoxoline (Polyamidoamine Epoxy).
- C. Gypsum Wall Board:
1. One coat of primer sealer
 2. Two coats of Latex Paint

3.8 SCHEDULE - COLORS

- A. Steel – Existing
1. To be selected by Owner.
- B. Exterior Siding, trim, soffit, fascia:
1. To be selected by Owner.
- C. Interior walls, ceiling, trim, and concrete floor:
- To be selected by Owner.

END OF SECTION

SECTION 22 45 00

EMERGENCY PLUMBING FIXTURES

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. This section includes the furnishing and installing of an emergency eye wash with all the required appurtenances.
- B. The Contractor shall provide all labor, equipment, materials, tools, incidentals, and supervision to construct and emergency eyewash unit, including but not limited to, the basic unit, piping and attachments, valves, and tests required to furnish complete and operable emergency eyewash system.

1.2 REFERENCED STANDARDS

- A. American National Standards Institute (ANSI)
 - 1. ANSI Z358.1: Standard for Plumbed and Portable Eyewash Stations

1.3 DEFINITIONS

- A. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- B. Tepid: 60 °F to 100 °F

1.4 SUBMITTALS

- A. The Contractor shall take field measurements prior to preparation of submittals and Shop Drawings and fabrication where required, to ensure proper fitting of the work.
- B. Submittals shall conform to the requirements of Section 01 33 00–Submittal Procedures.
- C. Product Data: Including flow rates and capacities, furnished specialties, and accessories.
- D. Dimensional Drawings: including mounting heights and required clearances.
- E. Parts List.
- F. Manufacturer's Installation requirements.
- G. Manufacturer's Operations and Maintenance information.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 PRODUCT

2.1 PERFORMANCE REQUIREMENTS

- A. ISEA Standard: Comply with ANSI Z358.1:
 - 1. All equipment should include safety coloring as per ANSI Z358.1 specifications for all safety shower and eyewash equipment.
- B. Eye wash and face wash units shall provide an inverted directional flow in accordance with standard medical protocols and emergency response guidelines for flushing eyes.
- C. Provide dual head delivery with controlled flow to both eyes simultaneously at a velocity that is non-injurious and a minimum recommended flow pressure of 30 psi.

2.2 THERMOSTATIC MIXING VALVE

- A. General: Valve controls outlet temperature over wide flow range and is suitable for eyewash applications. Valve includes temperature adjustment, integral strainer, and check stops.
- B. Inlet Water temperature: Maximum 180 °F.
- C. Tempered-Water Setting: Factory preset, 85 °F.
- D. Temperature Range: 60 to 100 °F.
- E. Inlets: ½-inch NPT.
- F. Outlets: ½-inch NPT.
- G. Manufacturers:
 - 1. Bradley.
 - 2. Acorn Safety.
 - 3. Haws Corporation.
 - 4. Guardian Equipment Co.
 - 5. Approved Equivalent.

2.3 EYE WASH EQUIPMENT

- A. Standard, Wall-Mounted, Plumbed Eye Wash Units:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation, Model S19224EW or comparable product by one of the following manufacturers:
 - a. Bradley Corporation.
 - b. Acorn Safety.
 - c. Haws Corporation.
 - d. Encon Safety Products.
 - e. Guardian Equipment Co.
 - f. Speakman Company
 - 2. Capacity: Not less than 0.4 gpm for at least 15 minutes.

3. Supply Piping: NPT ½ chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
4. Control-Valve Actuator: Paddle.
5. Spray-Head Assembly: Dual spray head.
6. Receptor: Plastic.
7. Mounting: Wall bracket.
8. Provide thermostatic mixing valve meeting ANSI Z358.1.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF EMERGENCY PLUMBING FIXTURE

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.
- D. Install shutoff valves in water-supply piping to fixtures, to facilitate maintenance of the equipment. Use ball or gate valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation.
- E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals.
- F. Install escutcheons on piping wall penetrations in exposed, finished locations.

3.3 CONNECTIONS

- A. Connect tepid water supply to the on-demand heater supplied with the onsite mixed oxidant generation system.
- B. Connect hot water supply to emergency fixture with a thermostatic mixing valve to ensure that tepid water is provided.
- C. Connect thermostatic mixing valve to cold potable water supply.
- D. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION

- A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Section 40 05 53—Identification for Process Piping, Water and Wastewater Equipment.

3.5 FIELD QUALITY CONTROL

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leak exists.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning equipment.
- C. Emergency plumbing fixtures will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust or replace fixture flow regulators for proper flow.
- B. Adjust equipment temperature settings to ensure tepid water supply is at a minimum of the temperature stated in paragraph 1.3.B above.

END OF SECTION

SECTION 26 05 00

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes equipment grounding conductors; bonding methods and materials; conduit and equipment supports; anchors and fasteners; nameplates and labels; and wire markers.

1.2 REFERENCES

- A. NECA (National Electrical Contractors Association) – Standard of Installation.
- B. NETA ATS (International Electrical Testing Association) – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. IEEE 142 (Institute of Electrical and Electronics Engineers) - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- D. NFPA 70 - National Electrical Code (NEC).
- E. ASTM B 8 - Specifications for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- F. ASTM B 187 - Specifications for Copper Bus, Rod, and Shapes.
- G. UL 83 - Thermoplastic-Insulated Wires and Cables.
- H. UL 467 - Electrical Grounding and Bonding Equipment.

1.3 SYSTEM DESCRIPTION

- A. Anchor and fasten electrical products to building elements and finishes as follows:
 - 1. Concrete Structural Elements: Provide preset inserts.
 - 2. Concrete Surfaces: Provide expansion anchors.
 - 3. Solid Masonry Walls: Use expansion anchors and preset inserts.
- B. Identify electrical components as follows:
 - 1. Nameplate for each electrical distribution and control equipment enclosure.
 - 2. Label for identification of individual wall switches and receptacles, control device stations, and equipment.
 - 3. Wire marker for each conductor at panelboard gutters; pull boxes; and each load connection.

1.4 DESIGN REQUIREMENTS

- A. Furnish products listed and classified by Underwriters Laboratories, Inc. (UL), Electrical Testing Laboratories, Inc. (ETL), or other recognized, acceptable testing and listing agencies as suitable for purpose specified and shown.

- B. Grounding shall be in accordance with the National Electrical Code (NEC). Where size, type, rating and quantities indicated or specified are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
- C. Select materials, sizes, and types of anchors, fasteners, and supports to carry loads of equipment and raceway, including weight of wire and cable in raceway.

1.5 SUBMITTALS

- A. Submit all product data, shop drawings, laboratory test results, material source information, and certificates of compliance listed in this Section under a single submittal cover for review. Incomplete submittals will not be reviewed.
- B. Product Data: Submit grounding electrodes and connections for fastening components and nameplates, labels, and markers.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and grounding electrodes.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- B. Installer: A firm with at least five years of successful installation experience on projects with electrical grounding work similar to that required for this project.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 GROUNDING SYSTEM

- A. Except as otherwise indicated, provide for each electrical ground indicated, an assembly of materials, including, but not necessarily limited to, cable/wire, connectors, terminals (solderless lugs), bonding jumper braid, and other items and accessories needed for a complete installation. Where more than one type meets indicated requirements, selection is Contractor's option. Where materials or components are not otherwise indicated, provide products as recommended by the accessories manufacturers and in compliance with the NEC, and established industry standards.
- B. All grounding materials required shall be furnished new and undamaged in accordance with the following requirements:

2.2 WIRE

- A. Electrical Equipment Grounding Conductor: Insulated, soft-drawn copper, Class B stranding or solid, with green-colored polyvinyl chloride insulation, UL 83, sized according to the NEC, unless otherwise noted.

2.3 MECHANICAL CONNECTORS

- A. Description: Bolt-on bronze connectors, suitable for grounding and bonding applications in configurations required for the particular installation.

2.4 ANCHORS AND FASTENERS

- A. Materials and Finishes: Corrosion resistant.

2.5 FORMED STEEL CHANNEL

- A. Description: Galvanized steel.

2.6 NAMEPLATES AND LABELS

- A. Nameplates: Engraved three-layer laminated plastic, white letters on black background.
- B. Letter Size:
 - 1. 1/8-inch (3 mm) letters for identifying individual equipment and loads.
 - 2. 1/4-inch (6 mm) letters for identifying grouped equipment and loads.
- C. Labels: Embossed adhesive tape, with 3/16-inch white letters on black background.

2.7 WIRE MARKERS

- A. Description: Cloth tape, split sleeve, or tubing-type wire markers.
- B. Legend:
 - 1. Power Circuits: Branch circuit or feeder number as indicated on Drawings.
 - 2. Control Circuits: Control wire number as indicated on shop drawings.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Perform work on energized equipment or circuits with experienced and trained personnel.
- B. Remove, relocate, and extend existing installations to accommodate new construction.

3.2 GROUNDING AND BONDING INSTALLATION:

- A. Installation:
 - 1. Remove paint, rust, mill-oils, and surface contaminants at connection points.
 - 2. Bond together each metallic raceway, pipe, duct and other metal object entering enclosures and exiting slabs. Install minimum # 12 AWG bare copper conductor.
 - 3. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
 - 4. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panel boards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
 - 5. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.3 GROUND CONDUCTORS

- A. Grounding conductors shall be located and connected as indicated on drawings.
- B. Exposed conductors shall be installed inconspicuously in vertical or horizontal positions on supporting structures. When located on irregular supporting surfaces or equipment, the conductors shall run parallel to or normal to dominant surfaces.
- C. Conductors routed over concrete, steel, or equipment surfaces shall be kept in close contact with those surfaces by using fasteners located at intervals not to exceed 3 feet.
- D. Provide a separate equipment-grounding conductor for low voltage distribution systems, single or three phase feeder circuit and each branch circuit with single or three phase protective devices. Install a grounding conductor in conduit with phase and neutral conductors. Single-phase branch circuits for 120 and 277 volt lighting, receptacles, and motors shall have a phase, neutral, and ground conductors installed in the common conduit. Provide suitable bonding jumpers and approved grounding type bushings for flexible conduits used for equipment connection utilized in conjunction with the above branch circuits with. Single-phase circuits for equipment and all branch circuits installed in non-metallic or flexible conduits shall be provided with a separate grounding conductor.

3.4 CONDUIT GROUNDING

- A. All grounding bushings within all enclosures, including equipment enclosures, shall be wired together and connected internally to the enclosure grounding lug or grounding bus with a bare copper conductor. Grounding bushings shall be grounded with conductors sized in accordance with NEC, but not smaller than #8 AWG.

3.5 EQUIPMENT GROUNDING

- A. Comply with NEC 250, except where larger sizes or more conductors are indicated.
 - 1. All electrical equipment shall be connected to the grounding system with an insulated, green, stranded or solid copper equipment-grounding conductor.
 - 2. Terminate each end on suitable lug, bus, or bushing. The term "electrical equipment", as used in this article, shall include, but not be limited to, all enclosures containing electrical connections or bare conductors, except that individual devices, such as solenoids, pressure switches, and limit switches, shall be exempt from this requirement, unless the device requires grounding for proper operation.
 - 3. Most other equipment will be furnished with grounding pads and/or grounding lugs which shall be connected to the grounding system. All ground connection surfaces shall be cleaned immediately prior to connection.
 - 4. Contractor shall furnish all grounding material required, but not furnished with the equipment.
- B. Install equipment grounding system such that all metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items in close proximity with electrical circuits will operate continuously at ground potential and provide a low impedance path for possible ground fault currents. The system shall comply with the NEC, Table 250-95.
- C. Where grounding system extension stingers are indicated on the drawings to be provided for connection to electrical equipment, connect the bare grounding conductor to the equipment ground bus, pad, or lug. Except where otherwise indicated on the drawings, all equipment ground conductors that are not an integral part of a cable assembly, shall be sized in

accordance with the requirements of NEC. All ground conductors installed in metallic conduit shall be insulated.

- D. Suitable grounding facilities, acceptable to the Engineer, shall be furnished on electrical equipment not so equipped. The grounding facilities shall consist of compression type terminal connectors bolted to the equipment frame or enclosure and providing a minimum of joint resistance.

3.6 ANCHORS, FASTENERS AND SUPPORT

- A. Installation:
 - 1. Locate and install anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
 - 2. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
 - 3. Do not use spring steel clips and clamps.
 - 4. Do not use powder-actuated anchors.
 - 5. Do not drill or cut structural members.
- B. Supports:
 - 1. Fabricate supports from structural steel or formed steel members. Rigidly weld members or install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 - 2. Install surface-mounted cabinets and panel board with minimum of four anchors.
 - 3. In wet and damp locations use steel channel supports to stand cabinets and panel boards 1-inch off wall.

3.7 IDENTIFICATION OF COMPONENTS

- A. Installation:
 - 1. Degrease and clean surfaces to receive nameplates and labels.
 - 2. Install nameplate and label parallel to equipment lines.
 - 3. Secure nameplate to equipment front using screws, rivets or adhesive.

3.8 ACCEPTANCE TESTING

- A. Grounding and Bonding: Perform inspections and tests in accordance with NETA ATS.

END OF SECTION

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SECTION 26 05 19

WIRE AND CABLE

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes building 600 volt wire and cable, instrumentation cable, control cable, wiring connectors and connections.

1.2 REFERENCES

- A. NECA (National Electrical Contractors Association) - Standard of Installation.
- B. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. ANSI/NFPA 70 - National Electrical Code

1.3 DESCRIPTION OF WORK

- A. The requirements of this section apply to cable and wires specified on the drawings and in these specifications. The extent of electrical wire and cable work is indicated on drawings and schedules, and by the requirements of this section. The applications for cable, wire and connectors required, but not limited to, are as follows:
 - 1. Power distribution circuitry.
 - 2. Lighting circuitry.
 - 3. Equipment circuitry.
 - 4. Wiring for motors of mechanical equipment.
- B. Conductor sizes are based on copper. Wire and cable routing shown on drawings is diagrammatic unless dimensioned. Route wire and cable as required for project conditions. Support raceway and cables in accordance with other sections of these specifications.

1.4 REGULATORY REQUIREMENTS

- A. Furnish products listed and classified by Underwriters Laboratories, Inc. (UL), Electrical Testing Laboratories, Inc. (ETL), or other recognized, acceptable testing and listing agencies as suitable for the purpose specified and shown.

1.5 SUBMITTALS

- A. Submit all product data, shop drawings, laboratory test results, material source information, and certificates of compliance listed in this Section under a single submittal cover for review. Incomplete submittals will not be reviewed.
- B. Product Data: Submit manufacturer's catalog cuts and technical data for building wire and cables.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and circuits.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years' experience.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements as indicated on drawings.

1.9 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
- B. Wire and cable routing indicated is approximate unless dimensioned. Include wire and cable lengths within 10 feet of length shown.

PART 2 PRODUCTS

2.1 BUILDING WIRE AND CABLE

- A. Building wire and cable shall be insulated, single conductor, copper, stranded, rated for 600-volts AC. The insulation shall be thermoplastic material rated for 90 degrees Celsius dry locations, 75 degrees Celsius wet locations, THHN/THWN, RHW or XHHW, per ANSI/NFPA 70.
- B. For Interior Dry Location: Use only building wire, THHN/THWN insulation, in raceway.
- C. For Exterior Wet or Dry Locations: Use only building wire, THHN/THWN insulation, in raceway.
- D. For Underground Dry or Wet Locations: Use only RHW or XHHW insulation in raceway.

2.2 INSTRUMENTATION CABLE

- A. Instrumentation cables for field mounted equipment and devices shall be minimum two (2) conductor No. 16 AWG, tin-coated copper, stranded, shielded twisted pair, 80 degree Celsius, PVC insulation foil shield with overall heavy duty polyethylene jacketing, rated for 600-volt AC, Belden No. 9342, General Cable No. C2536, or approved equal.
- B. Control cables to field mounted equipment and devices shall be a single conductor, insulated, No. 14 AWG minimum, copper, solid or stranded, rated for 600-volts AC. The insulation shall be thermoplastic material rated for 90 degrees Celsius dry locations, 75 degrees Celsius wet locations, THHN/THWN or XHHW, per ANSI/NFPA 70 and compliant with UL 83.
- C. Multi-conductor control cables for field mounted equipment and devices shall consist of several single conductor, insulated No. 14 AWG minimum, copper, solid or stranded, rated for 600-volts AC with an overall protective PVC jacket. The insulation shall be thermoplastic material rated for 90 degrees Celsius dry locations, 75 degrees Celsius wet locations, THHN/THWN or XHHW, per ANSI/NFPA 70 and compliant with UL 83. Circuit identification shall consist of Method 1 - color coding in accordance with ICEA S-66-524, Appendix K Table K-2.

- D. Instrumentation and control cable connected to equipment or devices within control panels shall be sized per requirements of equipment manufacturer (minimum #16 AWG).

2.3 WIRE COLOR CODE

- A. Color-code all conductors:
1. Wire sizes 10 AWG and smaller shall have integral color-coded insulation.
 2. Wire sizes 8 AWG and larger may have black insulation but shall be identified by color-coded electrical tape at all junction, splice, pull, or termination points.
 3. Color tape shall be applied to at least 3-inches of the conductor at the termination ends and in junction or pull boxes or where readily accessible.
 4. Conductors for all systems shall not change color at splice points.
 5. Where there are two or more neutrals in one conduit, each shall be individually identified with the proper circuit.
 6. Each phase shall be uniquely color-coded.
 7. Color-code wires as indicated below:

<u>120/240-Volts</u>	<u>120/208-Volts</u>	<u>277/480-Volts</u>
Phase: a – black	a - black	a – brown
b – red	b - red	b - orange
n – white	c - blue	c - yellow
g – green	n - white	n - white, or gray
	g - green	g – green

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that mechanical work likely to damage wire and cable has been completed.
- B. Verify that raceway installation is complete and supported.

3.2 PREPARATION

- A. Completely and thoroughly clean and swab raceway before installing wire.

3.3 EXISTING WORK

- A. Extend existing circuits using materials and methods and compatible with existing electrical installations, or as otherwise specified.
- B. Remove all unused and abandoned signal and control wiring from end to end.

3.4 INSTALLATION

- A. General:
1. Install wire and cable in accordance with manufacturer's instructions and NECA "Standard of Installation".
 2. Route wire and cable as required for project conditions.
 3. Identify and color code wire and cable. Identify each conductor with its circuit number or other designation indicated.
 4. Protect exposed cable from damage.
 5. Pull all conductors into raceway at same time.

6. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
7. Support cables above accessible ceiling using standard support methods to support cables from structure. Do not rest cable on ceiling panels.
8. Neatly train and lace wiring inside boxes, equipment, and panelboards

B. Cable and Wire Size:

1. Use conductor not smaller than 12 AWG for power and lighting circuits.
2. Use conductor not smaller than 14 AWG for control circuits.
3. Use 10 AWG conductors for 20 ampere, 120-volt branch circuits longer than 75 feet.
4. Use 10 AWG conductors for 20 ampere, 277-volt branch circuits longer than 200 feet.
5. Use stranded conductor for all equipment, branch and control circuits.

C. Special Techniques - Wiring Connections:

1. Clean conductor surfaces before installing lugs and connectors. Where an anti-oxidation lubricant is used, apply liberally, coating all exposed conductor surfaces.
2. Use suitable cable fittings and connectors.
3. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
4. Tape un-insulated conductors and connector with two layers of half-lapped rubber insulating compound tape and two layers of half-lapped, 7-mil electrical tape, Scotch 33+, or equal.
5. Use split bolt connectors for copper conductor splices and taps, 8 AWG and larger.
6. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
7. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
8. Stranded conductors for control circuits shall have fork or ring terminals crimped on for all device terminations. Bare stranded conductors shall not be placed directly under the screws.

3.5 FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection:

1. Inspect wire and cable for physical damage and proper connection.
2. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
3. Verify continuity of each branch circuit conductor.
4. Inspect compression-applied connectors for correct cable match and indentation.

B. Electrical Testing and Verification:

1. All 600 volt conductors 8 AWG and larger, shall be verified by use of a 500-volt meg-ohm-meter.
2. Perform continuity test to insure correct cable connection.
3. Correct malfunctions and/or deficiencies immediately as detected at no additional cost to the owner, including additional verification testing.
4. Compile test report results and submit for approval
5. Subsequent to final wire and cable terminations, energize all circuitry and demonstrate functional adequacy in accordance with system requirements.

C. Test Values

1. Compare bolted connection resistance to values of similar connections.
2. Bolt-torque levels should be in accordance with NETA ATS Table 10.12 unless otherwise specified by the manufacturer.
3. Minimum insulation-resistance values should not be less than 50 meg-ohms.
4. Investigate deviations between adjacent phases.

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes grounding electrodes and conductors; equipment grounding fasteners; sealing and fireproofing of sleeves and openings between conduits and wall.

1.2 REFERENCES, SPECIFICATIONS, CODES AND STANDARDS

- A. The standards referred to, except as modified in the Contract Documents, shall have full force and effect as though printed in these Specifications. These standards are not furnished to the Contractor since manufacturers and trades involved are assumed to be familiar with their requirements. The CONTRACTOR shall obtain copies of reference standards direct from publication sources as needed for proper performance and completion of the work.
- B. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- C. NECA - Standard of Installation.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- E. NFPA 70 - National Electrical Code (NEC). Latest edition.
- F. UL 467 - Electrical Grounding and Bonding Equipment.

1.3 SYSTEM DESCRIPTION

- A. Grounding electrode system consists of the following elements:
 - 1. Metal underground water pipe
 - 2. Metal frame of the building
 - 3. Concrete encased electrode
 - 4. Rod electrodes
 - 5. Service equipment
 - 6. Enclosures
 - 7. Separately derived systems.
- B. Anchor and fasten electrical products to building elements and finishes as follows:
 - 1. Concrete Structural Elements: Provide preset inserts.
 - 2. Concrete Surfaces: Provide expansion anchors.
 - 3. Interior Structural Steel: Provide appropriate size beam clamps.
 - 4. Solid Masonry Walls: Use expansion anchors and preset inserts.
 - 5. Sheet Metal: Provide sheet metal screws.

1.4 DESIGN REQUIREMENTS

- A. Furnish products listed and classified by Underwriters Laboratories, Inc. (UL), Electrical Testing Laboratories, Inc. (ETL), or other recognized, acceptable testing and listing agencies as suitable for purpose specified and shown.
- B. Grounding shall be in accordance with the National Electrical Code (NEC). Where size, type, rating and quantities indicated or specified are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
- C. Select materials, sizes, and types of anchors, fasteners, and supports to carry at least twice the loads of equipment and raceway, including weight of wire and cable in raceway.

1.5 CONTRACTOR'S SUBMITTALS

- A. Product Data: Submit grounding electrodes and connections for fastening components.
- B. Test Report: Measure overall resistance to ground. Provide certified test report for ENGINEER's Review.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and grounding electrodes.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- B. Installer: A firm with at least five years of successful installation experience on projects with electrical grounding work similar to that required for this project.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 GROUNDING SYSTEM

- A. Except as otherwise indicated, provide for each electrical grounding indicated, an assembly of materials, including, but not necessarily limited to, cable/wire, connectors, terminals (solderless lugs), grounding rods/electrodes, bonding jumper braid, and other items and accessories needed for a complete installation. Where more than one type meets indicated requirements, selection is Installer's option. Where materials or components are not otherwise indicated, provide products as recommended by the accessories manufacturers and in compliance with the NEC, and established industry standards.

- B. All grounding materials required shall be furnished new and undamaged in accordance with the following requirements:

2.2 WIRE

- A. Service Equipment Grounding Electrode Conductor: Bare, soft-drawn copper, Class AA stranding, ASTM B 8. Size per the NEC, Article 250, unless otherwise noted.
- B. Electrical Equipment Grounding Conductor: Insulated, soft-drawn copper, Class B stranding or solid, with green-colored polyvinyl chloride insulation, UL 83, sized according to the NEC, unless otherwise noted.

2.3 MECHANICAL CONNECTORS

- A. Description: Bolt-on bronze connectors, suitable for grounding and bonding applications in configurations required for the particular installation.
- B. Manufacturer
 1. Burndy Corp.
 2. Anderson
 3. Thomas & Betts
 4. 3-M Co.

2.4 BONDING PLATES, CONNECTIONS, TERMINALS AND CLAMPS

- A. Provide electrical bonding plates, connectors, terminals and clamps, and all accessories as recommended by bonding plate, connector, terminal and clamp manufacturer for indicated applications to obtain a complete system. Components shall be high-strength, high-conductivity copper alloy.

2.5 UFER GROUND

- A. In accordance with the latest edition of the National Electrical Code.

2.6 ROD ELECTRODES

- A. Material: Copper
- B. Diameter: 5/8-inch (16 mm)
- C. Length: 10 feet (3,000 mm)

2.7 GROUNDING WELL COMPONENTS

- A. Well Pipe: 8 inches NPS (DN200) by maximum 12 inches (300-mm) long, concrete or fiberglass pipe with belled end.
- B. Well Cover: Cast iron with legend "GROUND" embossed on cover.

2.8 ANCHORS AND FASTENERS

- A. Materials and Finishes: Corrosion resistant, Heavy-duty expansion type.

2.9 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Unistrut
 - 2. Kindorf
 - 3. Superstrut
 - 4. B-Line
 - 5. Approved Equal
- B. Description: Galvanized steel.

2.10 SEALING AND FIREPROOFING

- A. Fire and Smoke Rated Surfaces:
 - 1. Manufacturers:
 - a. 3M CP 25WB + Caulk
 - b. 3M FS 195 wrap or strip with restricting collar
 - c. 3M CS 195 composite sheets
 - d. Proset Systems fire rated floor and wall penetrations
 - e. Dow Corning Fire Stop System
 - f. Substitutions: Not permitted.
 - 2. Non-Rated Surfaces:
 - a. Use stamped steel, chrome plated, hinged, split ring escutcheons or floor/ceiling plates for covering openings in occupied areas where conduit is exposed.
 - b. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the conduit and the cored opening or a water-stop type wall sleeve.
 - c. At interior wall or floor openings use Tremco Fyre-Sil, Sika Corp. Sikaflex Ia, Sonneborn Sonolastic NPT, or Mameco Vulkem 116 urethane caulk or approved equal.
 - 3. General:
 - a. Furnish UL listed products or products tested by an independent testing laboratory.
 - b. Select products with rating not less than rating of wall or floor being penetrated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that final backfill and compaction have been completed before driving rod electrodes.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.

3.2 GROUNDING AND BONDING INSTALLATION

- A. Installation:
1. Remove paint, rust, mill-oils, and surface contaminants at connection points.
 2. Install grounding electrode conductor and connect to reinforcing steel in slab or foundation.
 3. Bond together metal siding not attached to grounded structure; bond to ground.
 4. Bond together reinforcing steel and metal accessories.
 5. Bond together each metallic raceway, pipe, duct and other metal object entering enclosures and exiting slabs. Install minimum # 12 AWG bare copper conductor.
 6. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
 7. Connect to site grounding system.
 8. Permanently ground power system in accordance with NEC, including service equipment, distribution panels, lighting panel boards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
 9. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panel boards with installed # 12 AWG conductor to grounding bus.
 10. Ground electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.
 11. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.3 GROUND CONDUCTORS

- A. Grounding conductors shall be located and connected as indicated on drawings.
- B. Ground conductors under buildings or structures shall be buried with at least 6 inches of earth cover. Buried grounding conductors extending beyond the foundations of buildings or structures shall have at least 18 inches of earth cover.
- C. Exposed conductors shall be installed inconspicuously in vertical or horizontal positions on supporting structures. When located on irregular supporting surfaces or equipment, the conductors shall run parallel to or normal to dominant surfaces.
- D. Conductors routed over concrete, steel, or equipment surfaces shall be kept in close contact with those surfaces by using fasteners located at intervals not to exceed 3 feet.
- E. Provide a separate equipment-grounding conductor for low voltage distribution systems, single or three phase feeder circuit and each branch circuit with single or three phase protective devices. Install a grounding conductor in conduit with phase and neutral conductors. Single-phase branch circuits for 120 and 277 volt lighting, receptacles, and motors shall have a phase, neutral, and ground conductors installed in the common conduit. Provide suitable bonding jumpers and approved grounding type bushings for flexible conduits used for equipment connection utilized in conjunction with the above branch circuits with. Single-phase circuits for equipment and all branch circuits installed in non-metallic or flexible conduits shall be provided with a separate grounding conductor.

- F. Ground the neutral of transformers of separately derived systems with a bare copper conductor, installed in conduit, from the neutral directly to the building interior cold water pipe or nearest solidly grounded structural reinforcing steel, in accordance with the provisions of NEC Article 250-24. Use bolted accessible connections to the ground system so that the neutral ground can be disconnected for test. Ground the system ground conduit as detailed on drawing. Size the grounding electrode conductors in accordance with the NEC, Table 250-66, or as indicated.

3.4 CONNECTIONS

- A. All connections shall be made by the exothermic welding process, except where otherwise indicated on the drawings or in these specifications. The manufacturer's instructions on the use of exothermic welding materials shall be followed in all details. All surfaces to be joined by the welds shall be thoroughly cleaned. Paint, scale, and other deleterious substances shall be removed from surfaces of ungalvanized structural steel members by grinding. Galvanized steel surfaces shall be cleaned with emery paper. Powder and molds shall be kept dry and warm until used. Worn or damaged molds shall not be used.
- B. All exothermic welded connections shall successfully resist moderate hammer blows. Any connection which fails such test or which, upon inspection, indicates a porous or deformed weld shall be remade.
- C. All exothermic welds shall encompass 100 percent of the ends of the materials being welded. Welds, which do not meet this requirement, shall be remade.
- D. Worn, damaged, incorrectly sized, or improperly shaped molds which, in the opinion of the ENGINEER, do not make satisfactory welds, shall be removed from the jobsite after being physically rendered inoperable.
- E. All contact surfaces of bolted and screwed connections shall be thoroughly cleaned and coated with oxide inhibitor before being securely tightened.

3.5 CONDUIT GROUNDING

- A. All grounding bushings within all enclosures, including equipment enclosures, shall be wired together and connected internally to the enclosure grounding lug or grounding bus with a bare copper conductor. Grounding bushings shall be grounded with conductors sized in accordance with NEC, but not smaller than #8 AWG.

3.6 EQUIPMENT GROUNDING

- A. Comply with NEC 250, except where larger sizes or more conductors are indicated.
 - 1. All electrical equipment shall be connected to the grounding system with an insulated, green, stranded or solid copper equipment-grounding conductor.
 - 2. Terminate each end on suitable lug, bus, or bushing. The term "electrical equipment", as used in this article, shall include, but not be limited to, all enclosures containing electrical connections or bare conductors, except that individual devices, such as solenoids, pressure switches, and limit switches, shall be exempt from this requirement, unless the device requires grounding for proper operation.
 - 3. Large equipment, such as metal-clad or metal-enclosed switchgear, will be furnished with a grounding bus that shall be connected to the grounding system.

4. Most other equipment will be furnished with grounding pads and/or grounding lugs which shall be connected to the grounding system. All ground connection surfaces shall be cleaned immediately prior to connection.
 5. CONTRACTOR shall furnish all grounding material required, but not furnished with the equipment.
- B. Install equipment grounding system such that all metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items in close proximity with electrical circuits will operate continuously at ground potential and provide a low impedance path for possible ground fault currents.
- C. Where grounding system extension stingers are indicated on the drawings to be provided for connection to electrical equipment, the CONTRACTOR shall connect the bare grounding conductor to the equipment ground bus, pad, or lug. Except where otherwise indicated on the drawings, all equipment ground conductors that are not an integral part of a cable assembly, shall be sized in accordance with the requirements of NEC. All ground conductors installed in conduit shall be insulated.
- D. Suitable grounding facilities, acceptable to the ENGINEER, shall be furnished on electrical equipment not so equipped. The grounding facilities shall consist of compression type terminal connectors bolted to the equipment frame or enclosure and providing a minimum of joint resistance.
- E. The conduit system is not considered to be a grounding conductor, except for lighting fixtures. No grounding conductor shall be smaller in size than # 12 AWG, unless it is a part of an acceptable cable assembly.

3.7 GROUND SYSTEM RESISTANCE

- A. All ground resistance measurements shall be made with a three-terminal "Megger" type ground tester which applies alternating current to the electrodes and which gives a reading in direct current ohms. Two reference ground probes shall be used, and all tests shall be made in accordance with the instrument manufacturer's instructions for ground resistance testing. Some of the acceptable instruments are as follows:
1. Megger Null Balance Earth Tester, James G. Biddle and Company.
 2. Vibroground, Associated Research, Inc.
 3. Ground-Ohmer, Herman H. Sticht Co., Inc.
- B. Submit final certified test reports of all grounding tests.

3.8 ANCHORS, FASTENERS AND SUPPORT

- A. Installation:
1. Locate and install anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
 2. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
 3. Do not use spring steel clips and clamps.
 4. Do not use powder-actuated anchors.
 5. Do not drill or cut structural members.
- B. Supports:

1. Fabricate supports from structural steel or formed steel members. Rigidly weld members or install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
2. Install surface-mounted cabinets and panel board with minimum of four anchors.
3. In wet and damp locations use steel channel supports to stand cabinets and panel boards 1 inch off wall.
4. Use sheet metal channel to bridge studs above and below cabinets and panel boards recessed in hollow partitions.

3.9 SEALING AND FIREPROOFING

A. Fire-Rated Surface:

1. Seal opening at floor and wall as follows:
 - a. Opening through a fire rated wall, floor, ceiling or roof, must be sealed.
 - b. Install galvanized sheet metal sleeves (minimum 12-gage) through opening and extending beyond minimum of 1 inch on each side of building element.
 - c. Size sleeve allowing minimum of 1-inch void between sleeve and building element.
 - d. Pack void with backing material.
 - e. Seal ends of sleeve with UL listed fire-resistive silicone compound to meet fire rating of structure penetrated.
2. Where conduit penetrates fire-rated surface, install fire-stopping product in accordance with manufacturer's published instructions.

B. Non-Rated Surfaces:

1. Opening through a non-fire rated wall, floor, ceiling or roof must be sealed using an approved type of material.
2. Use galvanized sheet metal sleeves in hollow wall penetrations to provide a backing for the sealant. Grout area around sleeve in masonry construction.
3. Install escutcheons or floor/ceiling plates where raceway, penetrates non-fire rated surfaces in occupied spaces.
4. Install rubber links of mechanical seal tighten in place and sized for the pipe, in exterior wall openings below grade, in accordance with the manufacturer's instructions.
5. All pipe penetrations at interior partitions and/or walls, laboratory spaces, telephone, data and communication rooms and similar spaces where the room pressure or odor transmission must be controlled, shall be sealed. Sealant shall be applied to both sides of the penetration in such a manner that the annular space between the pipe sleeve and the pipe is completely filled.

3.10 ACCEPTANCE TESTING

A. Grounding and Bonding: Perform inspections and tests as outlined below (NETA ATS, Section 7.13 – Grounding Systems).

1. Visual and Mechanical Inspection
 - a. Inspect ground system for compliance with drawings and specifications.
 - b. Electrical Tests (Small Systems)
 - 1) Perform ground-impedance measurements utilizing the fall-of-potential method per ANSI/IEEE Standard 81 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potential of a Ground System." Instrumentation utilized shall be as defined in section 12 of the above guide and shall be specifically designed for ground impedance testing. Provide sufficient spacing so that the plotted curves flatten in the 62% area of the distance between the item under test and the current electrode.

- c. Electrical Tests (Large Systems)
 - 1) When sufficient spacing of electrodes per Electrical Tests (Small Systems) is impractical, perform ground impedance measurements utilizing either the intersecting curves method or the slope method. (Ref. Nos. 40 and 41 in IEEE Std. 81).
- d. Equipment Grounds
 - 1) Utilize two-point method of IEEE Std. 81. Measure between equipment ground being tested and known low-impedance grounding electrode or system.
- 2. Test Values
 - a. The main ground electrode system impedance-to-ground shall be no greater than five (5) ohms for commercial or industrial systems and one (1) ohm or less for generating stations, transmission stations, and large industrial systems. Equipment grounds, depending on size and length of grounding conductor, should be only fractionally higher than system ground.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.

1.2 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 2. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Threaded steel.

PART 3 EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be **1/4 inch** in diameter.
- C. Multiple Raceways: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- C. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes conduit and tubing, surface and buried raceways, wireways, outlet boxes, pull boxes, junction boxes, hand holes and concrete manholes.

1.2 REFERENCES - CODES AND STANDARDS

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. ASTM A 48 - Standard Specification for Grey Iron Castings.
- C. NECA - Standard of Installation.
- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- E. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- F. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit.
- G. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- H. NEMA TC 6 - Non-Metallic Conduit.
- I. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).
- J. NFPA 70 - NEC.
- K. UL 6 - Rigid Metal Conduit
- L. UL 514B - Conduit, Tubing and Cable Fittings.
- M. UL 651 - Rigid Non-Metallic Conduit

1.3 BOX APPLICATION

- A. Provide raceway, boxes and handholes located as indicated and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements and for a complete wiring system.

1.4 SUBMITTALS

- A. Detailed conduit routing plan as follows:
 - 1. Exposed and/or concealed in building walls for conduits larger than 2-inch outside diameter.
 - 2. All underground conduits (3/4-inch and larger) in duct bank; concealed in floor slabs, equipment pads and concrete slabs.

- B. Product Data:
 - 1. Rigid Steel Conduit.
 - 2. PVC Coated galvanized rigid steel conduit.
 - 3. Liquid tight flexible metal conduit.
 - 4. Nonmetallic conduit.
 - 5. Raceway fittings.
 - 6. Conduit bodies.
 - 7. Surface raceway.
 - 8. Pull boxes, junction boxes and manholes.
- C. Manufacturer's Installation Instructions:
 - 1. Submit application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.
 - 2. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents:
 - 1. Record actual routing of conduits.
 - 2. Record actual locations and mounting heights of outlet, pull boxes, junction boxes and manholes.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC and PVC-coated metallic conduit from sunlight.

PART 2 PRODUCTS

2.1 CONDUIT

- A. Galvanized Rigid Steel Conduit (GRSC or RGS), couplings and elbows shall be hot-dip galvanized, rigid mild steel in accordance with ANSI C80.1 and UL 6. The conduit interior and exterior surfaces shall have a continuous zinc coating with a transparent overcoat of enamel, lacquer, or zinc chromate. Conduit shall be formed with continuous welded seams with a uniform wall thickness, in minimum 10-foot lengths, with threaded ends.
- B. Polyvinyl Chloride (PVC) coated galvanized rigid steel conduit shall be in accordance with NEMA RN 1. Coating shall be applied under controlled factory conditions. Prior to coating, conduit shall meet requirements of ANSI C80.1 and UL 6 or ANSI C80.6 and UL 1242 as appropriate. PVC coated conduits shall have ultra-violet (UV) inhibitor in the coating material.
- C. Liquid-Tight Flexible Metal Conduit shall be plastic-jacketed, galvanized steel, "Sealtite" Type EF for general service areas. Conduit shall be UL listed.
- D. Non-Metallic Conduit shall be as follows:
 - 1. Schedule 40: Conduit shall be 90 degree Celsius, polyvinyl chloride in conformance with NEMA TC-2 and UL 651 requirements.
 - 2. Spacers used in duct bank installations shall be high impact plastic, interlocking bases, and intermediate type spacers. Place spacers between 6 and 10 feet apart.

- E. Electrical metallic tubing (EMT), rigid aluminum, flexible aluminum, or flexible non-metallic conduits shall not be used on this project.

2.2 RACEWAY FITTINGS

- A. Couplings and Thread Protectors. Each length of threaded conduit shall be provided complete from the manufacturer with a coupling on one end and a thread protector on the other. The thread protector shall have sufficient mechanical strength to protect the threads during normal handling and storage.
- B. Metal Conduit Fittings shall conform to the requirements of UL 514B where this standard applies. Galvanized iron or galvanized steel fittings shall be used with steel conduit. Threaded fittings shall engage a minimum of five threads made up wrench-tight and be compatible with conduit. EMT fittings shall be compression type, UL approved for rain tight applications and setscrew type with insulated throat for indoor applications.
- C. Liquid-Tight Flexible Conduit Fittings shall be galvanized steel, T&B 53XX series insulated throat, and shall bear the UL label. Die-cast malleable fittings are not acceptable.
- D. Liquid-Tight Flexible Metal Conduit Fittings shall be galvanized steel similar to T&B "Tite-Bite."
- E. Non-Metallic Conduit Fittings shall be of same material and strength characteristics as the conduit and shall be solvent welded as recommended by manufacturer. End bells shall be plastic, high impact, tapered to fit. Where conduit transition from non-metallic to metallic is required, provide non-metallic female "terminal" adapter. Non-metallic "male" adapters are not acceptable.
- F. Special Fittings. Conduit sealing, explosion proof, dust proof, and other types of special fittings shall be provided as required and shall be consistent with the area and equipment with which they are associated. Fittings installed outdoors or in damp locations shall be sealed and gasketed. Outdoor fittings shall be of heavy cast construction. Hazardous area fittings and conduit sealing shall conform to NEC requirements for the area classification.
- G. Bushings shall be provided for the termination of all conduits not terminated in hubs, couplings or insulated throat connectors. Grounding type insulated bushings with insulating inserts in metal housings shall be provided for conduit 1-1/4 inches and larger. Standard bushings shall be galvanized steel or malleable iron in all sizes.
- H. Locknuts. One interior and one exterior locknut shall be provided for all conduit terminations not provided with threaded hubs and couplings. Locknuts shall be designed to securely bond with the conduit to the box when tightened. Locknuts shall be so constructed that they will not be loosened by vibration.
- I. Unions. Watertight conduit unions shall be Appleton or Crouse-Hinds Type UNF or UNY, or Approved Equal.
- J. Raintight Conduit terminating hubs, where indicated on the drawings or required by these specifications, shall be Meyer's rigid conduit hubs, or Approved Equal.

2.3 CONDUIT BODIES

- A. Malleable iron conduit bodies shall be cast malleable iron with tensile strength meeting ASTM A 48, Class 30A requirements. Malleable conduit bodies shall be finished with an epoxy powder coating. Cover shall be malleable iron with captive screws.

- B. All conduit bodies' entrances shall be machined NPT threads with a smooth, rounded, internal conduit stop bushing.
- C. All conduit bodies shall be equipped with a sealed and gasketed cover. Cover shall be secured using stainless steel machine screws.

2.4 CONDUIT SUPPORTS

- A. Conduit supports shall be furnished and installed in accordance with other section of these specifications. Conduits shall be supported so that fittings are accessible. Support systems shall be limited to electrical conduits only.
- B. Hanger rods shall be 3/8-inch diameter galvanized threaded steel rods, minimum. Conduit racks over 18-inch wide, over one level, or supporting 2-inch RSC or larger, shall be 1/2-inch diameter rod minimum.
- C. Conduit Clamps. Conduits in single runs or groups of two shall be supported by steel clamps and clamp backs. They shall be galvanized malleable iron or Approved Equal cast ferrous metal for steel conduit or tubing.
- D. Support Channels. Supports for banks of three or more conduits shall be constructed of formed steel support channels (Unistrut, Kindorf, Superstrut, B-Line or Approved Equal) with associated conduit or tubing clips. Support channels shall be steel, hot-dip galvanized after fabrication with galvanized steel clips for steel conduit or tubing.

2.5 OUTLET BOXES AND SWITCH BOXES

- A. Outlet boxes shall be cast metal (FS or FD type) with mounting lugs and gasketed covers.
- B. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported, per NEC requirements.
- C. Outlet Box Accessories: Provide outlet box accessories as required for each installation, meeting requirements of individual wiring situations.

2.6 PULL BOXES, JUNCTION BOXES, AND HANDHOLES

- A. Surface-Mounted Cast Metal Box: NEMA 250, NEMA Type 3R or 4 as indicated, flat-flanged, surface-mounted junction box:
 - 1. Material: Cast Iron.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- B. Concrete pull boxes, vaults and hand holes for power, lighting, controls and telecommunications shall be pre-cast concrete boxes, sized as indicated. Pull boxes shall be equipped with a concrete cover for non-traffic rated locations, or cast-in frame, galvanized steel, adjustable, high impact traffic cover (H-20 load rated), sump, lifting lugs, and conduit knock-outs as indicated. Knockout location and sizes shall be coordinated with the duct bank for each location. Cover shall be engraved with the words "POWER," "LIGHTING," "CONTROLS," "COMM/DATA," "TELEPHONE" or similar as applicable.
- C. Concrete handholes and/or pull boxes for buried power (MH-P-xx) and control (MH-C-xx) conduits shall be either cast-in-place or pre-cast concrete vault.
 - 1. Size shall be indicated.
 - 2. Pull boxes, Vaults and Handholes shall be equipped with:

- a. Galvanized steel covers for non-traffic rated locations and cast-in frame, galvanized steel, adjustable, high impact traffic cover (H-20 load rated) for traffic rated locations.
- b. Sump, lifting lugs, conduit knock-outs, pick holes, bolt down holes in cover plate, and pull irons. Knockout location and sizes shall be coordinated with the duct bank for each location. Hot-dip galvanized cable racks shall be provided as required to support the cables in the pull box. Cover shall be engraved with the words "POWER," "LIGHTING," or "CONTROLS" as applicable.

2.7 CLOSURE FOAM

- A. All conduit, raceways, cables and sleeves penetrations through fire rated and hazardous location walls, shafts, floor, ceilings, etc., shall be sealed by closure foam as in Dow Corning #3-6548 silicone RTV, GE RTV 850 silicone foam, or Approved Equal.

2.8 SEALING AND FIREPROOFING

- A. Penetrations. All conduits, raceways, cables and sleeve penetrations through fire rated and hazardous location walls, shafts, floor, ceilings, etc., shall be sealed with a UL-approved fire stopping system.
- B. Furnish UL listed products or products tested by a nationally recognized independent testing laboratory. Select products with rating not less than the rating of the wall, ceiling or floor being penetrated.
- C. Manufacturers:
 - 1. 3M CP 25WB + Caulk
 - 2. 3M FS 195 wrap or strip with restricting collar
 - 3. 3M CS 195 composite sheets
 - 4. Proset Systems fire rated floor and wall penetrations
 - 5. Dow Corning Fire Stop System
- D. Use stamped steel, chrome plated, hinged, split ring escutcheons or floor/ceiling plates for covering openings in occupied areas where conduit is exposed.
- E. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the conduit and the cored opening or a water-stop type wall sleeve.
- F. At non-rated interior wall or floor openings use Tremco Fyre-Sil, Sika Corp. Sikaflex Ia, Sonneborn Sonolastic NPT, or Mameco Vulkem 116 urethane caulk or Approved Equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough in.

3.2 INSTALLATION OF RACEWAYS

- A. Routing
 - 1. Install raceway and boxes in accordance with NECA "Standard of Installation."
 - 2. Conduit routing is diagrammatic only. Contractor shall field route conduit and raceways between equipment and devices as required to obtain a complete wiring system.
 - 3. All exposed conduits shall be installed parallel or perpendicular to dominant surfaces with right-angle turns made of symmetrical bends or fittings.

4. Conduit shall not be installed on the outside face of exposed columns, but shall be routed on the web or on the inside of a flange of the column.
 5. Except where prevented by the location of other work, a single conduit or a conduit group shall be centered on structural members.
 6. Conduit shall be located at least 6 inches from hot water or steam pipes and from other hot surfaces
- B. Moisture Pockets
1. Moisture pockets shall be eliminated from conduits. If water cannot drain to the natural opening in the conduit system, a hole shall be drilled in the bottom of a pull box or a "C-type" conduit fitting provided in the low point of the conduit run.
- C. Couplings and Unions
1. Metal conduit shall be joined by threaded conduit couplings, with the conduit ends butted.
 2. The use of running threads, Erickson type couplings, split couplings or similar unions are not permitted.
- D. Conduit Bodies
1. Conduit bends shall meet the requirements of NEC, minimum bend radius of the cable installed or as indicated, whichever is greater.
 2. Conduits or tubing deformed or crushed in any way shall be removed from the Site.
- E. Bends and Offsets
1. Changes in direction of conduits shall be made with fittings or bends.
 2. Conduit bends shall meet the requirements of NEC, minimum bend radius of the cable installed or as indicated, whichever is greater.
 3. Bends shall be made using appropriate tools or mechanical equipment. The use of a pipe tee or vise for bending conduit or tubing will not be permitted.
 4. For non-metallic conduit or plastic coated steel, approved factory bends and offsets shall be used.
 5. Conduits or tubing deformed or crushed in any way shall be removed from the Site.
 6. Install no more than the equivalent of three 90 degree bends between boxes or outlets
- F. Cutting and Threading
1. The plane of all conduit ends shall be square with the centerline.
 2. Where threads are required, they shall be cut and cleaned prior to conduit reaming.
 3. The ends of all conduit and tubing shall be reamed to remove all rough edges and burrs.
 4. Cutting oil shall be used in threading operations; the dies shall be kept sharp, and provisions shall be made for chip clearance.
 5. Threads on conduits and fittings shall be lubricated with conducting and sealing compound.
 6. All steel conduits shall be coated after threading with cold-galvanized zinc coating. The Contractor shall furnish this protective material and shall apply it in the field prior to installing conduit or fittings.
- G. Connections to Boxes and Cabinets
1. Conduit shall be securely fastened to all boxes and cabinets.
 2. Threads on metallic conduit shall project through the wall of the box to allow the bushing to butt against the end of the conduit.
 3. The locknuts, both inside and outside, shall then be tightened sufficiently to bond the conduit securely to the box.
 4. Locknuts on connectors shall be tightened securely to bond the connectors.
- H. All conduits entering enclosures outdoors or in wet areas shall enter through Meyer's hubs, or Approved Equal, or threaded openings.

- I. Cleaning
 - 1. Precautions shall be taken to prevent the accumulation of water, dirt, or concrete in the conduit.
 - 2. Conduit in which water or other foreign materials have been permitted to accumulate shall be thoroughly cleaned or, where such accumulation cannot be removed by methods acceptable to the Owner, the conduit shall be replaced.
 - 3. For conduits sizes 3 inches and larger, draw a flexible testing mandrel approximately 12 inches long with a diameter less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of foreign materials. For conduits less than 3 inches, draw a stiff bristle brush through until conduit is clear of particles and foreign material.
- J. Empty Conduit
 - 1. All conduits installed for future use shall have a polypropylene pull line with a minimum tensile strength of 200 lbs., Jet Line, Cat. No. 232, polyolefin, or Approved Equal. Pull line shall be secured at both ends to ensure future accessibility.
- K. Rooftop Conduits
 - 1. Provide redwood sleepers on waterproof mastic base for all conduit runs exposed on roofs.
- L. Identification
 - 1. All conduits shall be identified in accordance with other section of these specifications.
- M. Grounding
 - 1. All conduits shall be grounded in accordance with these Specifications.
 - 2. A solid or stranded bare copper or green insulated copper solid or stranded ground wire shall be provided in all conduits and raceways.
- N. Polyvinyl Chloride (PVC) Coated Galvanized Rigid Steel Conduit
 - 1. PVC -coated, steel conduit and fittings shall be installed where highly corrosive conditions exist, indoors or outdoors.
 - 2. The Contractor shall patch any damaged coating according to the manufacturer's instructions.
- O. Non-Metallic Conduit
 - 1. Schedule 80 shall be used for all power, signal feeders and branch circuits, in earth under roadways. Conduits must be buried in earth in accordance with the NEC.
 - 2. Schedule 40 shall be used for all other power, signal feeders and branch circuits in earth or enclosed in concrete, unless otherwise noted on the drawings. Conduits must be buried in earth in accordance with the NEC.
- P. Conduit Support
 - 1. Fasten conduit supports to building structures and surfaces in accordance with these specifications.
 - 2. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
 - 3. Do not use wire, ceiling support wires or perforated pipe straps to support conduit. Remove any temporary installation support wire.
- Q. Spacing of Supports
 - 1. All conduit runs shall be rigidly supported, except where buried in concrete,.
 - 2. Each conduit shall be supported within one (1) foot of junction boxes and fittings.
 - 3. Spacers used in duct bank installations shall be placed no more than 6 to 10 feet apart.
 - 4. Support spacing along conduit runs shall be as follows.

CONDUIT SIZE	MAXIMUM DISTANCE BETWEEN SUPPORTS
½ inch through 1-1/4 inch	5 feet
1-1/2 inch and larger	8 feet

R. Ground and bond raceway and boxes in accordance with these Specifications.

3.3 CABINET AND BOX INSTALLATION

- A. Install electrical boxes as indicated, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- B. Locate boxes and conduit bodies so as to ensure ready accessibility of electrical wiring, maintain headroom and to present neat mechanical appearance.
- C. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only. In inaccessible ceiling areas, install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices with each other.
- E. Use flush mounting outlet boxes in finished areas.
 - 1. Do not install flush mounting boxes back-to-back in walls.
 - 2. Provide minimum 6-inch separation between adjacent boxes.
 - 3. Provide minimum 24-inch separation in acoustic rated walls.
 - 4. Use stamped steel bridges to fasten flush mounting outlet box between studs.
 - 5. Secure flush mounting box to interior wall and partition studs.
 - 6. Accurately position to allow for surface finish thickness.
 - 7. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
 - 8. Use adjustable steel channel fasteners for hung ceiling outlet box.
- F. Support boxes independently of conduits.
- G. Coordinate installation of electrical boxes and fittings with cable and raceway installation work. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- H. Fasten boxes rigidly to substrate or structural surfaces to which they are being mounted, or solidly embed electrical boxes in concrete or masonry as appropriate.
- I. Except as prevented by the location of other work, all junction boxes and outlet boxes shall be centered on structures.
- J. Conduit openings in formed boxes shall be made with a hole saw or shall be punched.
- K. Cabinets and boxes shall be rigidly mounted.
 - 1. Mounting on concrete shall be secured by self-drilling anchors.
 - 2. Mounting on steel shall be by drilled and tapped screw holes, or by special support channels welded to the steel, or by both.
 - 3. Cabinets shall be leveled and fastened to the mounting surface with not less than ¼-inch air space between the enclosure and mounting surface.
 - 4. All mounting holes in the enclosure shall be used.

- L. Large Pull Boxes - Boxes larger than 100 cubic inches in volume or 12 inches in any dimension.
 - 1. Interior Dry Locations - Use hinged enclosure.
 - 2. Other Locations - Use surface mounted box of appropriate location classification.

3.4 ANCHORS

- A. Where supports for raceways, boxes, and cabinets are mounted on concrete surfaces, they shall be fastened with self-drilling tubular expansion shell anchors with externally split expansion shells, single-cone expanders, and annular break-off grooved chucking cones. Anchors shall be Phillips "Red Head" or Approved Equal.

3.5 SEALING AND FIREPROOFING

- A. Fire-Rated Surface:
 - 1. Where conduit penetrates fire rated surface, install fire-stopping product in accordance with manufacturer's published instructions.
 - 2. All openings through fire rated wall, floor, ceiling or roof must be sealed.
 - 3. Install galvanized sheet metal sleeves (minimum 12-gage) through opening and extending beyond minimum of one (1) inch on each side of building element.
 - 4. Pack void between sleeve and building element with backing material.
 - 5. Seal ends of sleeve with UL listed fire-resistive silicone compound to meet fire rating of structure penetrated.
- B. Non-Rated Surfaces:
 - 1. Opening through a non-fire rated wall, floor, ceiling or roof must be sealed using an approved type of material.
 - 2. Use galvanized sheet metal sleeves in hollow wall penetrations to provide a backing for the sealant. Grout area around sleeve in masonry construction.
 - 3. Install escutcheons or floor/ceiling plates where raceway, penetrates non-fire rated surfaces in occupied spaces.
 - 4. Install rubber links of mechanical seal tightened in place and sized for the pipe, in exterior wall openings below grade, in accordance with the manufacturer's instructions.
 - 5. All pipe penetrations at interior partitions and/or walls, laboratory spaces, telephone, data and communication rooms and similar spaces where the room pressure or odor transmission must be controlled, shall be sealed. Sealant shall be applied to both sides of the penetration in such a manner that the annular space between the pipe sleeve and the pipe is completely filled.

3.6 PULL BOX AND VAULT INSTALLATION

- A. Openings or "knockouts" in precast concrete vaults shall be located as indicated and shall be sized sufficiently to permit passage of the largest dimension of pipe and/or flange.
- B. After the structure and all appurtenances are in place and approved, backfill shall be placed to the original ground line or to the limits indicated.
- C. All joints between precast concrete vault sections shall be made watertight. The plastic joint sealing compound shall be installed according to the manufacturer's recommendations to provide a watertight joint which remains impermeable throughout the design life of the structure. The outside of the entire structure shall be coated with an approved water proofing material.
- D. Access doors shall be built up such that the hatch is flush with the surrounding surface unless otherwise indicated or directed by the Owner. The Contractor is responsible for placing the

cover at the proper elevation where paving is to be installed and shall make all necessary adjustments so that the cover meets these requirements.

3.7 ADJUSTING

- A. Install knockout closures in unused openings in boxes.

3.8 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore manufacturer's finish.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. The extent of the electrical systems and equipment requiring identification is indicated, and the extent of identification required is specified herein and in individual sections of Work requiring identification. The types of electrical identification specified in this section include the following:
 - 1. Exposed conduit color banding.
 - 2. Buried cable warnings.
 - 3. Cable/conductor identification.
 - 4. Operational instructions and warnings.
 - 5. Danger signs.
 - 6. Equipment/system identification signs.

1.2 REFERENCES - CODES AND STANDARDS

- A. ANSI Z535.1 - Safety Color Code.
- B. APWA ULCC - Uniform Color Code for Buried Utilities.
- C. NFPA 70 – NEC.

1.3 SYSTEM DESCRIPTION

- A. Label the following electrical equipment with nameplates which clearly identify each item, the function or use of the item, and the circuit identification of the feed to the item:
 - 1. All transformers shall be identified by 1-inch high block letters cut in stencil and applied with yellow paint on a flat-black background. The transformer number, primary and secondary voltages, and the kVA shall be shown. The nameplate shall be located on the front of the transformer.
 - 2. All Metal-Clad Switchgear, Metal-Enclosed Switchgear, Switchboards, Distribution Panelboards, Power and Lighting Panels, Motor Control Centers, Local Control Panels, Terminal Cabinets and all electrical equipment enclosure shall be identified using laminated plastic nameplates. Show the equipment number, voltage rating, current rating, number of phases, connection type, short circuit interrupting rating, and circuit number
 - 3. Identify all receptacles and lighting switches, by the circuit number indicated using ¼-inch high white characters on ½-inch wide black stick-on tape placed on the device coverplate. Place the tape on the device enclosure if the device is not wall mounted.
 - 4. All motors, starters, disconnect switches, Time Switches, Special Function Pushbuttons and Switches, and miscellaneous control devices shall be identified by function and circuit number, with ¼-inch high white characters on a ½-inch wide black stick-on tape where installed indoors and engraved plastic nameplates where installed outdoors.
 - 5. All underground raceway or cable shall be marked with buried warning tape along its entire length.
 - 6. All exposed raceway longer than 10 feet in length shall be identified.
 - 7. Panelboard Directories: Furnish all panelboards with a complete 8-1/2-inch by 11-inch typewritten directory mounted in the inner door under a clear plastic cover set in a metal frame.

B. Branch circuits and devices:

1. Label all individual receptacle outlets at the outlet faceplate to indicate the panelboard of origin and branch circuit number. Label modular furniture feeds at the power pole drop in a visible and consistent location. Labels shall be self adhesive, thermal machine printed type such as Brothers, Panduit, T&B, or Approved Equal and shall be clear plastic with black lettering.
2. All branch circuits in outlet boxes shall be identified with circuit number using wrap-around labels (T&B, BRADY, 3M, or Approved Equal).
3. As an alternative to separate nameplates, device plates may be engraved directly with lettering filled with black enamel.

1.4 SUBMITTALS

A. Product Data: nameplates, labels, and markers.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70 – NEC.

B. Furnish products listed and classified by UL, ETL, or other recognized, approved testing and listing agencies as suitable for the purpose specified and shown.

PART 2 PRODUCTS

2.1 NAMEPLATES AND LABELS

A. Nameplates

1. Engraved, three layer laminated plastic, white letters on black background for normal power and white letters on red background for emergency power. Communications and control cabinets shall be labeled with white letters on green background.
2. Locations
 - a. Each electrical distribution and control equipment enclosure.
 - b. Communication cabinets.
 - c. Motor control centers, including each combination module.
3. Letter Size
 - a. Use 1/2-inch letters for identifying individual equipment and loads.
 - b. Use 1/4-inch letters for identifying grouped equipment, loads, panelboards, and transfer switch.
 - c. Use 1/2-inch letters for identifying the main switchboard, motor control centers, and large distribution switchboards.

B. Labels

1. Embossed adhesive tape, with 3/16-inch white letters on colored background to match color scheme of plastic laminate labels in 2.1.A. Use only for identification of individual wall switches and receptacles, control device stations, and multi-outlet devices.
2. Thickness.
 - a. 1/16-inch for units up to 20 square inches or 8-inch length; 1/8-inch for larger units.

2.2 WIRE MARKERS

A. Manufacturers

1. Brady.
2. Thomas & Betts.
3. 3-M Co.
4. Or Approved Equal.

B. Description: Tape, split sleeve, or tubing type wire markers, self-adhesive.

C. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, control panels, motor controllers and starters, and each load connection.

D. Legend

1. Power and Lighting Circuits: Branch circuit or feeder number indicated.
2. Control Circuits: Control wire number indicated on shop drawings.
3. Neutral Conductors: Clearly indicate the branch circuit or feeder number the neutral serves. In multi-wire circuits where the neutral is shared, mark the neutral with the circuit number of the "A" phase.

2.3 CONDUIT MARKERS

A. Provide manufacturer's standard preprinted, flexible or semi-rigid, permanent, plastic-sheet conduit markers, minimum of 3 mils thick and 1-1/2-inch wide extending 360 degrees around conduits; designed for self-adhesive attachment to conduit. Except as otherwise indicated, provide lettering that indicates the voltage of the conductor(s) in the conduit. Provide 8-inch minimum length for 2-inch and smaller conduit, 12-inch minimum length for larger conduit.

B. Identify conduits containing conductors above 600-volts with the following alternating markers

1. DANGER - HIGH VOLTAGE
2. The voltage, as applicable (i.e. – 12-kV, 4.16-kV, etc.).

C. Identify conduits containing conductors below 600-volts with the following markers.

1. The voltage, as applicable (i.e. 480-Volts, 240-Volts, etc.).

D. Location: Furnish markers for each conduit longer than 10 feet.

E. Spacing: 20 feet on center.

F. Color: Unless otherwise indicated or required by governing regulation, provide conduit tags in the following colors.

1. Normal and Emergency Power Systems: Orange w/black letters.
2. Fire Alarm System: Red w/black letters.
3. Telephone System: Green w/yellow letters.
4. Data/Communication. System: White w/black letters.

G. Legend:

1. 480 Volt System: Normal 480Y/277-volts.
2. 208 Volt System: Normal 208Y/120-volts.
3. Fire Alarm System: Fire alarm.
4. Telephone System: Telephone.
5. Data/Communication System: Data/Communications.

2.4 FASTENERS

A. Secure all labels and nameplates with self-tapping stainless steel screws. Use contact type permanent adhesive where screws cannot or should not penetrate the substrate.

2.5 BAKED ENAMEL DANGER SIGNS

- A. Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20 gage steel; of standard red, black and white graphics; 14-inch by 10-inch size except where 10-inch by 7-inch is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording (e.g. HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH).
 - 1. At each entry doors of Electrical Rooms: "DANGER HIGH VOLTAGE – KEEP OUT, AUTHORIZED PERSONNEL ONLY".

2.6 LETTERING AND GRAPHICS

- A. Coordinate names, abbreviations and other designations used in the electrical identification Work, with the corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

2.7 UNDERGROUND WARNING TAPE

- A. Three-inch minimum width, 5 mil thickness, foil bonded polyethylene tape, detectable type, with suitable continuous warning legend describing buried electrical lines. Tape color shall conform to APWA uniform color code using ANSI Z535.1 safety colors. Text shall be black, 2-inch minimum letters.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive nameplates and labels.
- B. Coordination: Where identification is to be applied to surfaces that require finish, install identification after completion of painting.
- C. Regulations: Comply with governing regulations and the requests of governing authorities for the identification of electrical Work.

3.2 APPLICATION

- A. Install nameplate and label parallel to equipment lines.
- B. Secure nameplate to equipment front using screws, rivets, or adhesive.
- C. Secure nameplate to outside moveable surface of door on panelboard.
- D. Conduit Identification:
 - 1. Where electrical conduit is exposed in spaces with exposed mechanical piping, which is identified by a color-coded method, apply color-coded identification on the electrical conduit in a manner similar to the piping identification. Except as otherwise indicated, use orange as the coded color for conduit.
 - 2. Paint red band or provide red tape on each fire alarm conduit longer than 10 feet, minimum 20 feet on center.
- E. Cable/Conductor Identification:

1. Apply cable/conductor identification on each cable and conductor in each box/enclosure/cabinet where the wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided.
 2. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project electrical Work.
- F. Operational Identification and Warnings
1. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems, and electrically connected mechanical systems and general systems and equipment, including the prevention of misuse of electrical facilities by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes.
- G. Danger Signs
1. In addition to the installation of danger signs required by governing regulations and authorities, install appropriate danger signs at the locations indicated and at locations subsequently identified by the Installer of electrical Work as constituting similar dangers for persons in or about the project.
 2. High Voltage
 - a. Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power of voltages higher than 110-120 volts.
 - b. Critical Switches/Controls
 - c. Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely or inadvertent operation (by anyone) could result in significant danger to persons, or damage to or loss of property.
- H. Equipment/System Identification Signs
1. Install an engraved plastic-laminate sign on each major unit of electrical equipment in the building; including the central or master unit of each electrical system and the communication/signal systems, unless the unit is specified with its own self-explanatory identification or signal system.
 2. Except as otherwise indicated or specified, provide single line of text, ½-inch high lettering on 1-1/2-inch high sign (2-inch high where two lines are required), white lettering in black field.
 3. Provide text matching terminology and numbering of the shop drawings.
 4. Provide signs for each unit of the following categories of electrical Work.
 - a. Major electrical switchboard.
 - b. Electrical substation.
 - c. Motor control center.
 - d. Fire alarm control panel and annunciators.
 - e. Data / communications.
- I. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrata with fasteners, except use adhesive where fasteners should not or cannot penetrate the substrata.
- J. Identify underground conduits using underground warning tape. Install one tape per trench at 3 inches below finished grade.

END OF SECTION

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SECTION 26 22 00

LOW-VOLTAGE TRANSFORMERS

GENERAL

1.1 SUMMARY

A. Section Includes:

1. Two-winding transformers – provision of single-phase and three-phase general purpose, individually mounted, dry-type transformers of the two-winding type, self-cooled, with ratings and voltages as indicated on the drawings.

1.2 REFERENCE STANDARDS

A. ANSI C57.96 Guide for Loading Dry-Type Distribution and Power Transformers

B. National Electrical Manufacturers Association:

1. NEMA ST 1 - Specialty Transformers (Except General Purpose Type).
2. NEMA ST 20 - Dry Type Transformers for General Applications.
3. NEMA TP-1 - Guide for Determining Energy Efficiency for Distribution Transformers

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 DESIGN REQUIREMENTS

- A. Transformers shall be designed, manufactured, and tested in accordance with the latest applicable ANSI, NEMA and IEEE standards. All 600-volt class transformers 2 kVA through 750 kVA shall be UL listed and bear the UL label.
- B. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.
- C. Transformer shall be energy efficient type, meeting the requirements of NEMA TP 1.

1.4 SUBMITTALS

A. Product Data:

1. Outline and support point dimensions of enclosures and accessories.
2. Unit weight, voltage, kVA, and impedance ratings and characteristics.
3. Tap configurations, insulation system type, and rated temperature rise.
4. Winding configuration.
5. Terminations / Connection points.

B. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

C. Manufacturer's Instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

D. Submit calculations and anchoring methods (anchor bolt size, embedment and assembly details) to meet California Seismic Zone IV requirements.

E. Manufacturer's Certification and Test Reports:

1. Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level. Factory test data on a prototypical unit of identical size and features is acceptable.
2. Manufacturer's Certificate. Certify that products meet or exceed specified requirements.

F. Field Quality Control Submittals: Indicate results of Contractor furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

- A. Record Documentation: Record actual locations of transformers.
- B. Operation and Maintenance Manual.
- C. Field Test Report

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years of experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver transformers individually wrapped for protection and mounted on shipping skids.
- B. Inspect transformers as they arrive on site for damage and immediately report any damage discovered to the Owner and the Engineer.
- C. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

- A. The transformers shall be as manufactured by one of the following manufacturers:
 1. General Electric Co.
 2. Cutler-Hammer.
 3. Square D Co.
 4. Or Approved equal

2.2 STANDARD DRY-TYPE TRANSFORMERS

- A. Transformers shall be NEMA ST-20 Class AA dry-type, voltage, phase, kVA rating, and method of mounting as indicated in the drawings. All three-phase transformers shall have three-winding primaries and three-winding secondary.
- B. Insulation System
 1. Transformers shall be insulated as follows:
 - a. 2-kVA and below - 150 degrees C insulation system.
 - b. 3 through 30 kVA - 180 degrees C insulation system.
 - c. 45-kVA and above - 220 degrees C insulation system.
 2. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40°C maximum ambient, with a 30°C average over 24 hours.
 3. All insulation material shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.
 4. Transformers 30 kVA through 225 kVA shall be 115° C temperature rise above 40° C ambient. 115° C rise transformers shall be capable of carrying a 15 percent continuous overload without exceeding 150° C rise in a 40°C ambient.

5. Transformers rated 300 kVA through 500 kVA shall be 80° C temperature rise above 40° C ambient. 80° C rise transformers shall be capable of carrying a 30 percent continuous overload without exceeding a 150° C rise in a 40° C ambient.
6. Limit transformer surface temperature rise to maximum of 50 degrees C.

C. Core and Coil Assemblies

1. Transformer core shall be constructed with high grade, non-aging, grain-oriented silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point.
2. The transformer core volume shall allow sufficient transformer operation at 10 percent above the highest tap voltage.
3. The core laminations shall be tightly clamped and compressed.
4. Coils shall be wound of electrical grade copper or aluminum with continuous wound construction, terminations brazed or welded.
5. On units rated below 3 kVA, the core and coil assembly shall be completely encapsulated in a proportioned mixture of resin and aggregate to provide a moisture proof, shock resistant seal. The core and coil encapsulation system shall minimize the sound level.
6. On units rated 3 kVA and above, the core and coil assembly shall be impregnated with non-hygroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture. The assembly shall be installed on vibration-absorbing pads.

D. Taps

1. For transformers rated 25 kVA and larger, provide primary windings with 6 taps; two 2-1/2 % increments above full-rated voltage and four 2-1/2 % increments below full-rated voltage.
2. For transformers rated below 25 kVA, provide two taps at 5 percent below full rated voltage...

E. Provide terminal enclosure, with screw cover, to accommodate primary and secondary coil wiring connections and electrical supply raceway terminal connector.

1. Provide terminal board with mechanical compression type connectors. Limit terminal compartment temperature to 75° C when transformer is operating continuously at rated load with ambient temperature of 40° C.
2. Provide wiring connections suitable for stranded copper wiring, rated 75° C, and loaded to the 75° C ampacity.

F. Basic Impulse Level

1. 10-kV for transformers less than 300-kVA
2. 30-kV for transformers 300-kVA and larger.

G. Grounding

1. Ground core and coil assembly to enclosure by means of a visible flexible copper-grounding strap. Provide grounding in accordance with these Specifications.

H. Enclosure

1. The enclosure shall be made of heavy gauge steel and shall be degreased, cleaned, primed, and finished with ANSI 61 color weather-resistant enamel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90° C. The core of the transformer shall be grounded to the enclosure.
2. On units rated below 3 kVA, encapsulated, the enclosure construction shall be totally enclosed, non-ventilated, NEMA 3R, with lifting eyes as required.
3. On units rated 3 kVA and above, the enclosure construction shall be ventilated NEMA 1 suitable for indoor use, with lifting lugs as required. All ventilation openings shall be protected against falling dirt and water

4. On outdoor units, the enclosure shall be ventilated, NEMA 3R suitable for outdoor use, with weather shields over ventilation openings.

I. Nameplate

1. Provide Manufacturer's nameplate that includes transformer kVA, primary and secondary voltage, impedance, temperature rating, winding connection data, and overload capacity based on rated allowable temperature rise.

J. Sound Level

1. Transformer sound levels shall be per NEMA ST 20 Table 3-9, as follows:

EQUIVALENT TWO-WINDING KVA	AVERAGE SOUND LEVEL IN DECIBELS	
	1.2 KV OR LESS	ABOVE 1.2 KV
1 – 9	40 db	45 db
10 – 50	45 db	50 db
51 – 150	50 db	55 db
151 - 300	55 db	58 db
301 - 500	60 db	60 db
501 - 700	62 db	62 db
701 – 1,000	64 db	64 db
1,001 – 2,000	66 db	66 db
2,001 – 3,000	68 db	68 db

2.3 SOURCE QUALITY CONTROL

- A. The following factory test results shall be provided for each transformer:
1. Ratio tests at the rated voltage connection and at all tap connections
 2. Polarity and phase relation tests on the rated voltage
 3. Applied potential tests
 4. Induced potential test
 5. No-load and excitation current at rated voltage on the rated voltage connection.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify mounting supports are properly sized and located including concealed bracing in walls.
- B. Provide concrete housekeeping pad for mounting and leveling of the transformer.

3.2 INSTALLATION

- A. Install transformer(s) in accordance with manufacturer's instructions.
- B. Set transformer plumb and level.
- C. Use flexible conduit, in accordance with Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- D. Support transformers in accordance with NEC requirements.
1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.
 2. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.

3. Mount trapeze-mounted transformers as indicated on Drawings.
4. Provide seismic restraints.

E. Install grounding and bonding in accordance with Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS as outlined below:

1. Dry Type Air-Cooled Transformers, 600 Volt and Below (167-kVA Single-Phase, 500-kVA Three-Phase, and smaller).
 - a. Visual and Mechanical Inspections
 - 1) Compare equipment nameplate data with drawings and specifications.
 - 2) Inspect physical, electrical and mechanical condition.
 - 3) Verify that resilient mounts are free and that any shipping brackets have been removed.
 - 4) Inspect all bolted electrical connections for high resistance using one of the following methods:
 - a) Use of low-resistance ohm meter in accordance with NETA ATS Section 7.2.1.1.2 (Electrical Tests).
 - b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 10.12.
 - b. Electrical Tests
 - 1) Perform resistance measurements through all bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Section 7.2.1.1.1 (Visual and Mechanical Inspection).
 - 2) Perform insulation-resistance tests winding-to-winding and each winding-to-ground with test voltage in accordance with NETA ATS Table 10.5.
 - 3) Perform turns ratio tests at all tap positions.
 - 4) Verify that as-left tap connections are as specified.
 - c. Test Values
 - 1) Compare bolted connection resistances to values of similar connections.
 - 2) Bolt-torque levels should be in accordance with NETA ATS Table 10.12 unless otherwise specified by manufacturer.
 - 3) Micro-ohm or milli-volt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values that deviate from similar connections by more than 50 percent of the lowest value.
 - 4) Insulation-resistance test values at one minute should not be less than the values calculated in accordance with the formula in NETA ATS Table 10.5. Results shall be temperature corrected in accordance with NETA ATS Table 10.14.
 - 5) Turns-ratio test results should not deviate more than one-half percent from either the adjacent coils or the calculated ratio.
 - 6) In the event that a transformer fails any of the above testing, and repairs/corrections cannot be made in the field while maintaining all appropriate product listings, replace the transformer at no cost to the owner with a new unit and repeat the testing.
- B. Energize primary circuit at rated voltage and frequency from normal power source and test transformer, including, but not limited to, audible sound levels, to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance otherwise, remove and replace with new units and proceed with re-testing.

3.4 ADJUSTING

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- A. Measure primary and secondary voltages and make appropriate tap adjustments.

3.5 CLEANING

- A. Remove grease, spilled/splashed paint, and wipe transformer down prior to final punch walk.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes distribution and branch circuit panelboards and circuit breakers.

1.2 REFERENCES - CODES AND STANDARDS

- A. ANSI C2 - National Electrical Safety Code.
- B. NECA - Standard of Installation
- C. NEMA AB 1 - Molded Case Circuit Breakers.
- D. NEMA ICS 6 - Enclosures
- E. NEMA PB 1 - Panelboards.
- F. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- G. NETA ATS - (National Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
- H. NFPA 70 - NEC

1.3 SUBMITTALS

- A. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- B. Product Data: Submit catalog data showing specified features of standard products.
- C. Test Report:
 - 1. Factory Tests:
 - a. Certified factory test reports shall be submitted for manufacturer performed routine factory tests, including tests required by standards listed in Section 1.2. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in Section 3.3 shall be included.
- D. Installation, Operation, and Maintenance Manuals: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.4 EXTRA MATERIALS

- A. Furnish two (2) of each panel board key. Panelboards keyed alike to Owner's current keying system.

PART 2 - PRODUCTS

2.1 DISTRIBUTION AND BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers:
 - 1. General Electric Co.
 - 2. Eaton Co.
 - 3. Schneider Electric Co.
 - 4. Siemens
 - 5. Or Approved equal
- B. Product Description
 - 1. NEMA PB 1, circuit breaker type distribution, lighting and appliance branch circuit panelboard.
- C. Service Conditions:
 - 1. Temperature: 104 degrees F (40 degrees C) ambient
 - 2. Altitude: 100 feet (35 m) above sea level.
- D. Panelboard Bus
 - 1. Tin plated copper current carrying components, ratings as indicated on drawings.
 - 2. Main bus ampacity shall be equal to the main circuit breaker frame size rating unless otherwise noted on the drawings.
 - 3. Furnish copper ground bus in each panelboard.
- E. Minimum integrated short circuit rating
 - 1. Panelboards rated 208-Volts - 22,000 amperes RMS symmetrical
 - 2. Panelboards rated 480-Volts - 22,000 amperes RMS symmetrical
 - 3. Circuit Breaker rating shall match or exceed the panel interrupting rating
 - 4. Series rated circuit breakers are not acceptable
- F. Enclosure:
 - 1. Indoor Installation
 - a. NEMA PB 1, Type 1, gasketed, steel construction, minimum 6 inches deep, 20 inches wide suitable for flush or surface mounting as indicated on drawings.
 - b. Flush or surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.
 - c. Fully hinged door with flush lock and metal directory frame.
 - d. Finished in manufacturer's standard gray enamel (ANSI 61).
 - 2. Outdoor Installation
 - a. Panel shall be housed inside an outer weatherproof, NEMA 3R enclosure constructed as follows:
 - b. Steel support frame with body stiffeners for added strength and minimum 12 gauge panels all around.
 - c. Steel panels shall have seams that are continuously welded and ground smooth with no holes or knockouts.
 - d. The outer door shall provide two-door protection, isolation of electrical equipment and easy access to the interior section doors and devices.
 - e. Provide rolled lip around three sides of each outer door and along the top of enclosure opening to channel away liquids and contaminants.
 - f. Provide oil-resistant door gasket attached with oil resistant adhesive and held in place with steel retaining strips.
 - g. Provide heavy gauge steel continuous piano hinged, 3-point latch, hasp and staple for pad-locking.

- h. Provide continuous external support channels for floor mounting, leveling and anchoring the assembly.
- i. Provide heavy duty removable lifting angles and/or lugs.
- j. Provide suitable grounding stud on door and body.
- k. Provide adequate cable entry space and conduit fittings approved for NEMA Type 3R enclosure for top or bottom conduit entry as indicated on the drawings.
- l. Provide space heaters with thermostat control in each section to prevent condensation.

2.2 MOLDED CASE CIRCUIT BREAKERS

- A. NEMA AB 1, bolt-on type thermal magnetic and instantaneous magnetic trip circuit breaker. Circuit breaker thermal elements shall be of the bimetallic type and shall be capable of withstanding sustained overload and short-circuit currents without injury and without affecting the calibration of the bimetallic element. The thermal element shall have inverse time characteristics. The instantaneous elements shall trip the circuit breaker at the minimum standard trip setting.
- B. Provide common trip handle for multiple pole circuit breakers.
- C. Provide type SWD for lighting circuits and type HACR circuit breakers for air conditioning equipment circuits.
- D. Provide Class A ground fault interrupter circuit breakers as indicated on drawings.
- E. Trip rating shall be as indicated on drawings.
- F. Minimum integrated short circuit rating shall match panelboard rating. Series ratings are not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1 and NECA "Standard of Installation", NFPA 70 and IEEE C2.
- B. Install panelboards plumb.
- C. Install recessed panelboards flush with wall finishes.
- D. Mounting height: 6 feet to top of panelboard. Install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- E. Install filler plates for unused spaces in panelboards.
- F. Provide typed circuit directory for each panelboard. Revise directory to reflect circuiting changes to balance phase loads.
- G. Install engraved plastic nameplates in accordance with these Specifications.
- H. Ground and bond panelboard enclosure according to these Specifications. Connect equipment ground bars of panels in accordance with NEC.

3.2 FIELD QUALITY CONTROL

- A. Field Inspect and testing shall be in performer under the provisions of NETA ATS 7.6 (1) (1) – Circuit Breaker, Low Voltage, Insulated Case/Molded Case, as outlined below:
 - 1. Visual and Mechanical Inspection:
 - a. Compare equipment nameplate data with drawings and specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect circuit breaker for correct mounting.
 - d. Operate circuit breaker to insure smooth operation.
 - e. Inspect case for cracks or other defects.
 - f. Verify appropriate anchorage, required area clearances, physical damage, and correct alignment.
 - g. Inspect all doors, panels, and sections for corrosion, dents, scratches, fit, and missing hardware.
 - h. Verify that fuse and/or circuit breaker sizes and types correspond to drawings.
 - i. Perform circuit breaker inspections and operation test.

3.3 ADJUSTING

- A. Rearrange circuits in panelboard to balance phase loads to within 20 percent of each other.
- B. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

SECTION 26 24 19

MOTOR CONTROL CENTER

PART 1 GENERAL

1.1 SUMMARY

- A. This section covers the furnishing and installation of motor control center equipment, motor starters, controls, and accessories.

1.2 MEASUREMENT AND PAYMENT

- A. Refer to Section 01 22 00 Measurement and Payment.

1.3 RELATED SECTIONS

- A. Section 26 05 19 – Wire and Cable
- B. Section 26 05 26 – Grounding and Bonding for Electrical Systems
- C. Section 26 05 53 – Identification for Electrical Systems
- D. Section 26 24 16 – Panelboard
- E. Section 26 01 26 – Electrical Equipment Testing

1.4 REFERENCES - CODES AND STANDARDS

- A. The standards referenced herein, except as modified in the Contract Documents, shall have full force and effect as though included in these Specifications. These standards are not furnished to the Contactor since manufacturers and trades involved are assumed to be familiar with these requirements. The Contractor shall obtain copies of reference standards direct from publication sources as needed for proper performance and completion of the work.
 - 1. ANSI C37.17 Trip Devices for AC and General-Purpose DC Low Volume Power Circuit Breakers.
 - 2. IEEE 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 3. NECA Standard of Installation
 - 4. NEMA AB 1 (National Electrical Manufacturers Association) Molded Case Circuit Breakers
 - 5. NEMA ICS 2 Industrial Control Devices, Controllers and Assemblies
 - 6. NEMA ICS 2.3 Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers
 - 7. NEMA ICS 3 Industrial Control and Systems: Factory Built Assemblies
 - 8. NEMA ICS 3.1 Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems
 - 9. NEMA ICS 4 Industrial Control and Systems: Terminal Blocks
 - 10. NEMA ICS 5 Industrial Control and Systems: Control Circuit and Pilot Devices
 - 11. NEMA ICS 6 Industrial Control and Systems: Enclosures
 - 12. NEMA ICS 7 Industrial Control and Systems: Adjustable Speed Drives.
 - 13. NEMA FU 1 Fuses
 - 14. NEMA KS 1 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

15. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
16. NFPA 70 National Electrical Code
17. UL 94 Tests for Flammability of Plastic Materials for Part in Devices and Appliances.
18. UL 845 Electrical Motor Control Center

1.5 REGULATORY REQUIREMENTS

- A. Equipment shall conform to the requirements of ANSI/NFPA 70, NEMA ICS 2 and UL 845.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. (UL), Electrical Testing Laboratories, Inc. (ETL), or other recognized, acceptable testing and listing agencies as suitable for the purpose specified and shown.

1.6 SUBMITTALS

- A. Shop Drawings:
 1. Motor Control Center front panel elevation, side views and plan views showing overall dimensions; conduit entrance locations; circuit breaker and motor starter arrangement; and enclosure details including support point.
 2. Electrical characteristics including voltage rating; ampacity of horizontal and vertical main bus, neutral bus, and ground bus; integrated short circuit ampere rating; starter size; circuit breaker frame size and trip ratings; and name plate legends.
 3. Single line diagrams, interconnection diagrams, connection diagrams, control logic diagrams, and point-to-point wiring diagrams.
 4. Complete elementary and schematic wiring diagrams with all wires numbered for all control systems.
 5. Calculations and enclosure anchoring method (anchor bolt size, embedment, and assembly details) to meet California seismic Zone 4 requirements.
 6. Complete description of the MCC enclosure primer and finish painting, including paint manufacturers and types, paint colors, painting processes, and dry film thicknesses.
- B. Product Data:
 1. Catalog sheets showing equipment rating and size of all motor control center components.
 2. Circuit breaker time-current characteristic curves and overload relay thermal element (heater strip) time-current characteristic curves.
- C. Test Report:
 1. Factory Tests.
 - a. The motor control centers shall be factory-tested in accordance with NEMA standards and ANSI C37.17, together with any additional tests which may be required to ensure that the wiring is correct and that all equipment is in a satisfactory operating condition.
 - b. Certified factory test reports shall be submitted for manufacturer performed routine factory tests, including tests required by standards listed in paragraph "References". Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph "Field Testing" shall be included.
 2. Field Testing.
 - a. Submit a proposed field test plan 20 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed. Test equipment required, and tolerance limits.
 3. Field Test Report: As indicated in Section 26 01 26 – Electrical Equipment Testing

1.7 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Product Data and shop drawings as described under Submittals.
- B. Operation and Maintenance Data: Submit instructions and service manuals for normal operation and routine maintenance. List special tools, maintenance materials, and replacement parts. Include complete information for tightening of all electrical connections secured with bolts or studs.
- C. Furnish as-built elementary and schematic drawings with all manufacturer's equipment, control panels, devices, etc., in detail on the elementary diagram with all terminal points of such equipment indicated.
- D. Manufacturer's Field Report: Indicate inspections, findings, and recommendations.

1.8 MAINTENANCE MATERIALS

- A. The MCC manufacturer shall provide at least one complete set of the following:
 - 1. Power fuses – 3 of each size
 - 2. Control fuses – 12 of each size
 - 3. Cluster LED type indicating lights – 6 of each color
 - 4. Control transformer
 - 5. Other field-replaceable component parts
- B. Maintenance material shall be suitably packaged with labels indicating the contents of each package. The material shall be delivered to the District.

1.9 WARRANTY

- A. Furnish two (2) year manufacturer's warranty from date of substantial completion for defective parts and labor to install the part.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in 60-inch maximum width shipping splits, individually wrapped for protection, and mounted on shipping skids.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic. Provide space heaters if required, to prevent condensation and keep the equipment dry.
- C. Handle in accordance with NEMA ICS 2.3. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.11 QUALIFICATIONS

- A. Manufacturer: Company specialized in manufacturing the products specified in this section with recent minimum five (5) years experience.
- B. Supplier: Authorized distributor of specified manufacturer with recent minimum five (5) years experience.

1.12 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication

PRODUCTS

1.13 ACCEPTABLE MANUFACTURERS

- A. The following is a list of acceptable manufacturers for the motor control center.
 - 1. Allen Bradley / Rockwell Automation
 - 2. Eaton Cutler Hammer
 - 3. General Electric Company
 - 4. Siemens Energy & Automation, Inc.
 - 5. Square D Company
 - 6. Or approved equal

1.14 MOTOR CONTROL CENTER

- A. General
 - 1. The motor control center shall be designed and constructed for use on a 480 volt, three-phase, four-wire, 60 Hz, solidly grounded system.
 - 2. Except as specified otherwise herein all equipment shall be designed for service below 3,000 feet above sea level at an ambient temperature of 40°C maximum.
- B. Arrangement
 - 1. The motor control center shall be located as indicated on the drawings.
- C. Construction
 - 1. Motor control center equipment shall be mounted in compartmented vertical sections fabricated of steel and assembled to provide a rigid self-supporting structure. Each vertical section shall be nominally 90 inches high, 20 inches wide and 20 inches deep. Thickness of the steel sheets shall be not less than the thickness specified in UL 845, Table 1.
 - a. Protect all iron and steel components of the motor control center against corrosion by methods specified in UL 845.
 - b. Fasteners for removable panels shall be stainless steel screw type, inserted in captive nuts, held in place by nut retainer clips.
 - c. Provide 100 percent replacement screw type fasteners if they are of a non-captive type and 50 percent replacement of screw type fasteners if they are of a captive type.
 - d. Provide lifting angles on top of each motor control center shipping section.
 - e. Provide a metal protective pouch, in each compartment, to hold wiring diagrams and equipment information.
 - 2. Enclosures
 - a. Indoor Locations: Motor Control Center located outdoors shall be housed in an outer weatherproof, painted, NEMA 1
 - 1) panels shall have seams that are continuously welded and ground smooth with no holes or knockouts.
 - 2) Provide oil-resistant door gasket attached with oil resistant adhesive and held in place with steel retaining strips.
 - 3) Provide heavy gauge steel continuous piano hinged, 3-point latch, hasp and staple for padlocking.
 - 4) Provide continuous external support channels for floor mounting, leveling and anchoring the assembly.
 - 5) Provide heavy duty removable lifting angles and/or lugs.
 - 6) Provide suitable grounding stud on door and body.
 - 7) Provide adequate cable entry space and conduit fittings approved for NEMA Type 1 enclosure for top or bottom conduit entry as indicated on the drawings.
 - 3. Wire Troughs. Horizontal wire troughs shall be located at the top and bottom of each section, aligned and located to provide a continuous wire way of the same cross-

- sectional dimensions throughout the length of the assembled motor control center. A vertical wire trough equipped with wire ties shall extend the full height of each section.
4. Compartments. Each motor control section shall accommodate not more than six NEMA Size 1 or Size 2 combination magnetic starters. All individual units shall be isolated from each other by metal barriers when the units are assembled in the operating position and when the units are removed or replaced in the section structure. All section compartments shall be front accessible only.
 5. Doors. Provide gasketed and full length piano hinged doors on the front of each starter unit and each feeder tap unit. Doors shall be designed to allow easy maintenance or replacement of all removable starters, disconnecting and branch circuit overcurrent protective devices and similar devices from the front. A separate hinged and gasketed full-height door shall be furnished on the front of each section to allow access to the vertical wire trough without opening any starter unit or feeder tap unit door.
 6. Equipped Spare. A space designated as "Spare" shall be furnished complete with stab-ins, guide rails, guide rail supports, starter unit or feeder tap unit, doors and all control devices and other hardware to permit connection of a load.
 7. Space. Blank unassigned spaces shall be complete with vertical bus and removable covers over all openings between the unit compartment and the bus, but shall not include stab-ins, guide rails, guide rail supports, etc.
 8. Future Additions and Modifications. The ends of each end vertical section shall be arranged to allow the future installation of similar sections. Each section shall be arranged to allow the removal, addition, interchange, or replacement of individual units as may be required.
 9. Variable Frequency Drives shall be sized for the motor load and shall be in accordance with Section 26 29 23 - 600-Volt Variable Frequency Drives requirements.
- D. Circuit Breakers. Each compartment not designated as "Space" shall include a circuit breaker with RMS symmetrical interrupting rating to match MCC main bus in accordance with the requirements of Section 26 24 16 – 600-Volt Panelboards.
1. Circuit Breaker shall be three-pole, single-throw, 600-volt, molded-case air circuit breaker with not less than 25,000 amperes RMS symmetrical interrupting rating at 480-volts. All breakers, including magnetic trip only type breakers, shall bear the UL label and shall be manually operated with quick-make, quick-break, trip-free mechanisms of the toggle type. The breakers shall be equipped with suitable arc quenching devices. Main current carrying contacts shall be silver-plated and shall be capable of carrying their rated current without exceeding the UL specified temperature rise.
 2. All circuit breakers shall be of the same manufacture throughout the composite motor control center assembly.
 3. Manual operating handles shall be furnished on the access doors of the compartment to operate the circuit breaker. Provisions shall be made for padlocking each handle in the open position. Each operating handle shall indicate when the breaker has tripped automatically.
 4. Access doors shall be interlocked with the operating handles to prevent opening the doors normally when the circuit breakers are in the CLOSED position. Provisions shall be made for overriding this interlock.
- E. Bussing
1. Main and Neutral Bus. The motor control center main horizontal and vertical busses shall be insulated copper designed to continuously carry the full load rated current as specified, without exceeding temperature rise requirements.
 - a. Main Horizontal Busses: Ampere rating equal to the Main circuit breaker frame size rating
 - b. Vertical Busses: Ampere rating equal to the sum of connected load on that buss but not less than 300-amperes.
 - 1) The bus shall be installed with rigid, non-tracking, fire-resistant, and non-hygroscopic molded insulating supports with high dielectric strength and high

- creepage surface capable of withstanding the mechanical forces imposed by short-circuit currents of the magnitude specified on the drawings.
 - 2) Bus shall be silver-plated for the entire length of the bus.
 - 3) All joints shall have silver-plated contact surfaces with minimum contact resistance.
 - 2. Ground Bus. An un-insulated copper bar ground bus with a continuous current rating of 50 percent of the horizontal main bus shall be furnished through the entire length of the motor control center. All motor control center equipment requiring grounding shall be connected to this ground bus.
 - 3. The main horizontal bus shall be isolated from the horizontal wiring trough by means of removable barriers. The vertical bus shall be isolated from the removable combination starter units and feeder tap units by means of barriers that are part of the motor control center stationary structure. Barriers shall be sheet steel or other material that will pass the vertical burning test of UL 94.
 - 4. Provisions shall be made for bus expansion, to prevent undesirable or destructive mechanical strains in the bus supports and connections, through a full-ambient temperature range from -30°C to +50°C. Expansion joints shall be furnished where required.
- F. Cable Entry and Termination
- 1. External Connections. Facilities for the entrance, support, termination, and connection of power, control, and ground conductors shall be furnished in accordance with NEMA requirements for Class I, Type B motor control centers, and in accordance with the following requirements.
 - a. An incoming line termination compartment shall be provided for entry cables. The manufacturer shall extend the main bus into a compartment of the vertical section for termination of the incoming line. Each incoming line termination compartment shall be not less than 18 inches high and shall be located at the top or bottom of the vertical section to coordinate with the direction of incoming line cable entrance specified.
 - b. Adequate openings shall be furnished for all power cable and control cable entering the motor control center from both top and bottom as indicated on the drawings.
- G. Configuration
- 1. All motor starter units and feeder circuit breakers shall be readily interchangeable with units of same type and size. In addition, all NEMA size 1 and 2, full voltage, single-speed, non-reversing combination motor starters shall be readily interchangeable with each other. NEMA sizes 3, 4 and 5 combination, single-speed, non-reversing combination starters shall occupy spaces, that are multiples of the space occupied by the NEMA size 1 and 2 starters.
 - 2. Two (2) 100 ampere frame feeder tap unit circuit breakers shall be mounted in the space required for one NEMA size 1 or 2, full voltage, single-speed, non-reversing combination starter. One (1) 225 ampere or larger feeder tap unit breaker shall be mounted in the space required for one (1) NEMA size 2 full voltage, single-speed, non-reversing combination starter.
 - 3. All units, except Size 5 starter units and 400-ampere frame or larger feeder tap units, shall be automatically disconnected, and connected to the bus as the units are removed or replaced in the motor control center. Size 5 starter units and 400-ampere frame or larger feeder tap units shall have fixed mounting within the motor control center.
 - 4. Reduced voltage (Soft Start) solid state starters and variable frequency drives shall be provided in accordance with the requirements of other sections of these specifications and as indicated on the drawings.
- H. Integrated Short Circuit Rating. The integrated short circuit rating of the motor control center shall be as indicated on the drawings, but no less than 22,000 amperes RMS symmetrical at 480-volts, 60 Hertz nominal, and minimum 80 percent power factor.

- I. Terminals. Provide terminals for all power, control, and ground conductors entering the motor control centers. Terminal connectors shall be furnished for all incoming line cables and shall be as listed in the following table or acceptable equal. Solder-type terminals are not acceptable.
 - 1. Terminal connectors shall be furnished for all load and control conductors of combination motor starter and feeder tap units as part of the manufactured assembly.
 - 2. Each combination motor starter unit shall be furnished with terminal blocks located adjacent to the vertical wire way for termination of control cable. Terminal blocks shall be manufacturer's standard side-mounted, pressure pull-apart type control terminal blocks rated 480-volt AC. Control cable terminal blocks for combination motor starter units shall be furnished with not less than 18 terminals, with provisions for future terminal blocks.
 - 3. Connectors for attachment of ground busses to the external equipment grounding conductor system shall be suitable for copper conductors, sized to connect to the installed equipment grounding conductor. One connector shall be provided at each end of each motor control center ground bus. A load ground connector shall be furnished by the Contractor, on the ground bus, for each combination starter unit and each feeder tap unit.
- J. Nameplates. An engraved nameplate shall be furnished for the motor control center, each starter unit door, and each feeder tap unit door. In accordance with the requirements of Section 26 01 26 – Electrical Equipment Identification. Nameplate inscriptions will be as indicated on the drawings or as provided by the Engineer during shop drawing review.

1.15 MOTOR STARTER UNIT

- A. Motor Starter Units shall be full voltage single speed, non-reversing, combination type and shall include disconnect, motor circuit protector devices (MCP); branch circuit overcurrent protective devices; dry-type control transformers; contactors, thermal overload relays, auxiliary control devices, door mounted pilot devices, control relays and accessories as indicated and required.
- B. Disconnecting and branch circuit overcurrent protective devices for all combination motor starters shall be magnetic instantaneous trip-only type motor circuit protectors sized and rated in accordance with the latest National Electrical Code and manufacturer's recommendations based on the service conditions and contractor-supplied motor data.
- C. Control transformer leads, starter overload relay contacts, contactor operating coils, and starter auxiliary contacts shall be wired to marked unit terminal blocks as indicated on the typical schematic diagrams for combination starters required in this section.
- D. Control transformers shall be minimum 250-volt-amp rated and equipped with primary and secondary fusing. Control transformers shall be rated for 60 Hz and shall permit operation at a primary voltage from 440 to 480 volts with a voltage ratio of 4 to 1. Assuming 440 volts on the primary terminals, each control transformer shall maintain a minimum potential of 105 volts at its secondary terminals during starter coil inrush. Each control transformer shall be mounted as part of the removable combination starter unit. Provide disconnects for a separate control power source or any associated foreign circuit where shown or specified. Disconnects may be by normally open auxiliary contacts on the circuit breaker, a door operated switch, an enclosed relay with operating coil energized by the unit's 480-volt power, or a clearly marked manual switch located immediately adjacent to the control power transformer.
- E. Starter Contactors shall have continuous current carrying capacity as listed in NEMA ICS 2, Table 2-210-1 for that size contactor. The interrupting capacity of each starter contactor shall be not less than 10 times the rated continuous current-carrying capacity listed in NEMA ICS 2, Table 2-210-1 for that size contactor.

- F. Overload Relays. Thermal overload relays shall be furnished (in each current carrying leg). The overload capacity of the relays shall be manually adjustable through a range of 85 to 115 percent of the normal trip rating. The relays shall not be temperature compensated. Provisions shall be made for manually resetting the thermal relays without opening the starter door.
1. Overload heaters shall be furnished for all starters and shall be sized in the range of 115 to 125 percent of motor full-load current. The starters shall be shipped with overload heaters. Verify and replace the overload heaters if required, after obtaining actual motor nameplate field data.
 2. Combination motor starters shall be furnished with an auxiliary overload contact for use as an overload alarm. This overload auxiliary contact shall have a Form C, normally closed and normally open, contact and shall be wired to the starter terminal block.
 3. Provide bimetallic type overload relays. The Engineer may consider substitution and use of eutectic alloy type overload relays after evaluating the technical information, construction and experience records of the eutectic alloy overload relay proposed as provide by the Contractor.
 4. Overload relay and heater assemblies, or alternate type overload relays accepted by the Engineer, shall operate within a range of ± 5 percent of the overload relay trip setting. Assemblies, which do not meet this requirement, both when field-tested and when in actual operation, shall be replaced at no expense to the Engineer.
- G. Mechanically Operated Auxiliary Contacts
1. Each magnetic motor starter shall be furnished with a minimum of four (4) mechanically operated auxiliary contacts, two (2) normally open and two (2) normally closed, mounted on the main contactor. The use of auxiliary relays to furnish the specified quantities of auxiliary contacts for size 3 or larger starters is acceptable.
 2. Combination starter units that require line voltage to energize the main contactor operating coils shall be equipped with auxiliary contacts. Provide an operating coil sized for a total of eight (8) NO or NC auxiliary contacts mounted on the starter units.
- H. Remote Control.
1. Each magnetic starter will be controlled by remote pilot devices and a Programmable Logic Controller (PLC). All necessary internal wiring for this feature shall be furnished and connected to terminal blocks as required on the typical schematic diagrams for Combination Starters in this section.
 2. Furnish complete elementary and schematic wiring diagrams with all wires numbered for all control systems. Furnish the as-built drawings with the above and show all manufacturers equipment, control panels, devices, etc., in detail on the elementary diagram with all terminal points of such equipment indicated.
- I. Push Buttons and Selector Switches. Push buttons and selector switches shall be heavy-duty oil-tight, Allen-Bradley Bulletin 800H, Square D Class 9001 Type K, or acceptable equal. Toggle switches shall be Honeywell Micro Switch Type TL or acceptable equal.
- J. Indicating Lights. Status and Alarm indicating lights shall be cluster type light emitting diodes (cluster LED's) rated for 120-volt AC operation. Indicating light colors shall be coordinated with indicated conditions as specified in the following table. Indicating lights shall be energized when the condition exists and shall be de-energized when the condition does not exist.

LED Color	Status and Alarm Condition Indication
Amber	Equipment Control in "Auto" Mode. Controlled by Internal or External Control or Sensing Device(s). Equipment Abnormality – Circuit Breaker Trip.
Blue	Equipment Control in "Remote" Mode. Controlled by Remote device such as Level Switches or PLC or Remote Panel.

LED Color	Status and Alarm Condition Indication
Green	Equipment De-Energized - Motor Stopped, Valve Closed, Circuit Breaker Open.
Red	Equipment Energized - Motor Running, Valve Open or Circuit Breaker Closed. Alarm Indication – Abnormal Condition.
White	Equipment Power On Indication

- K. Circuit Breaker Type Feeder Tap Units. Include thermal magnetic trip type molded case air circuit breakers as specified previously. Circuit breaker thermal elements shall be bimetallic type, capable of withstanding sustained overload and short-circuit currents without injury and without affecting the calibration of the bimetallic element. The thermal elements shall have inverse time characteristics. The instantaneous elements shall trip the breaker at the adjustable minimum standard trip setting.
- L. Power Conductors. Provisions shall be made for bus expansion, to prevent undesirable or destructive mechanical strains in the bus supports and connections, through a full-ambient temperature range from -30°C to +50°C. Expansion joints shall be furnished where required.

1.16 CONTROL RELAYS AND PILOT DEVICES

- A. Solid State and Magnetic Control Relays
 - 1. Description: NEMA ICS 5, solid state relay or Class A300 magnetic control relay.
 - 2. Contacts: Form A or B (or both) as required.
 - 3. Contact Ratings: 10 amperes continuous, minimum.
 - 4. Coil Voltage: 120-volts, 60 Hz.
 - 5. Enclosure: NEMA ICS 6, Type 1.
- B. Time Delay Control Relays (On-Time Delay and Off-Time Delay)
 - 1. Description: NEMA ICS 5, solid-state time delay relay – time delay after energization or after de-energization as indicated on drawings.
 - 2. Contacts: Form A or B (or both) as required.
 - 3. Contact Ratings: 10 amperes continuous, minimum.
 - 4. Coil Voltage: 120-volts, 60 Hz.
 - 5. Enclosure: NEMA ICS 6, Type 1.
- C. Plug-in Control Relays
 - 1. Description: NEMA ICS 5, miniature, hermetically sealed relay.
 - 2. Contacts: 4 pole double throw (4PDT) Form A or B.
 - 3. Contact Ratings: 5 amperes continuous, minimum.
 - 4. Coil Voltage: 120-volts, 60 Hz.
 - 5. Enclosure: Hermetically sealed, suitable for Class 1, Division 1 and 2 installations.
 - 6. Socket: To match relay and meet conditions of installation.
- D. Switches and Push Buttons:
 - 1. Product Description: NEMA ICS 5, heavy-duty oil tight.
 - 2. Contact Ratings: 10 amperes continuous, minimum.
 - 3. Selector Switches: Rotary type.
 - 4. Toggle Switches: Honeywell Micro Switch Type TL or approved equal.
 - 5. Each switch shall have a legend plate – “Hand-Off-Auto”, “Local-Remote”, “Start-Stop”, etc. as required to describe the control mode or function.

E. Terminal Blocks

1. Description: NEMA ICS 4 terminal blocks.
2. A Power Terminal is defined as any terminal that is required to carry a current greater than 1 amp or a voltage in excess of 50-volts. Power terminals shall be of the unit construction type with closed back and tubular pressure screw connectors, rated 600 volts minimum, and with a continuous current carrying capacity of 15-amp minimum.
3. A Signal and/or Control Terminal is defined as any terminal that is required to carry a current that may not exceed 1,000 mA instantaneous and a voltage that is not to exceed 50-volt instantaneous. Signal and/or control terminals may be of the modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300-volts minimum.
4. Terminal connections shall be made using solid copper conductor. If stranded conductor is to be used, it must be terminated with a "spade" type lug. Stranded wire may not be directly landed on terminal blocks.

1.17 CORROSION PROTECTION

- A. All iron and steel components of the motor control center shall be protected against corrosion by one of the methods specified in UL 845, Paragraphs 57 and 58.
- B. Prepare surfaces for painting. The shop drawings shall include a complete description of motor control center prime and finish painting, including paint manufacturers and types, paint colors, painting processes, and dry film thicknesses.

1.18 SOURCE QUALITY CONTROL

- A. The motor control centers shall be factory-tested in accordance with NEMA standards and ANSI C37.17, together with any additional tests which may be required to ensure that the wiring is correct and that all equipment is in a satisfactory operating condition.

INSTALLATION

1.19 INSTALLATION

- A. Motor control center shall be assembled and installed in the location indicated on the drawings in conformance to applicable requirements of the NFPA 70, NECA Standard of Installation and manufacturer's instructions for assembly, leveling and alignment.
- B. All power and control circuits shall be connected to the motor control center as indicated on the drawings. The motor control center shall be grounded in conformance with the requirements of Section 26 05 26 – Basic Electrical Materials and Methods.
- C. Tightening of Connections:
 1. The Contractor shall obtain from the manufacturer complete information for tightening of all electrical connections secured with bolts or studs. The information furnished shall include torque wrench settings or complete details of other tightening procedures recommended for bus joints, connector attachments, and contact attachments. Provide this information with the submittals and in the Operation and Maintenance manuals provided to the Engineer upon project completion.
 2. All electrical connections secured with bolts or studs shall be tightened using a torque wrench or other tightening procedures recommended by the manufacturer for tightening bus joints, connector attachments, and contact attachments.

1.20 COMMISSIONING AND PERFORMANCE TESTING

- A. Commission the equipment and conduct operational tests:
 - 1. Check motor control center electrical circuits for continuity and for short circuits.
 - 2. Check all control devices including interlocks, indicating lights, control relays, timers, time delay relays, and push buttons for correct operation.
 - 3. Verify that all thermal overload heater elements are installed in each motor starter and properly sized for the actual motor full load current.
 - 4. Subsequent to power hookup, energize motor control center and demonstrate functioning of each system in accordance with requirements for the project.

PART 2 PAYMENT

Full compensation for furnishing all labor, materials, and equipment necessary to complete the work as described within this section as shown on the plans, and specified herein, and as directed by the Engineer shall be considered as included in the lump sum price paid for the respective "Electrical System, Controls System, Generator and Enclosures" bid item, and no additional payments will be allowed therefore.

END OF SECTION

SECTION 26 28 19
DISCONNECT SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section includes fusible and non-fusible switches.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Product Data: Submit switch ratings and enclosure dimensions.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.5 QUALIFICATIONS

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

PART 2 PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturer: Square D Company, or approved equal.
- B. Fusible Switch Assemblies: Horsepower rated, heavy-duty type; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
 - 1. Fuse Clips: Designed to accommodate Class R fuses only and reject all others.

- C. Non-fusible Switch Assemblies: Horsepower rated, heavy-duty type; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- D. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Handle lockable in OFF position.
- E. Fuse clips: Designed to accommodate NEMA FU 1, Class J fuses.
- F. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 4x.
- G. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- H. Furnish switches with entirely copper current carrying parts.

2.2 NON-FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturer: Square D Company, or approved equal.
- B. Non-fusible Switch Assemblies: Horsepower rated, heavy-duty type; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position enclosed load interrupter knife switch. Handle lockable in OFF position.
- D. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from [steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 4x.
- E. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- F. Furnish switches with entirely copper current carrying parts.

2.3 FUSES

- A. Manufacturers:
 - 1. Bussmann.
 - 2. Gould Shawmut.
 - 3. Littelfuse.
- B. Fuses 600 Amperes and Less: UL 198E, Class RK5, sized as indicated on Drawings.
- C. Interrupting Rating: 200,000 RMS amperes.

2.4 SWITCH RATINGS

- A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
- B. Short Circuit Current Rating: UL listed for 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600 ampere) 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes). 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200 ampere).

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned enclosed switches.
- B. Maintain access to existing enclosed switches and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Clean and repair existing enclosed switches to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install enclosed switches plumb.
- B. Height: 4 feet (1500 mm) to operating handle.
- C. Install fuses for fusible disconnect switches.
- D. Install engraved plastic nameplates
- E. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.3 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION

SECTION 26 29 13

MOTOR CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes Soft Start motor controllers.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:

1. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
2. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
3. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
4. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

- B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

- C. Underwriters Laboratories Inc.

1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- C. Test Reports: Indicate field test and inspection procedures and test results.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Project Closeout: Closeout procedures.
- B. Project Record Documents: Record actual locations and ratings of enclosed controllers.
- C. Operation and Maintenance Data: Submit Replacement parts list for controllers.

- D. Furnish as-built elementary and schematic drawings with all manufacturer's equipment, control panels, devices, etc., in detail on the elementary diagram with all terminal points of such equipment indicated.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years' experience.
- B. Supplier: Authorized distributor of specified manufacturer with minimum three years' experience with that manufacturer's products.

1.6 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication

PART 2 PRODUCTS

2.1 MOTOR STARTER UNITS

- A. The following is a list of acceptable manufacturers for motor starter units:
 - 1. Allen Bradley / Rockwell Automation.
 - 2. Eaton Electric.
 - 3. General Electric Company.
 - 4. Siemens Energy & Automation, Inc.
 - 5. Square D Company.
 - 6. Or approved equal.
- B. Motor Starter Units shall be full-voltage, single-speed, non-reversing, combination motor starter units and shall include disconnecting and branch circuit over-current protective devices; dry-type control power transformers; contactors, overload relays, auxiliary control devices, door mounted pilot devices, control relays and accessories as indicated and required for the system provided.
- C. Disconnecting and Branch Circuit Overcurrent Protective Devices for all motor starters shall be magnetic, instantaneous trip-only type, motor circuit protector circuit breakers sized and rated in accordance with the latest NEC and the manufacturer's recommendations based on the service conditions and contractor-supplied motor data.
- D. Starter Contactors shall have rated continuous current carrying capacity as listed in NEMA ICS 2, Table 2-210-1 for that size contactor. The interrupting capacity of each starter contactor shall be not less than 10 times the rated continuous current-carrying capacity listed in NEMA ICS 2, Table 2-210-1 for that size contactor.
- E. Overload Relays. Thermal overload relays shall be furnished in each phase leg of each motor starter. Provisions shall be made for manually resetting the thermal relays without opening the starter door.
- F. Mechanically Operated Auxiliary Contacts. Each magnetic motor starter shall be furnished with a total of two (2) mechanically operated auxiliary contacts, normally open, convertible in the field, and mounted on the main contactor. The use of auxiliary relays to furnish the specified quantities of auxiliary contacts will not be acceptable.

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- G. Each starter will be controlled by remote pilot devices. All necessary internal wiring for this feature shall be furnished and connected to terminal blocks.
- H. Verify required control voltage and furnish starter with compatible coil voltage, or replacement coil.

2.2 FULL-VOLTAGE NON-REVERSING CONTROLLERS

- A. Enclosure: NEMA ICS 6, to meet conditions of installation.
- B. Control Voltage: 120 volts, 60 Hertz, or as indicated on the Drawings.
- C. Overload Relay: NEMA ICS 2; bimetal.
- D. Product Features:
 - 1. Auxiliary Contacts: NEMA ICS 2, 2 each field convertible contacts in addition to seal-in contact.
 - 2. Cover Mounted Pilot Devices: NEMA ICS 5, standard duty type.
 - 3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
 - 4. Pushbuttons: Lockable type.
 - 5. Indicating Lights: LED type.
 - 6. Selector Switches: Rotary type.
 - 7. Relays: NEMA ICS 2, as required per Drawings.
 - 8. Control Power Transformers: 120 volt secondary, 250 VA minimum, in each motor starter. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
- E. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to UL 489, with integral thermal and instantaneous magnetic trip in each pole.
- F. Enclosure: NEMA ICS 6, Type 1 or 4 to meet conditions of installation.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install controllers plumb. Provide supports in accordance with Section 26 05 29 – Hangers and Supports for Electrical Systems.
- B. Height: 5 feet maximum, 3 feet minimum to operating handle.
- C. Select and install overload heater elements in motor controllers to match installed motor characteristics.

- D. Install engraved plastic nameplates. Refer to Section 26 05 53 – Identification for Electrical Systems for product requirements and location.
- E. Neatly type label and place inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

3.2 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements, 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.16.1.
- D. Check phase-to-phase and phase-to-ground insulation for proper resistance levels. Check motor control center electrical circuits for continuity and for short circuits.
- E. After wire and cable hookups, energize motor controllers and demonstrate functioning in accordance with requirements.
- F. All control devices including interlocks, indicating lights, control relays, timers, time delay relays, and push buttons shall be checked for correct operation.

END OF SECTION

SECTION 26 29 23

VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Variable frequency drives.

1.2 REFERENCES

- A. Reference Standards:
 - 1. Section 01 40 00 - Quality Control: Requirements for references.
 - 2. Institute of Electrical and Electronics Engineers:
 - a. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 - 3. National Electrical Manufacturers Association:
 - a. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - c. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives.
 - d. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.
 - 4. International Electrical Testing Association:
 - a. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
- D. Test Reports: Indicate field test and inspection procedures and test results.
- E. Manufacturer's Field Reports: Indicate startup inspection findings.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Project Closeout: Requirements for closeout submittals.

- B. Operation and Maintenance Data: Submit instructions complying with NEMA ICS 7.1. Include procedures for starting and operating controllers, and describe operating limits possibly resulting in hazardous or unsafe conditions. Include routine preventive maintenance schedule.
- C. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 3 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. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle according to manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

1.7 AMBIENT CONDITIONS

- A. Conform to NEMA ICS 7 service conditions during and after installation of variable frequency controllers.

1.8 WARRANTY

- A. Section 01 70 00 - Project Closeout: Requirements for warranties.
- B. Furnish 4-year manufacturer warranty for variable frequency controller.

PART 2 PRODUCTS

2.1 VARIABLE FREQUENCY CONTROLLER

- A. Manufacturers:
 - 1. Xylem Aquavar IPC Model AVA40400 series
 - 2. Or approved Equal.
- B. Description: NEMA ICS 7, enclosed variable frequency controller suitable for operating specified loads. Select unspecified features and options according to NEMA ICS 7.1.
- C. Ratings:
 - 1. Rated Input Voltage: 480 volts (V), three phase, 60 Hz.
 - 2. Motor Nameplate Voltage: 460 volts (V), three phase, 60 Hz.

3. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
4. Operating Ambient: 14 to 113 degrees F (-10 to 45 degrees C).
5. Minimum Efficiency at Full Load: 98 percent.
6. Time to Stop: 6 seconds.

D. Design Features:

1. Employ microprocessor-based inverter logic isolated from power circuits.
2. Employ pulse-width-modulated inverter system.
3. Design for ability to operate controller with motor disconnected from output.
4. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.

E. Indicators and Manual Controls:

1. Input Signal: 4-20 mA
2. Display: Furnish integral digital display to indicate output voltage, output frequency, and output current.
3. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.
4. Volts per Hertz Adjustment: Plus or minus 10 percent.
5. Current Limit Adjustment: 60 to 110 percent of rated.
6. Acceleration Rate Adjustment: 0.5 to 30 seconds.
7. Deceleration Rate Adjustment: 1 to 30 seconds.
8. HAND-OFF-AUTOMATIC selector switch and manual speed control.
9. Control Power Source: Integral control transformer.

F. Safeties and Interlocks:

1. Door Interlocks: Mechanical means to prevent opening of equipment with power connected, or to disconnect power when door is opened; include means for defeating interlock by qualified persons.
2. Safety Interlocks: Terminals for remote contact to inhibit starting under both manual and automatic mode.
3. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.
4. Manual Bypass: Includes contactor, motor running overload protection, and short circuit protection for full voltage, non-reversing operation of motor. Includes isolation switch to allow maintenance of inverter during bypass operation.
5. Emergency Stop: Use dynamic brakes for emergency stop function.
6. Disconnecting Means: Integral fused disconnect switch with clips for NEMA FU 1, Class J fuses on line side of each controller.

G. Fabrication:

1. Wiring Terminations: Match conductor materials and sizes as shown on the Drawings.
2. Enclosure: NEMA 250, Type 1; suitable for equipment application in places restricted to persons employed on premises.
3. Finish: Manufacturer's standard enamel.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Control: Testing, inspection, and analysis requirements.
- B. Shop inspect and perform standard production tests for each controller.

- C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify owner and engineer at least 7 days before inspections and tests are scheduled.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 – Project Closeout: Verification of existing conditions before starting work.
- B. Verify building environment is maintained within service conditions required by manufacturer.

3.2 EXISTING WORK

- A. Disconnect and remove abandoned controllers.
- B. Clean and repair existing controllers to remain or to be reinstalled.

3.3 INSTALLATION

- A. Install according to NEMA ICS 7.1.
- B. Tighten accessible connections and mechanical fasteners after placing controller.
- C. Install fuses in fusible switches.
- D. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- E. Install engraved plastic nameplates according to Section 26 05 53.
- F. Neatly type label inside controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.
- G. Ground and bond controller according to Section 26 05 26.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Control: Field inspecting and testing.
- B. Inspect and test according to NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.16 and NEMA ICS 7.1.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Control: Requirements for Requirements for manufacturer's field services.
- B. Prepare and startup variable frequency controller.

3.6 DEMONSTRATION AND TRAINING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Furnish 2 hours of instruction each for two persons.

3.7 MAINTENANCE

- A. Furnish service and maintenance of variable frequency controller for 1 year from the date of Substantial Completion (Performance).

END OF SECTION

SECTION 31 00 00

EARTHWORK

PART 1 GENERAL

1.1 DESCRIPTION

- A. Earthwork shall consist of performing all operations necessary for excavation, subgrade preparation and grading where applicable.
- B. All work shall conform to the lines, grades and cross-sections or elevations shown on the Drawings. Prior to placing fill, the area shall be cleared and grubbed in conformance with Section 31 11 00, "Site Clearing and Grubbing." The exposed area shall then be disked, plowed, benched and/or compacted as directed by the Engineer or specified herein, to insure proper bonding and compaction.
- C. Prior to bid, Contractor shall verify existing topography and notify Engineer of any discrepancy between existing topographic information indicated on the plans and actual field topographic data. Failure to notify Engineer of any discrepancy prior to bid indicates Contractor acceptance of existing conditions in conformance with those shown on the Plans.
- D. See Section 02 32 00, "Geotechnical Investigation Data" for Soils Report prepared for the project.
- E. Recycled Water Tank Location:
 - 1. The tank site is predominantly underlain by three soil units. Unit 1 at the top is soft to very stiff fat clay and lean clay. Unit 2 materials were encountered below Unit 1 soils and generally consist of medium dense to very dense and poorly graded sand with clay, clayey sand, silty sand and poorly graded sand. Unit 3 materials were encountered below Unit 2 soils and consist of variably weathered and fractured sedimentary rock.
 - 2. Soil strengthening improvements, sub-excavation and compaction will be required to densify the upper layer of soil to make it suitable for foundations.
 - 3. Groundwater was encountered in the exploratory borings at the site, and may be present at varying depths depending on time of year and precipitation history. Groundwater was encountered at a depth of approximately 18 feet below ground. Seasonal fluctuations in the local groundwater table at the project site and vicinity are generally highest at the end of the winter rainy season and lowest at the end of the summer dry season. The Contractor should expect groundwater and soil moisture conditions within the project area to vary depending on seasonal rainfall and runoff conditions. Groundwater may be present close to the ground surface during prolonged wet winter weather. Groundwater will drop during dry summer and fall weather.
- F. State Route 1 HDD Crossing:
 - 1. State Route 1 and Little Lake Road in the vicinity of the trenchless pipeline construction is predominantly underlain by two soil units. Unit 1 at the top is asphalt concrete and aggregate base generally consisting of dense to very dense well-graded sand with silt and silty sand. Unit 2 materials were encountered below Unit 1 soils and generally consist of variably weathered/fractured sedimentary rock. The rock unit consists of sandstone underlain by siltstone and shale.
- G. Wastewater Treatment Plant Site:
 - 1. The site of the chlorine contact tank and recycled water storage tank at the WWTP is blanketed by topsoil consisting of dark brown silty sand that is loose to a depth of about 2

feet. Underlying the topsoil layer is brown silty sand that is medium dense and varies from 3 feet to a depth of about 9.5 feet. Below the silty sand to the maximum depth explored of 19.5 feet, is a light grayish sandstone of the Franciscan Formation that ranges from highly to moderately weathered.

- H. Existing power and telephone lines, trees, fences, pipelines or other conduits, embankments, and structures in the vicinity of the work that are to remain shall be supported and protected from injury by the Contractor during the construction and until the completion of the Work. The Contractor shall be liable for all damages to such structures, as herein provided, and shall save and keep the District and Engineer harmless from any liability or expense for injuries, damages, or repairs to same.
- I. Excess material from the excavation shall become the property of the Contractor and shall be disposed of by him at his expense.

1.2 RELATED ITEMS DESCRIBED ELSEWHERE:

- A. California Department of Transportation, Standard Specifications, 2025.
- B. Section 02 01 00 - Site Conditions.
- C. Section 02 01 10 - Existing Utilities and Underground Structures.
- D. Section 02 32 00 - Geotechnical Investigation Data.
- E. Section 31 01 40 - Shoring and Trench Safety.
- F. Section 31 09 13 - Geotechnical Instrumentation and Monitoring.
- G. Section 31 11 00 - Site Clearing and Grubbing.
- H. Section 31 23 00 - Trench Excavation and Backfill.
- I. Section 31 23 19 – Dewatering.
- J. Section 33 05 23.13 - Horizontal Directional Drilling.

1.3 QUALITY ASSURANCE

- A. Qualifications of workmen: Provide sufficient skilled workmen and supervisors who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of construction involved and the materials and techniques specified.
- B. Codes and Standards:
 - 1. Wherever a test method is referenced in this Section it shall be made in accordance with the most current test methods in use by the California Department of Transportation (Caltrans) as listed in the State Standard Specifications, latest edition, or ASTM method as listed below at the District's option:

TEST	TEST METHOD
Standard Specification for Concrete Aggregates	ASTM C33
Particle-Size Analysis of Soils	ASTM D422
Density of Soil in Place by Sand Cone Method	ASTM D1556
Moisture-Density Relations of Soil & Soil Aggregates	ASTM D1557
Unconfined Compressive Strength of Cohesive Soil	ASTM D2166

Laboratory Determination of Water Content of Soil & Rock	ASTM D2216
Classification of Soils for Engineering Purposes	ASTM D2487
Resistance R-Value and Expansion Pressure of Compacted Soils	ASTM D2844
Density of Soil and Soil-Aggregate in Place by Nuclear Methods	ASTM D2922
Density of Soil in Place by the Drive-Cylinder Method	ASTM D2937
Direct Shear Test of Soils Under Consolidated Drained Conditions	ASTM D3080
Liquid Limit, Plastic Limit, & Plasticity Index of Soils	ASTM D4318
Expansion Index of Soils	ASTM D4829

2. Where reference is made to the State Standard Specifications, reference shall mean the State of California, Department of Transportation (Caltrans), Standard Specifications, 2018, excluding measurement and payment Sections.

1.4 TESTING

- A. Relative compaction, moisture, and permeability tests will be made at locations determined by the Engineer. When tests indicate that the specified compaction has not been achieved, that portion of the Work shall be reworked until the required density, moisture, and permeability has been attained.
- B. The Contractor shall be responsible for the sampling and testing costs associated with any failed test.
- C. The Contractor shall be responsible for the sampling and testing costs associated with soil disposal requirements for soils that are not determined to be contaminated.
- D. The Geotechnical Engineer will perform all observations and testing for excavations and trenches.
- E. A minimum of 72 hours' notice shall be given to the Engineer by the Contractor prior to commencing or recommencing any grading operation.

1.5 SUBMITTALS

- A. Submit all product data, shop drawings, laboratory test results, material source information, and certificates of compliance listed in this Section under a single submittal cover for review. Incomplete submittals will not be reviewed.
- B. Gradation curves for all aggregate material being used on the project.
- C. Samples: In accordance with the provisions of Section 01 33 00, "Submittals," of the specifications, submit samples of all materials 15 days prior to construction. Periodic testing of the material will also be made during construction.
- D. Product Data: submit data for geotextile fabric indicating fabric properties, test methods, and manufacturer's installation instructions.
- E. Material Source: Submit name of imported fill materials supplied.
- F. Load slips for all material delivery trucks shall be delivered to the job site with the truck. (The Contractor shall retain all load slips and shall make them available to the Engineer upon request.)
- G. Proposed methodology of excavation and embankment for reconstruction of slopes, and any proposed embankment material substitutions.

- H. Manufacturer's Certificate: Submit Certifications that products meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 TOPSOIL AND UNDOCUMENTED FILL

- A. Topsoil is classified as the top three inches of excavated material including buried organics, shallow vegetation roots and other deleterious materials and excluding cleared and grubbed materials.
- B. Undocumented fill pertains to soils previously imported and placed at the project site.

2.2 GENERAL FILL MATERIAL

- A. Shall be non-expansive and free of debris and organic material, with a Liquid Limit less than 35 and a plasticity index less than 12 percent as determined by ASTM D4318, shall not contain clumps/rock larger than 3 inches, and should consist predominantly of materials less than 1/2 inch in greatest dimension.
- B. Existing material excavated on site may be used as general fill provided it meets the requirements of subparagraph 2.2.A, after vegetative matter, rocks larger than 3 inches, and other debris is removed and after approval by the Geotechnical Engineer.
- C. All on-site and off-site sources of fill shall be approved by the Geotechnical Engineer a minimum of 2 working days prior to placement or importation to the site.
- D. Standard Specifications, Section 19-3.02C, Structure Backfill.

2.3 ENGINEERED FILL

- A. Material specified in paragraph 2.2, except that river run aggregate and potentially expansive soils shall not be used as engineered fill within the top 3 feet of subgrade beneath lightly loaded structures, building foundations, concrete slabs and paving. Highly plastic soils (Plasticity Index >25) should not be placed in areas that support foundations or pavements.
- B. Standard Specifications, Section 26, Class 2, 3/4-inch maximum.

2.4 IMPORT FILL

- A. Imported fill shall be approved by the Geotechnical Engineer, and shall:
 - 1. Be predominately granular.
 - 2. 100% passing a 3-inch sieve.
 - 3. A Liquid Limit less than 35.
 - 4. A plasticity index less than 12 percent.

2.5 STRUCTURAL AGGREGATE

- A. Structural aggregate material shall consist of washed angular aggregate with the following ASTM D422 test particle size distribution:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/4 Inch	100%
No. 4	0-5%

No. 200 0-3%

2.6 PIPE BEDDING MATERIAL

- A. Pipe bedding material shall have a minimum sand equivalent value of 30 and shall conform to the following ASTM D422 test particle size distribution:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 Inch	100%
3/4 Inch	100%
3/8 Inch	80% - 100%
No. 4	10% - 50%
No. 16	5% - 30%
No. 200	0% - 4%

2.7 TRENCH BACKFILL MATERIAL

- A. The following materials may be used as Trench Backfill Material above the pipe zone in unpaved areas:
1. General Fill Material.
 2. Engineered Fill Material.
 3. Standard Specifications, Section 19-3.02C, Structure Backfill.
 4. Standard Specifications, Section 26, Class 2, 3/4-inch maximum. Required within paved roadway areas in the County of Mendocino Right-of Way.
- B. Backfill shall be placed and compacted as described in Paragraph 3.12.
- C. Backfill for trench sections in finished gravel surface areas shall be as indicated on the Drawings.

2.8 PERMEABLE MATERIAL

- A. State Standard Specification Section 68.2.02F(3), Class 2.

2.9 AGGREGATE BASE

- A. Standard Specifications, Section 26-1.02B, Class 2, 3/4-inch maximum.

2.10 SAND

- A. Standard Specifications, Section 19-3.02F(2), Salt Free.

2.11 PEA GRAVEL

- A. Pea gravel material shall be clean, dried, free of organic/deleterious materials, have a minimum sand equivalent value of 30 and shall conform to the following ASTM C33 test particle size distribution:

<u>Sieve Size</u>	<u>Percent Passing</u>
1/2 Inch	100%
3/8 Inch	85% - 100%
No. 4	10% - 30%
No. 8	0% - 10%
No. 200	0% - 15%

2.12 SUBGRADE ENHANCEMENT GEOTEXTILE

- A. Standard Specifications, Section 96-1.02O, Class B1.

2.13 GEOGRID

- A. General: manufactured from a coextruded, composite polymer sheet, which is then punched and oriented. The resulting structure consists of continuous and non-continuous ribs forming three aperture geometries (hexagon, trapezoid, and triangle) and an unimpeded suspended hexagon.
- B. Manufacturer:
 - 1. Tensar InterAx NX750 Geogrid.
 - 2. Approved Equivalent.

PART 3 EXECUTION

3.1 GENERAL

- A. Verify exact location (horizontal and vertical) of all utilities by potholing prior to the start of excavation. Underground pipe or conduits to remain shall be protected during the work to not disturb their function.
- B. All active portions of the construction site and material excavations shall be sufficiently watered to prevent excessive amounts of dust. Watering shall occur at least twice a day with complete coverage, preferably in the late morning and after work for the day.
- C. All grading, earthmoving and excavation shall cease during periods of winds greater than 20 miles per hour average over a one hour period.
- D. All material transported offsite shall be either sufficiently watered or securely covered to prevent excessive amounts of dust.

3.2 Areas disturbed by earthmoving or excavation activities shall be minimized at all times.

- A. Clearing and grubbing shall conform to Section 31 11 00, "Site Clearing and Grubbing."

3.3 TOPSOIL EXCAVATION

- A. Remove all topsoil and organics.
- B. Material specified in Paragraph 2.1 shall be removed before commencement of any excavation. Do not use this material for fill or backfill, except as approved by the Geotechnical Engineer. Topsoil shall be spread on fill slopes or other areas of the site approved by the Engineer.

3.4 STORAGE OF MATERIALS

- A. It shall be the sole responsibility of the Contractor to store all earthwork material in a safe location out of the construction area and travel way, in a manner that does not allow sediment to migrate into storm drains or waterways.

3.5 DISPOSAL OF WASTE MATERIAL

- A. Refer to Technical Specification Section 01 74 19 – Construction Waste Management.
- B. Burning is prohibited. Remove unsuitable material from the site in accordance with all local laws, codes and ordinances.
- C. Existing clean suitable fill material may be stockpiled at a designated location on site after approval by the Engineer.

3.6 COMPACTION EQUIPMENT

- A. Compaction Equipment: All compaction shall be by mechanical means. Compaction equipment shall be of suitable type and adequate to obtain the densities specified and approved.

3.7 GENERAL EXCAVATION

- A. Perform all excavation of every description, regardless of the type, nature, or condition of material encountered, as specified, shown, or required to accomplish the Work.
- B. The Contractor shall control excavations and stockpiling in a manner to prevent water from entering the excavations. Protect excavations and stockpiles from weather, water ponding, water inflow, and moisture intrusion. Material for fill, backfill, or for protection of excavations from surface drainage shall be neatly placed and kept shaped and covered so as to cause no dust or interference with other work.
- C. The Contractor shall control excavations through careful backfill and shoring placement that prevents excavation wall sloughing, and shall remove all material that sloughs into the excavation. In addition, all voids or cavities that result from sloughing excavation walls shall be backfilled and compacted with the same material used to backfill the excavation, installed at the same relative compaction percentage requirements as shown on the excavation detail for that excavation. If, in the opinion of the Engineer, additional asphalt, concrete, or other surface material must be removed to compact or vibrate the backfill placed in these voids or cavities adequately, the Contractor shall sawcut and remove the surface material to the limits of the voids or cavities as directed by the Engineer. All costs associated with the removal of material that has sloughed into the trench; placement and compaction of the additional backfill material; and the sawcutting, removal, and patching of additional surface material shall be the sole responsibility of the Contractor, and no additional payment will be made to the Contractor for this work.
- D. The Geotechnical Engineer shall observe all excavated bottoms, including foundations and utility structures and trenches, following removal of material. Unsuitable materials observed by the Geotechnical Engineer in the excavated bottom shall be removed by the Contractor and stabilized using Engineered Fill material, as specified in Paragraph 2.3.

3.8 STRUCTURAL EXCAVATION

- A. Recycled Water Tank:
 - 1. Overexcavate at least 6 feet horizontally beyond the tank foundation in every direction, and to a minimum depth of 18 inches below the bottom of the tank foundation.
 - 2. The exposed subgrade shall be approximately level, scarified to a minimum depth of 6 inches, moisture conditioned to near optimum, and compacted to at least 90 percent relative compaction in accordance with ASTM D1557.
 - 3. Place a layer of geogrid on the prepared subgrade.

4. Place 12 inches of Class 2 Aggregate Base in maximum 8-inch-thick loose lifts. Compact each lift to at least 90 percent relative compaction in accordance with ASTM D1557.
 5. Place a second layer of geogrid on the compacted aggregate base.
 6. Place 6 inches of Class 2 Aggregate Base in one maximum 8-inch-thick loose lift. Compact to at least 90 percent relative compaction in accordance with ASTM D1557.
 7. Place the remaining Engineered Fill in maximum 8-inch-thick loose lifts. Compact each lift to at least 90 percent relative compaction in accordance with ASTM D1557.
- B. In other areas where structural fill is to be placed, over-excavate the upper three feet of soils beneath the entire fill and/or building area and extending a minimum of three feet beyond the limits of the structure and/or building foundation in all directions, or as otherwise shown on the Drawings.
- C. Excavate for structures to the lines and grades shown on the Drawings or as required to accomplish the Work. Perform all excavation regardless of the type, nature, or condition of the material encountered. Shore and brace (e.g., driven sheet piles, trench bracing) excavations as required. Protect adjacent utility facilities to remain. Remove all debris and sort material to be reused as Engineered Fill. The method of excavation used is optional; however, no heavy equipment shall be operated within 4 feet of existing structures or newly completed construction, except as approved by the Engineer. Excavation that cannot be accomplished without endangering existing or new structures shall be performed with hand tools. All benching, shoring and sloping of excavations shall be at the Contractor's expense.

3.9 REMOVAL OF WATER

- A. See Section 31 23 19 – Dewatering.
- B. The Contractor shall provide and maintain sufficient means and facilities to divert, remove, and properly dispose of all water in the area of the excavation from any source. Failure to protect excavations from water inflow and infiltration does not constitute grounds for a change order. Contractor shall maintain all work areas and excavations in a clean, dry, and safe condition.
- C. The Contractor shall dewater all excavations to keep groundwater out of the excavation. Water shall not be allowed in excavations during concrete pours, or bedding, utility placement, backfill, and compaction operations. Dewatering shall be accomplished by methods that will ensure a water-free excavation, preserve the design lines and grades of the bottom of the excavations, maintain the groundwater level at least 1 foot below the excavation design grade, and prevent the loss of fines from the bottom of the excavation. Dewatering shall be a continuous 24-hours-a-day, 7-days-a-week operation until construction and backfilling are complete. Disposal of dewatering product shall conform to the requirements of the Regional Water Quality Control Board (RWQCB) and local agencies having oversight authority. Sediment laden dewatering product shall not be discharged to the ground, to drainage structures, piping, or channels, or to surface water bodies.
- D. If excessive groundwater is present and cannot be adequately controlled, or if "pumping" of the subgrade material occurs during compaction, the Engineer may deem the bottom of the excavation unsuitable for placement of backfill material (see Paragraph 3.7).
- E. Water disposal shall meet Federal, State, and local requirements and as specified.

3.10 SUBGRADE STABILIZATION

- A. Any base or soft areas shall be brought to the attention of the Geotechnical Engineer for evaluation of over-excavated depth and stabilized. Stabilization may be accomplished by

excavating to firm, native material and replacing with engineered fill. If unsuitable materials are observed within the excavation bottom by the Geotechnical Engineer over-excavation will be required.

- B. Areas receiving fill shall be prepared according to the following, unless noted otherwise on the Drawings or in this Specification:
 - 1. Scarified to a depth of at least 12-inches.
 - 2. Moisture conditioned to within 2 percent of optimum moisture content.
 - 3. Compacted to at least 90 percent relative compaction in accordance with ASTM D1557.

3.11 OVER-EXCAVATION

- A. If groundwater or excessive soil moisture prevents operations described in 3.9.B, the bottom of the excavation may require over-excavation and a layer of subgrade stabilization fabric and aggregate base placed on the excavation bottom to provide a firm base on which to place and compact subsequent fill. The thickness of the aggregate base layer and/or need for subgrade stabilization fabric shall be evaluated by the Geotechnical Engineer at the time of excavation.
- B. If the bottom of an excavation is found to consist of soft or unstable material that is incapable of properly supporting the pipe or structure, the Engineer shall be advised immediately in writing.
- C. The Contractor shall obtain the Engineer's approval prior to performing any over-excavation. Any over-excavating and resultant backfill and compaction without such approval shall be at the Contractor's expense. The quantity of approved unsuitable material excavated and its replacement shall be paid for as extra work only with the authorization of the Engineer and in accordance with the Contract Documents.
- D. Where undocumented fill is encountered during construction, Contractor shall over-excavate and recompact per requirements of Paragraph 3.11.D.

3.12 ROCK EXCAVATION

- A. Rock excavation is included in general and structural excavation, and shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding deposits, and unstratified masses; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits and sandstone which are so firmly cemented that they possess the characteristics of solid rock.
- B. Explosives and Blasting: Use of Explosives and Blasting will not be permitted.

3.13 MOISTURE CONDITIONING

- A. The term "moisture conditioning" as used in these Specifications, is defined to refer to any approved method of obtaining a required moisture content for materials to be compacted. Included under moisture conditioning requirements shall be the furnishing of all required water and the furnishing of all other necessary labor, materials and equipment required to provide the approved or required percent of moisture content. Moisture conditioning, as required, shall be performed for all materials specified to be compacted regardless of whether or not such requirement is specifically stated. No separate payment will be made for any or all operations of the Contractor pertaining to moisture conditioning or from delays occasioned thereby.
- B. Prior to and during compaction, all earthwork materials specified to be compacted, including but not limited to backfill, refill and foundation subgrade, shall have an approved moisture content which shall be uniform in each layer of material compacted. If the moisture content is

less than the approved requirement, compaction operations shall not proceed until the Contractor has added the necessary amount of water. If the moisture content is greater than the approved requirement, compaction operations shall not proceed until such time as the materials have dried sufficiently or have been otherwise mechanically dewatered or replaced with materials having the approved moisture content. The soil should be mixed after water is added to distribute the water evenly throughout the lift. Sufficient time should be allowed between water application and compaction to allow the water to penetrate the soil clods and reach a uniform value in the lift. If the soil is too moist, aeration will be required to lower moisture content to the desired level.

- C. Contractor shall be responsible to demonstrate throughout the duration of all earthwork operations, that required moisture conditioning limits are being obtained. Care must be exercised to ensure that the moisture content is not above moisture requirements. This is to ensure that the structural stability of the material is not affected.

3.14 COMPACTION

- A. For general engineered fill construction, the following compaction requirements apply:
 - 1. Maximum 8-inch lifts of uncompacted thickness.
 - 2. Compact to a minimum 90% relative compaction as determined by ASTM D1557 for fills less than 5 feet in thickness. For fills 5 feet or thicker, the fill shall be entirely compacted to at least 95% relative compaction.
- B. For structural fill construction, the following compaction requirements apply:
 - 1. Maximum 8-inch lifts of uncompacted thickness.
 - 2. Compact to a minimum 90% relative compaction as determined by ASTM D1557.
- C. The upper 3 feet of on-site trench backfill in slab and pavement areas should be compacted to at least 95% relative compaction. Jetting is not acceptable for compaction of trench backfill.
- D. Nuclear density testing should be performed on each lift of compacted fill to confirm compaction at a frequency of at least one test:
 - 1. Per 5,000 cubic yards for mass fill
 - 2. per 5,000 square feet for building pad, tank pad, and parking lot subgrade
 - 3. per 300 feet for trench or wall backfill
 - 4. per 300 feet for roadway subgrade (<40 feet wide)

3.15 SITE GRADING

- A. Perform all earthwork to the lines and grades as shown and/or established by the Engineer. Shape, trim, and finish slopes to conform to the lines, grades, and cross sections as shown or approved. Make slopes free of all exposed roots and stones exceeding 3 inches in diameter which are loose and liable to fall. Round tops of banks to circular curves, in general, not less than a 6-foot radius. Rounded surfaces shall be neatly and smoothly trimmed.
- B. Work that has been suspended by weather, scheduling or for any other reason, shall be protected against the effects of such weather or other conditions. Grading which has been considered acceptable, but which has been subsequently damaged shall be re-worked to meet the requirements of the Specifications.
- C. Slopes shall be re-dressed as required to mitigate any erosion that may occur prior to establishment of the erosion control mitigation measures.
- D. All grades shown on the Plans are expressed as finished elevations.

- E. Permanent cut and fill slopes shall be no steeper than 2H:1V. Fill slopes should be laterally overbuilt at least one foot, and the slope face trimmed back to firm, compacted material.
- F. Fills placed on slopes with inclinations of 6H:1V or steeper shall be benched during placement of engineered fill. The benches shall consist of a level surface excavated at least 4 feet horizontally into native subgrade. The benches shall continue progressively up the slope at vertical increments of not greater than 3 feet.
- G. Fill placed on slopes steeper than 4H:1V shall be keyed into firm native soil at the toe of the fill slope. The bottom of the keyway shall extend a minimum of 3 feet below the downslope grade at the toe of the proposed fill and have a minimum width of 10 feet extending beneath the toe of the fill slope with a gradient of no less than 5% toward the back of keyway.
- H. Upon field observations at the time of construction, the Geotechnical Engineer may determine subdrainage of the keyways is necessary.

3.16 CONCRETE SLABS ON GRADE

- A. Excavate to subgrade, scarify 6-inches and compact to at least 90% of the ASTM D1557 maximum dry density with a moisture content within 2 percent of the ASTM D1557 optimum moisture content.
- B. Install structural aggregate layer to the thicknesses shown on the Drawings and compact to a minimum of 90 percent of the ASTM D1557 maximum dry density with a moisture content within 2 percent of the ASTM D1557 optimum moisture content.

3.17 CONTAMINATED SOILS HANDLING

- A. Contaminated soils are not anticipated to be encountered during construction.
- B. If contaminated soil is discovered during construction activities, notify the Engineer and District.
- C. Contractor to maintain separate stockpiles for potentially contaminated soil such that potentially contaminated soil is not commingled with non-contaminated soil.
- D. Contractor to prepare a 10-mil, polyethylene plastic sheeting lined containment area for stockpiling and covering of potentially contaminated soils. Overlap the plastic sheeting a minimum of two feet to prevent run off underneath the plastic sheeting.
- E. Collect soil samples to fully characterize excavated soil for disposal and manage accordingly. Sample, according to protocols set forth in ASTM E1903-97, Standard Guide for Environmental Site Assessments: Phase II Environmental Site Assessment Process, any soils generated as a result of excavations in these areas, as well as the bottoms and side walls of any such excavations.
- F. Contractor to hire a California-certified laboratory to sample and test the potentially contaminated soil in accordance with sampling requirements of the nearest Class II or III landfill that accepts contaminated soils, or other type of disposal means preapproved by the District, as laboratory results indicate. In general, for gasoline and diesel contaminated soils, this includes the collection of one 4-point composite for every 100 cubic yards of excavated contaminated soil, and analysis for TPH-gas and TPH-diesel by EPA 8015, and for volatile organic compounds by EPA 8260.

- G. Should the laboratory testing confirm the presence of contaminated soil, submit test results and any additional reporting requirements to the Class II or III landfill at least three working days prior to the planned disposal date.
- H. Upon review of the test results, the Class II or III landfill will determine if the contaminated soil may be disposed of at the facility.
- I. If the test results exceed the acceptance limits of the Class III landfill, Contractor shall submit test results and any additional reporting requirements to the nearest Class II landfill.
- J. Upon review of the test results, the Class II landfill will determine if the contaminated soil may be disposed at the facility or if additional testing is required.
- K. If additional testing is necessary, Contractor shall hire a California-certified laboratory to sample and test the contaminated soil in accordance with the additional sampling requirements.
- L. If characterization determines that wastes are hazardous under RCRA or CalEPA Hazardous Waste guidelines, treat and/or dispose of all contaminated soils at properly permitted facilities approved by the District and all other controlling regulatory agencies for such purposes.
- M. Complete disposal facility applications as necessary to obtain preapproval for disposal of all contaminated soil.

3.18 ADDITIONAL EXCAVATION IF CONTAMINATION IS DISCOVERED

- A. If contaminated soil is discovered during construction activities, notify the Engineer and District.
- B. Call upon an OSHA-certified, trained personnel, experienced in identifying unknown contaminants (such as a Professional Geologist or Registered Civil Engineer) to collect confirmation samples. Identify possible contaminated areas, and notify the Engineer or District. If warranted or directed by the Engineer or District, perform additional remedial excavation of soil and collect confirmation soil samples.
- C. In areas where additional remedial excavation is required, complete excavation and backfilling as requested by the Engineer, District, or trained personnel prior to continuing with project.
- D. If additional soils are excavated, follow the same protocol for stockpiling, characterizing, reloading, and disposal as described in other sections of this specification.
- E. This work will be completed as an extra scope, once total contaminated soil exceeds estimations for the project.

3.19 DISCOVERED CONTAMINATION NOT PREVIOUSLY KNOWN TO EXIST

- A. If contaminated soil is discovered where not expected and contaminants cannot be identified, call upon an OSHA-certified, trained personnel experienced in identifying unknown contaminants (such as a Professional Geologist/Engineer) to collect samples and field identify possible contaminated areas.

3.20 WASTE MINIMIZATION

- A. Minimize the generation of contaminated waste. Take all necessary precautions to avoid mixing clean and contaminated wastes.

3.21 CONTAMINATED MATERIAL STORAGE AREA MAINTENANCE

- A. When contaminated materials are present and require stockpiling, complete the following tasks:
 - 1. Stockpile Site Locations
 - 2. Liner Maintenance: Maintain a stockpile area bottom to prevent tears or holes in the plastic. Any tears shall be patched or the area relined with 10-mil plastic within 24 hours. Sweep clean roadways leading to stockpile areas and repair all surface damage caused by the stockpile traffic.
 - 3. Dust Control: Control all dust that may arise during stockpiling activities by keeping roads swept or wet, as necessary.
 - 4. Conduct: All activities will be conducted in a manner that minimizes litter, nuisances, dust, noise impacts, and mud.
 - 5. Access: Unauthorized access will be prevented within potentially contaminated soil areas.
 - 6. Traffic Control: Traffic will be controlled in a safe manner.
 - 7. Emergency Communications: The Contractor using the stockpile area shall provide telephone or radio communication capacity for emergency purposes.
 - 8. Record Keeping: Maintain a log book in which storage dates, quantity of material accepted and leaving, and concentrations of constituents are tracked and any special occurrences such as written public complaints will be recorded.
 - 9. Length of Use/Site Closure: When Contractor completes the use of the stockpile area, he shall ensure the area is clean of any potentially contaminated soils and have approval from District prior to leaving the site.

3.22 TRANSPORTATION OF CONTAMINATED SOIL

- A. With preapproval from the District and the disposal facility, reload, transport, and dispose of contaminated materials in accordance with all local, state, and federal laws, rules, and regulations for transporting contaminated soil.
- B. Contractor shall arrange the hauling and disposal of the contaminated soil at the accepted landfill licensed to accept such soil.
- C. Transport all contaminated soil off site only to appropriate permitted Treatment and/or Disposal Facilities, approved by the District. The Contractor performing the work of this Section shall be licensed for the transportation and hauling of hazardous wastes. The firm shall provide a route plan, which clearly identifies the routes he proposes to follow while transporting soil to the off-site disposal facility.
- D. Compliance with Federal Motor Carrier Safety Regulations: A motor carrier driver or other person must comply with the rules when he/she is transporting hazardous materials by a motor vehicle, which must be marked or placarded in accordance with DOT 177.823.
- E. Transport drivers will offload soil only at the approved disposal facilities.
- F. Ensure contaminated soil is free of debris, concrete, or asphalt rubble. Ensure no free water is ponding or leaking from trucks.

3.23 REPORT, MANIFESTS, AND RECORDS

- A. Provide the Engineer or District with a compliance certificate verifying that all waste soils were received by the approved landfill has been properly disposed.

- B. Provide copies of all manifests, permits, or other documents currently in effect relating to the specific wastes to be transported, treated, and disposed hereunder except as otherwise stated in this Section.
- C. As the waste generator, the District shall furnish completed State of California Hazardous Waste Manifests (or the Uniform Manifest - 40 CFR Parts 260, 262, 271 - if effective at time of preparation) for all contaminated soils to be removed from the project area for transportation to an appropriate disposal facility. These manifests shall accompany the waste loads to disposal and be properly completed by the hauler and disposal agent as required by federal and state hazardous waste management law. The final manifest shall then be returned by registered mail to the District within the designated time period specified by federal law.
- D. The contract work will not be considered complete nor will the District make final payment until the Engineer or District receives certifications of treatment and/or disposal.

3.24 NON-CONTAMINATED SOIL REUSE

- A. Soil containing very low levels of contamination may be considered for reuse as backfill, but must be cleared with the Engineer or City for reuse, prior to reuse.
- B. Non-contaminated soil may be reused for backfill, if preapproved by the Engineer or District, and is permitted in other sections of the specifications.

3.25 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off project site.
- B. Location of disposal site and length of haul are the Contractor's responsibility.
- C. Soil characterization testing required for hauling and off-site disposal or reuse of excess excavated material are the Contractor's responsibility.
- D. Place excess excavated materials suitable for fill and/or backfill on site where directed by Engineer.
- E. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.
- F. Segregate all excavated contaminated soil designated by the Engineer from all other excavated soils, and stockpile on site on two 6 mil polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Provide and maintain temporary erosion controls on and around soil stockpiles until they are removed from site. Dispose of excavated contaminated material in accordance with State and Local requirements.

3.26 CLEAN UP

- A. Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove debris, rubbish, and excess material from the site.

END OF SECTION

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SECTION 31 01 40

SHORING AND TRENCH SAFETY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Shoring required for general safety, worker protection, and protection of adjacent property from the hazards of caving ground.
- B. Shoring for trench excavations.
- C. Shoring for structural excavations.
- D. Contractor's responsibilities.
- E. Contractor's trench safety plan.
- F. Contractor's supervisor.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

- A. Division 01 – Requirements for temporary facilities, controls, public safety, and convenience.
- B. Section 02 01 00 - Site Conditions
- C. Section 02 01 10 - Existing Utilities and Underground Structures
- D. Section 31 00 00 - Earthwork
- E. Section 31 11 00 - Site Clearing and Grubbing
- F. Section 31 23 00 - Trench Excavation and Backfill
- G. Section 31 23 19 - Dewatering
- H. Section 33 05 17 - Precast Concrete Meter and Valve Boxes
- I. Section 33 11 00 - Recycled Water Utilities

1.3 CONTRACTOR'S RESPONSIBILITIES FOR SAFETY

- A. The Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons (including employees) and property during performance of the work. This requirement shall apply continuously and not be limited to normal working hours.
- B. Safety provisions shall conform to U.S. Department of Labor (OSHA), the California Occupational Safety and Health Act, and all other applicable Federal, State, county, and local laws, ordinances, codes, the requirements set forth below, and any regulations that may be detailed in other parts of these Specifications.
- C. Contractor is advised that Part 1926 of 29 CFR, subpart P, has been revised. This regulation governs excavations, trenching and protective systems, sloping, benching, wood, and

aluminum shoring for various types of soils, and depths of excavations. The Contractor shall follow these regulations (including the latest revisions) for this project.

- D. Where any of these are in conflict, the more stringent requirement shall be followed.

1.4 PERMIT

- A. For trenches or excavations of depth five (5) feet or deeper, the Contractor shall obtain from the State Division of Industrial Safety a permit for such excavation; submit a copy of the permit to the Engineer, prior to initiating any work requiring said permit.

1.5 CONTRACTOR SUBMITTALS

- A. Submit all plans, product data, shop drawings, laboratory test results, material source information, and certificates of compliance listed in this Section under a single submittal cover for review. Incomplete submittals will not be reviewed.
- B. The Contractor's attention is directed to the provisions for "Shoring and Bracing Drawings" in Section 6705 of the California Labor Code. The Contractor, prior to beginning any trench or structure excavation five (5) feet deep or greater, shall submit to the Engineer for review for compliance with Section 6705 the Contractor's detailed plan showing design of all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation. If such plan varies from the shoring system standards established in the Construction Safety Orders of the State of California, such alternative system plans shall be prepared, stamped and signed by a civil or structural engineer licensed in the State of California at the Contractor's expense.
- C. Certificates of Compliance: Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.
- D. For all materials that are not pre-approved by the District the Contractor shall designate the source and/or submit samples of all materials in advance of their use for required testing and Engineer's approval. All testing costs shall be at the Contractor's expense.

1.6 SAFETY ORDERS

- A. The Contractor shall have at the work site, copies or suitable extracts of the Construction Safety Orders of Cal-OSHA, and Part 1926 of 29 CFR, subpart P.
- B. All work shall comply with the provisions of these and all other applicable laws, ordinances and regulations.

1.7 TRENCH SAFETY PLAN

- A. For trenches and excavations five feet or more in depth, the Contractor shall submit to the Engineer a detailed plan, design of shoring, bracing, sloping, or other provisions to be made for worker protection from the hazards of caving ground.
- B. If such plan varies from the shoring system standards established by the Construction Safety Orders, or Part 1926 of 29 CFR, Subpart P, the plan shall be prepared, sealed and signed by a civil or structural engineer registered in California. Signed and sealed copies of calculations necessary to qualify the system shall also be submitted.

- C. Nothing herein shall be deemed to allow the use of shoring, sloping, or protective system less effective than that required by the Construction Safety Orders of the Division of Industrial Safety, or Part 1926 of 29 CFR, subpart P.
- D. If Contractor proposes to use trench jacks or speed shores, submittals shall show length and type of shoring vertical and horizontal spacing, vertical or horizontal wales and planks. Shields, when proposed or used, shall show depth allowed in the soils expected to be encountered.

1.8 ENGINEER'S REVIEW

- A. The duty of the Engineer to conduct construction review of the Contractor's performance is not intended to include a review or approval of the adequacy of the Contractor's safety supervisor, the safety program, or any safety measures taken in, on, or near the construction site.
- B. The Engineer will review the submittal of the Contractor's proposed shoring system to verify the general scope of the Work, to determine that qualified professional engineering services are used and to determine that appropriate construction techniques are proposed for use. This review shall not in any way be construed to relieve the Contractor from sole responsibility for the design and safety of such shoring.

1.9 CONTRACTOR'S SUPERVISOR

- A. The Contractor shall appoint a qualified supervisory employee who shall be responsible to determine the sloping or shoring system which shall be used depending on local soil type, water table, stratification, depth, etc.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 31 09 14

GEOTECHNICAL INSTRUMENTATION AND MONITORING

PART 1 GENERAL

1.1 Description

- A. This section specifies the requirements for geotechnical instrumentation consisting of one or more of the following: survey control point, settlement monitoring point, and utility monitoring point.
- B. The Work includes furnishing, maintaining, monitoring, reading, recording, and removing all instrumentation associated with the Work, specified herein, and shown on the Approved Plans.
- C. The instrumentation is supplemented using high quality pre-construction condition photographs and similar post-construction condition photographs as part of a Building and Structures Assessment Plan as specified herein.
- D. All Work under this section is part and incidental to shaft excavation and tunneling which is included and paid under their specific bid items. No separate payment shall be made for Instrumentation and Monitoring.
- E. Contaminated soils and contaminated groundwater are not anticipated to be encountered in this project.
- F. Tunnels located within Caltrans (CT) ROW are subject to CT review, acceptance, and inspection. This includes associated work required to complete the work.

1.2 Related Work Specified Elsewhere

- A. All related work specified elsewhere, or in other codes or standards, will be as last revised at time of bid, unless a specific date of issuance is called out in opposition to later revision date(s).
- B. Other sections of the technical specifications, not referenced below, shall also apply to the extent required for proper performance of this work.

1.3 Related Documents

- A. Section 01 10 00 Summary of Work
- B. Section 01 30 00 Administrative Requirements: Construction Surveying
- C. Section 01 33 00 Submittal Procedures
- D. Section 02 01 00 Existing Utilities and Underground Structures
- E. Section 31 00 00 Earthwork: Contaminated Soil Excavation & Groundwater, Removal, Treatment, Hauling, and Disposal
- F. Section 31 23 19 Dewatering

G. Section 33 05 23.13 Horizontal Directional Drilling (HDD)

1.4 Specifications and Standards

The publications listed below form a part of this specification to the extent referenced.

- A. ASTM C150 Standard Specification for Portland Cement
- B. ASTM C778 Standard Specification for Standard Sand
- C. ASTM D6230 Standard Practices for Monitoring Earth or Structural Movement Using Inclinometers
- D. NSF/ANSI Standard 60 Drinking Water Chemicals Health Effects
- E. Standard Specifications for Public Works Construction (SSPWC)
- F. California Code of Regulations (CCR), Title 8, Tunnel Safety Orders
- G. Caltrans (CT) Encroachment Permits Manual
- H. CT Trenching and Shoring Manual

1.5 Definitions

- A. See Section 33 05 23.13, Horizontal Directional Drilling.
- B. Response value: Predetermined value when attained Contractor stops the Work and provides written notice and written plan discussing operational changes made to avoid attaining the Shutdown Value. Operational changes shall include a discussion at what conditions the Contractor will replace the tunnel equipment operator. Operations shall not resume until operational changes are implemented.
- C. Shutdown value: Predetermined level when attained Contractor stops Work until submittal and District's acceptance of a written plan detailing corrective actions and restoration.
- D. Survey control point: Temporary location established outside the zone of influence of any construction activities and used as a fixed reference or control point to monitor by optical survey methods the occurrence and amount of vertical and horizontal displacements at instrument locations.
- E. Threshold value: Predetermined level at where Contractor provides immediate written notice of condition.

1.6 Performance Requirements

- A. Locate all utilities before commencing excavation.
- B. Install all instruments within 100 feet tunnels before tunnel excavation commences.
- C. Obtain permits and submit as required for instrumentation installation.
- D. Drill, grout and dispose of resultant spoils.
- E. Prepare and submit bore log of as-built instrument.

- F. Prepare ground and surfaces for instrument installation and testing.
- G. Provide access, such as temporary or mobile platforms, and assistance to the District during instrumentation installation on or in the temporary works as directed by the District.
- H. Protect instrumentation from damage during construction and maintain instruments and components. Repair or replace instruments and components damaged during performance of Work, to the satisfaction of the District. Immediately provide written notice to District of any damage or maintenance problems.
- I. Monitor instrumentation; provide data to District as specified herein.
- J. Perform and submit written visual observation records of the ground surface during construction operations and note observations and note changes. Document using pictures and measurements.

1.7 Quality Assurance

A. Qualifications:

1. Geotechnical Instrumentation Specialist: Individual shall be a professional engineer registered in the State of California with experience in the installation and maintenance of geotechnical instrumentation similar to that specified herein on at least two prior projects similar in scope and size to this Project. Instrumentation specialist shall prepare and stamp instrumentation shop drawings and supervise and direct instrument installation, instrument readings, and interpretations.
 - a. Surveyor: Individual shall be a land surveyor licensed in the State of California for at least five years.
 - b. Technicians: Individuals shall be qualified with a minimum of two (2) years of experience in the installation and reading of geotechnical instrumentation similar to those specified herein.
 - c. Drillers: Personnel employed for drilling instrumentation boreholes shall have at least four (4) years of direct field experience in drilling boreholes.
2. Product Data: Includes manufacturer's product description, installation requirements, shop drawings, operation, maintenance procedures, and samples where applicable, as well as description of methods and materials for installing and protecting the instruments, including post installation acceptance tests.
3. Sources of information: All sources shall be widely available within the industry, specific to the purpose, and acceptable to the District. Reference shall be specific and include page number.
4. Survey Control Point Installation Procedure: Includes the following:
 - a. Method for cleaning the inside of casing.
 - b. Grout mix design, including commercial names, proportions of admixtures and water, mixing sequence, mixing methods and duration, pumping methods and tremie pipe type, size and quantity.
 - c. Drill casing or auger type and size.
 - d. Depth increments for backfilling boreholes with sand and granular bentonite.
 - e. Method for overcoming buoyancy of instrumentation components during grouting.
5. Settlement Surveying and Monitoring Plan: The plan shall identify the location of all instruments; survey control points; surface monitoring points; and survey schedules, procedures, and reporting formats.
6. Drill logs: Log boreholes under the supervision of a geologist or engineer with a minimum of three (3) years of experience. Logs shall be on an accepted format and include the depth, angle and orientation of hole, station and offset (if any) from the trenchless installation, trenchless installation description, geologic log, and notes of any inflows of water or other material, if encountered.
7. Installation:

- a. Provide written notice to the District not less than five (5) workdays before inclinometer installation and not less than one (1) workday for all other instrument installations. Label all instruments with the same identifying instrument number as shown on the Approved Plans or in a manner acceptable to the District.
 - b. Installation Tolerances: Position all instruments within 12 inches of the horizontal location as specified herein. Position instrumentation to within 6 inches of the bottom elevation or deeper as specified herein. Position settlement monitoring points and instrument casings to the more restrictive of two degrees of vertical for the entire depth of each instrument or as required by the manufacturer.
 - c. When actual field conditions prevent installation of instruments at the location and elevations specified herein, obtain prior acceptance from the District for new instrument location and elevation. The proposed location is to provide similar information.
 - d. Shop Drawings: Show installed locations, the instrument identification number, the instrument type, the installation date and time, established elevations, initial elevations, offset and stationing, initial coordinates and boring log, and the anchor to tip elevation and instrument length, when applicable. Shop drawings include as-built shop drawings showing each instrument including installation records, depths, lengths, elevations, and dimensions of all key elements.
 - e. Perform a baseline reading for each instrument. Baseline readings shall include at least two readings from each instrument before commencing underground construction. The two readings are to be completed on two different workdays each requiring a separate set-up. The readings are to provide statistically valid reproducible results allowing for temperature adjustments to both atmosphere and facility. If results are not valid, perform additional daily readings or re-install instrument until readings are reproducible.
 - f. Submit results within two (2) workdays following readings and not less than three (3) workdays preceding the commencement of excavation.
8. SMPs come in various configurations and are installed in the settlement array or as a single point along the tunnel alignment.
 9. Surveys for monitoring geotechnical instrumentation shall be referenced to the same control points and benchmarks established for setting out the work. Control points shall be tied to benchmarks and other monuments outside of the zone of influence of the underground excavations.
 10. UMPs measure movement of a known utility from the surface. UMPs are to be located over the tunnel alignment.

B. Submittals

1. Submittals shall be in accordance with Section 01 33 00 and as specified herein.
2. Submittals shall be coordinated with all cross-referenced sections, assembled, and submitted as a single, complete, and comprehensive submittal.
3. Where calculations are required, they shall be signed and sealed by a Professional Civil Engineer registered in the State of California. Calculations shall clearly identify all parameters used, state all assumptions made in the calculation, and identify all sources of information.
4. All shop drawings shall be legible with dimensions accurately shown and clearly marked in English.
5. Provide written notifications as specified herein or within one workday.
6. Preconstruction submittals:
 - a. Name and qualifications for the following:
 - Geotechnical Instrumentation Specialist
 - Technicians
 - Surveyors
 - Drillers
 - b. Sample drilling logs for instrumentation drilling

- c. Schedule for installation of survey control points as specified herein or at least two (2) weeks prior to installation
- d. Site specific shop drawings indicating the layout and designation of all control points and monitoring points as specified herein
- e. Survey control point installation procedure
- f. The Settlement Survey and Monitoring Plan should describe the proposed methods for monitoring each instrument type
- g. All instrument manufacturers' product data at least two (2) weeks prior to installation
- h. All permits required for instrument installation
- i. Contingency plan in the event ground movement reaches the prescribed Response Values as specified herein
- j. All instrument baseline readings
- 7. Construction submittals:
 - a. Shop drawings and as-built drawings within five (5) workdays following installation of each instrument.
 - b. All instrument readings in a cumulative record on the same workday as the readings are taken or as soon as data is known if excessive ground movement is suspected.
 - c. All interpretations within two (2) workdays following readings
- 8. Post-Construction submittals:
 - d. Signed and sealed cumulative records and interpretations within 4 weeks following instrument removal.
 - e. Record of legal destruction of instruments within 4 weeks of instrument removal.
- 9. Construction Submittals:
 - a. Notifications: Provide all written notifications within one working day unless otherwise specified herein.
 - b. Immediately notify the District upon implementation of any contingency plan.
 - c. Provide daily drilling reports as specified herein.
 - d. The automated data recording system shall record the same operating parameters as specified for manual recording, unless otherwise specified by the District.
 - e. Provide contemporaneous log of all line and grade checks.
 - f. Provide log daily.
 - g. Provide all manual and automated records and logs by 9 AM the following workday. Provide hard copy and electronic copy of automated records in formats acceptable to the District.
- 10. Post-Construction Submittals:
 - a. Provide as-built survey. Provide results in both tabular format and AutoCAD format acceptable to the District. Scale to be acceptable to the District. Survey shall confirm that carrier pipe can be installed within design tolerances.
 - b. Provide a final copy of all project records organized in a systematic system acceptable to the District and in a format acceptable to the District.
All documents not yet received.
Daily logs
Photographs, videos, and recording media
Any report or test results

1.8 Project conditions

- A. See Section 33 05 23.13.

1.9 Safety

- A. See Section 33 05 23.13.

1.10 Access

- A. See Section 33 05 23.13.

1.11 Permits

- A. See Section 33 05 23.13.

1.12 As-Built Drawings

1. Review and provide comments to ensure as-built drawings reflect the as-built conditions and conform to the design intent.

1.13 Compliance With Specifications

1. Deficiencies: Any deficiencies or omissions in materials or workmanship found by inspection, review of documentation, or otherwise, shall be rectified.

PART 2 MATERIALS

2.1 Materials

- A. Sand: Compatible with manufacturer's written recommendations and ASTM C778.
- B. Cement: Shall be Type II Portland cement and water in accordance with ASTM C150 and compatible with instrument manufacturer's written recommendations.
- C. Water: Potable including source.
- D. Drilling fluid:
 1. High yield sodium bentonite.
 2. Water furnished from a potable water source.
 3. Test all water for pH and treat with soda ash, or accepted equal, to adjust the pH of the water as required in the accepted mix design(s).
 - a. Bentonite, polymers, and additives, other than soda ash, shall be NSF/ANSI Standard 60 compliant.
- E. Cement-Bentonite Grout: 22 lbs. cement; 12 lbs. bentonite; 1.5 gallons water.
- F. Bentonite Slurry Grout: 50 lbs. sodium bentonite sealing and plugging agent; 7 lbs. sodium bentonite drilling mud; 32 gallons of water.

2.2 Equipment

- A. Provide as shown on the Approved Plans, specified herein, and acceptable to the District.
- B. Utility Monitoring Points (UMPs): Provide sensor with accuracy of at least ± 0.01 foot.
- C. Settlement Monitoring Points (SMPs): Provide sensor with accuracy of at least ± 0.01 foot.

PART 3 EXECUTION

3.1 General

- A. Perform all work in accordance with accepted submittals.
- B. Do not commence any HDD operation until all submittals, including submittals for all related work specified elsewhere, are reviewed and accepted by the District.

- C. All work within Caltrans ROW requires Caltrans review and acceptance of submittals before work commences.
- D. All work within Caltrans ROW is subject to Caltrans inspection and acceptance before acceptance by District.
- E. Maintain a copy of the Contract Documents in the HDD control container or other location acceptable to the District and accessible to the HDD operator.
- F. Protect all instruments, components, systems, and utilities from damage.
- G. If any instrument is to be located on private property then the Contractor shall provide a right of entry and waiver in a form acceptable to the District from said property owner. Include picture before instrument placement and instrument in-place. At end of project include similar pictures of instrument in-place, upon removal of instrument, and following all restoration work. Ensure lighting is similar in all cases.
- H. Provide the District with access to the instrument locations. Installation of the instrumentation by the Contractor does not preclude the District, through an independent Contractor, from installing instrumentation in, on, near, or adjacent to the Work.
- I. Maintain a copy of the Contract Documents in a location acceptable to the District and accessible to the geotechnical instrumentation specialist and the District.
- J. Treat and dispose of all water in accordance with the requirements specified in Section 31 23 19.
- K. Ensure each instrument is functional for its intended purpose and installed in manner that protects the instrument from damage and the public from injury.
- L. Place all instruments a minimum of ten (10) workdays prior to start of excavation unless otherwise specifically stated otherwise.
- M. Locate and avoid drilling into or damaging conduits and other underground facilities.
- N. Perform and record baseline readings.
- O. Remove and replace any damaged instrument or component that affects the fit, form, or function of the instrument.
- P. Markings for each instrument identifying instrumentation name, location, and numbering shall be refreshed weekly or more frequently to ensure legible visibility of its location and unique identifier marking

3.2 Survey

- A. Adhere to the following requirements concerning survey oversight:
 - 1. Perform initial survey and record the horizontal coordinates and elevations within an accuracy of 0.005 feet (1/16 inch) for each survey point location and all subsequent surveys. Reference survey points so that they are accurately re-established if lost or destroyed.
 - 2. Perform a final survey, with two readings similar to the initial survey, of all control points and instruments upon completion of construction operations. Submit final readings as specified herein.

3.3 Drilling, grouting, preparation, access, and protection

- A. Drill holes of appropriate size and depth in masonry, concrete and asphalt and cased holes in fills and ground for installation of instruments.
- B. Clean holes to remove debris. Holes which the District considers unsatisfactory because of misalignment or other irregularities shall be re-drilled as directed by the District.
- C. Withdraw the casing or auger minimizing ground collapse into the excavated hole.
- D. Provide access and temporary facilities, such as power and sufficient general area lighting necessary for installing instruments.
- E. Mix grout using equipment capable of thoroughly mixing grout material so that grout is of uniform consistency with no unsuspended solids. Place grout using a tremie method, where applicable, with side discharge ports on tremie pipe.

3.4 UTILITY MONITORING POINTS (UMPS)

- A. Provide one (1) UMP for each utility crossed by the trenchless methods.
- B. Remove pavement over utility by coring or cutting. Minimize area of pavement removal.
- C. Excavate to top of utility using vacuum truck, hand auger, or other suitable method. Do not damage utility during excavation.
- D. Construct temporary casing, trench box, or similar protective equipment as required to provide safe support and access for installation of point.
- E. Construct bar and pipe riser to protect the UMPs. Maintain centralized alignment throughout installation. Do not allow the bar to contact the inside of the riser pipe.

3.5 SETTLEMENT MONITORING POINTS (SMPS)

- A. SMPs shall be located as in the accepted submittals.
- B. Grout the casing housing so it is in intimate contact with the ground and as shown in the Contract Drawings.
- C. Provide up to six (6) additional surface monitoring points at locations to be determined in the field by the District.

3.6 MONITORING

- A. Frequency: As a minimum, follow the following schedule to determine frequency and duration of the monitoring:

Instrument Type	Monitoring Frequency within Active Zone⁽¹⁾	Monitoring Frequency outside Active Zone⁽¹⁾
Utility Monitoring Point (UMP)	Prior to start of work, every two hours continuously throughout project, and upon completion	Weekly/Monthly ⁽²⁾
Settlement Monitoring Point (SMP)	Prior to start of work, every two hours continuously throughout project, and upon completion	Weekly/Monthly ⁽²⁾

NOTES:

(1) The active zone for tunneling is measured parallel to the tunnel alignment and is 100 feet in front and behind the tunnel face. The active zone for shaft excavation is 100 feet from the open shaft and covers the duration from the start of shaft construction and for four weeks following shaft restoration.

(2) Weekly until movement substantially stops and monthly thereafter. Movement substantially stops when four consecutive, regularly scheduled measurements remain unchanged.

(3) Monitor and report weekly for four weeks following shaft restoration.

- B. Perform additional monitoring as necessary to control construction and to ensure the safety of the Work.
- C. Provide a report with the following:
 - 1. Data sheets containing a cumulative history of readings; including weather conditions, temperature, and proximity of the excavation to the instrument location itself at the time of each reading.
 - 2. A plot of measured values versus time, including a time history of construction activity likely to influence such readings.
 - 3. Interpretation: Data or interpretation shall not be published or disclosed to other parties without advance written permission of the District. Provide instrument readings and interpretations of monitoring data to the District within the times specified herein.

3.7 RESPONSE VALUES

- A. Instrument Response Values:

Instrument Response Level by Requirement	
Instrument	Caltrans
Settlement Monitoring Point (SMP)	± 0.008 inch*(H), H or V (H= excavation depth in feet)

- B. When a given Response Value is reached, the Contractor shall provide verbal notice within one hour upon occurrence, confirming written notice within 1 workday, and respond in accordance with the following:

Contractor Response Level Values		
Threshold Value	Response Value	Shutdown Value
50%	80%	100%

1. Threshold Value: Provide written notice within 24 hours of occurrence and meet with the District within 24 hours of providing notice to discuss means and method to determine what changes, if any, shall be made to better control ground movement. Instrument readings shall be made on a daily basis until five consecutive workdays of readings remain unchanged; at which point the readings will revert to the reading frequency specified herein.
2. Response Value: Provide written notice and meet with the District within 24 hours to discuss means and methods to determine what changes shall be made to better control ground movement. Actively control ground movement in accordance with the accepted plan to prevent reaching the Shutdown Value. Instrument readings shall be made on a daily basis until five consecutive workdays of readings remain unchanged; at which point the readings will revert to the reading frequency specified herein.
3. Shutdown Value: Stop all Work immediately and provide immediate written notice. Meet with the District to develop a plan of action before any Work resumes.

- C. All measured deflection values are relative to the baseline value identified at the start of construction. Baselines shall not be reset after each bore and shall remain the same for the duration of this Contract.
- D. The required responses specified herein shall apply to any visualization of ground movement between monitoring points including sinkholes, rat holes, and other visual forms of ground movement.

3.8 Removal and site restoration

- A. Verify with District that instrumentation is no longer required.
- B. Remove the instrument prior to substantial completion of the Work, unless otherwise indicated.
- C. Remove and/or abandon the instrumentation in accordance with the permit.
- D. Backfill surface excavations with unshrinkable fill, when within apron, roadways, or sidewalks, and with selected fill when outside of such areas up to the underside of surface restoration. Steel casings, if any shall be removed to a minimum depth of five (5) feet below ground surface.
- E. Surfaces affected by installation of instruments shall be restored to their original condition prior to completion of Work.

END OF SECTION

SECTION 31 11 00

SITE CLEARING AND GRUBBING

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. This section includes the following:
 - 1. Removing surface debris.
 - 2. Removing designated shrubs and other plant life.
 - 3. Excavating topsoil.
- B. Related Sections include, but are not limited to, the following:
 - 1. Section 01 10 00 - Summary of Work
 - 2. Section 01 33 00 - Submittals
 - 3. Section 01 50 00 - Construction Facilities and Temporary Controls
 - 4. Section 02 01 10 - Existing Utilities and Underground Structures
 - 5. Section 02 41 10 - Demolition, Salvage, and Abandonment

1.3 SUBMITTALS

- A. Submit all product data, shop drawings, laboratory test results, material source information, and certificates of compliance listed in this Section under a single submittal cover for review. Incomplete submittals will not be reviewed.
- B. Product Data: Submit data for herbicide in accordance with Section 01 33 00, "Submittal Procedures." Indicate compliance with applicable codes for environmental protection.

1.4 QUALITY ASSURANCE

- A. The Contractor shall be responsible for all actions, damage, and effects arising out of any and all herbicide and/or pesticide use. The Contractor shall obtain and pay for all required permits and licenses prior to application.
- B. Conform to applicable code for environmental requirements, disposal of debris, and use of herbicides.

1.5 REFERENCES

- A. "Guide for Plant Appraisal" 10th Edition, published by International Society of Arboriculture, printed 2020.
- B. State of California, Department of Transportation (Caltrans) Specifications and Standards Section 14 Environmental Stewardship.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 SITE ACCEPTANCE

- A. The Contractor shall examine the area and conditions under which work in this Section will be performed. If conditions are detrimental to timely and proper completion of the work as described in the Construction Documents and these Specifications, the Contractor shall notify the Engineer in writing, describing the nature and extent of the issues.
- B. Verify existing plant life designated to remain is tagged or identified
- C. Identify waste area or salvage area for placing removed materials.

3.2 PROTECTION

- A. The Contractor shall contact Underground Services Alert (USA) (800) 227-2600 or 811 in accordance with the requirements of Section 02 01 10, "Existing Utilities and Underground Structures."
- B. The Contractor shall be solely responsible for the protection of adjacent properties, structures, streets, and utilities. Any damage shall be repaired to its original condition, as determined by the Engineer and District, at the Contractor's expense.
- C. The Contractor shall be financially responsible for the health and well-being of all existing plants designated to remain. In case of damage, the Contractor shall forfeit an amount in proportion to the extent of damage, as determined by the District and Engineer.
- D. The Contractor shall protect benchmarks, survey control points, and existing structures not identified for removal from damage or displacement.

3.3 CLEARED MATERIAL

- A. Clearing and grubbing shall consist of removal of all objectionable material within the limits of work shown on the plans and as directed by the Engineer. Objectionable materials shall include but are not limited to all abandoned pipes, conduits, waste concrete, undergrowth and dead wood. All objectionable cleared material shall become the property of the Contractor and shall be removed from the project site and disposed of or recycled properly.

3.4 REMOVAL

- A. Remove debris, rock, trees, roots and root balls, and extracted plant life from site.
- B. Remove paving and concrete slabs as indicated on the drawings. Neatly saw cut edges at right angle to surface.
- C. Remove abandoned utilities in accordance with Section 02 41 10, "Demolition, Salvage, and Abandonment," and as indicated on the drawings. Indicate removal termination point for underground utilities on Record Documents.
- D. Remove trees and shrubs indicated and as described in Section 02 41 10, "Demolition, Salvage, and Abandonment."

- E. Continuously cleanup and remove waste materials from site. Do not allow materials to accumulate on site.
- F. Do not burn or bury materials on site. Leave site in clean condition.

3.5 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated or re-graded without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Control dust in accordance with Section 18 of the Standard Specifications.
- D. Topsoil to be removed from the site or reused at location shown on the Drawings with approval of the Engineer.

3.6 SITE PREPARATION

- A. Prior to beginning any grading, the Contractor shall spray weeds with a non-selective herbicide. Herbicide shall be applied only by qualified personnel and in full accordance with all manufacturer recommendations and instructions. A second spraying may be required if weeds are not killed.
- B. Shape slopes and swales with no abrupt change of gradient. All mounds and swales indicated on the plans shall be constructed and approved before soil preparation is started.
- C. All areas to be planted shall be cultivated to a minimum depth of six inches (6") and the soil shall be loose and friable.

END OF SECTION

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SECTION 31 23 00

TRENCH EXCAVATION AND BACKFILL

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes: The Work covered in this section consists of performing all operations necessary to excavate all earth, regardless of character and subsurface conditions, from the trench or adjacent thereto and to place stabilization, bedding, cover, water removal, backfill, base, and compaction as shown on the Drawings and as specified, or as may be ordered by the Engineer.
- B. Such earthwork shall include, but may not necessarily be limited to, the loosening, removing, loading, transporting, depositing, and compacting in its final location of all materials wet and dry, as required for the purposes of completing the Work, which shall include, but not necessarily be limited to, the furnishing, placing, and removing of sheeting, shoring and bracing necessary to safely support the sides of all excavations; all pumping, ditching, draining and other required measures for the removal or exclusion of water from the excavation; the supporting of structures above and below the ground; all backfilling around structures and all backfilling of trenches and pits; the disposal of excess excavated materials; borrow of materials to make up deficiencies for fills; and all other incidental earthwork.
- C. General intent:
 - 1. It is the general intent of these specifications to specify conduct of the Work in such manner as to cause no exposure to unsafe conditions during construction and to provide a trench that will properly support and protect the pipe and only minor settlement in areas where such settlement will not be noticed, or compensation made for any expected settlement. The degree of compaction and type of material will vary in accordance with type of pipe, and soil and surface conditions.
 - 2. The Contractor shall obtain compaction and install base and temporary paving. He shall keep access roads clean and free of dust, mud or debris by providing cleanup as necessary.
 - 3. If the Contractor does not properly clean up, (to preconstruction conditions) the District shall have the option of using outside equipment and labor to perform the Work and such costs will be deducted from the contract.
 - 4. Stabilization material will be required only where soil conditions warrant and as directed by the Engineer.
 - 5. No backfilling shall be done until the installation to be covered has been inspected and approved for covering. Compaction of backfill shall proceed immediately after backfilling, in appropriate layers.
 - 6. During construction, heavy rains may be encountered causing wet backfill and other unsuitable working conditions. During these periods the District will have authority to shut down the Work to avoid poor working conditions, wet unsuitable backfill, damage to base and paving, unsafe conditions, etc.
- D. Contaminated soil and groundwater shall be handled in accordance with Section 31 00 00, "Earthwork," and all regulatory agency requirements.
- E. Related Work:
 - 1. Section 02 01 10 - Existing Utilities and Underground Structures
 - 2. Section 26 05 00 - Basic Electrical Materials and Methods
 - 3. Section 26 05 33 - Raceway and Boxes for Electrical Systems
 - 4. Section 31 00 00 - Earthwork
 - 5. Section 31 01 40 - Shoring and Trench Safety
 - 6. Section 31 23 19 - Dewatering
 - 7. Section 33 11 00 - Recycled Water Utilities

1.2 QUALITY ASSURANCE

- A. Qualifications of workmen: Provide sufficient skilled workmen and supervisors who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of construction involved and the materials and techniques specified.
- B. Codes and standards:
 - 1. Wherever a test method is referenced in this section it shall be made in accordance with the most current test methods in use by the California Department of Transportation (Caltrans).
 - 2. Where reference is made to the State Standard Specifications, reference shall mean: State of California, Business and Transportation Agency, Department of Transportation (Caltrans), Standard Specifications, 2018, excluding measurement and payment Sections.

1.3 GUARANTEES

- A. The Contractor shall guarantee his Work against settlement for a period of one year after the Notice of Completion has been filed and shall repair all damage caused by settlement within that time. For the purpose of this specification, settlement will be deemed to have occurred if the following conditions exist, unless otherwise stipulated by the County of Mendocino and Caltrans:
 - 1. Along unpaved portions, a depression of 1 inch below the average of the sides of the uncut portion shall be deemed a settlement.
 - 2. In paved areas, the depression of 1/4 inch below the average of the sides of the uncut portion will be deemed a settlement.

1.4 CONTRACTOR SUBMITTALS

- A. Submit all product data, shop drawings, laboratory test results, material source information, and certificates of compliance listed in this Section under a single submittal cover for review. Incomplete submittals will not be reviewed.
- B. The Contractor's attention is directed to the provisions for "Shoring and Bracing Drawings" in Section 6705 of the California Labor Code. The Contractor, prior to beginning any trench or structure excavation five (5) feet deep or over, shall submit to the Engineer for review for compliance with Section 6705 the Contractor's detailed plan showing design of all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation. If such plan varies from the shoring system standards established in the Construction Safety Orders of the State of California, such alternative system plans shall be prepared, stamped and signed by a civil or structural engineer licensed in the State of California at the Contractor's expense.
- C. Certificates of Compliance: Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.
- D. For all materials, the Contractor shall designate the source and/or submit samples of all materials in advance of their use for required testing and Engineer's approval, if requested. All testing costs shall be at the District's expense.

1.5 QUALITY ASSURANCE

- A. General: All soils testing will be performed by the District.
- B. Where soil material is required to be compacted to a percentage of maximum density the maximum density at optimum moisture content will be determined in accordance with the standards outlined ASTM D1557. Field density in-place tests will be performed by the District.

- C. The Contractor shall notify the Engineer at least 2 working days prior to performing any utility excavation.

PART 2 PRODUCTS

2.1 EXCAVATION

- A. The Contractor shall complete all excavation regardless of type, nature, or condition of the material encountered. The Contractor shall make his own estimate of the kind and extent of the various materials to be excavated in order to accomplish the Work. The Contractor should refer to the available Geotechnical Engineering Investigation report (soils report) for anticipated excavation conditions. Native backfill shall not be used for any utility trench backfill, unless noted otherwise on the Drawings.

2.2 BEDDING AND COVER MATERIAL

- A. Pipe Bedding Material: Section 31 00 00, "Earthwork."

2.3 TRENCH BACKFILL

- A. Trench Backfill Material: Section 31 00 00, "Earthwork."

2.4 PERMEABLE MATERIAL

- A. Permeable Material: Section 31 00 00, "Earthwork."
- B. Permeable material shall be used in over-excavated areas of trenches, including where the bottom of excavations is unstable, disturbed or wet.

2.5 GEOTEXTILE FABRICS

- A. Filter Fabric: Section 31 00 00, "Earthwork."
- B. Subgrade Stabilization Fabric: Section 31 00 00, "Earthwork."

2.6 SLURRY CEMENT BACKFILL

- A. Slurry Cement Backfill: Standard Specifications Section 19-3.02E.

2.7 STEEL PLATE

- A. When steel plate bridging is provided, it shall conform to Section 602.1 of the Caltrans Encroachment Permit Manual, with the following minimum thicknesses:

Trench Width	Minimum Plate Thickness
(10") 0.25 m	(1/2") 13 mm
(1' - 11") 0.58 m	(3/4") 19 mm
(2' - 7") 0.80 m	(7/8") 22 mm
(3' - 5") 1.04 m	(1") 25 mm
(5' - 3") 1.60 m	(1 1/4") 32 mm

- B. For spans greater than 5 feet-3 inches, a structural design shall be prepared by a California registered civil engineer.
- C. Plates to be coated with a "no slip" surface.

PART 3 EXECUTION

3.1 GENERAL

- A. The Contractor shall perform all excavation of whatever substance is encountered to the lines and grades shown on the plans. All excavated materials shall become the property of the Contractor and disposed of in accordance with local and state requirements.
- B. Not more than 300 feet of excavation trench will remain unbackfilled at the end of each day of Work. The maximum amount of open trench permitted in any one location shall be the length necessary to accommodate the amount of pipe installed and backfilled in a single day. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day. The above requirements for backfilling or use of steel plate may be waived in cases where the trench is located further than 100 feet from any traveled roadway or occupied structure. In such cases, however, barricades and warning lights meeting safety requirements shall be provided and maintained. All operations shall be carried out in an orderly fashion. Backfilling, compacting, base, and cleanup will be accomplished as sections of the pipe are installed.
- C. Where abandoned underground structures are encountered, remove to sufficient depth to allow underground lines to cross, backfill and compact during rough grading. The Engineer may require further work to be done if visual inspection indicates during construction.
- D. If County road drainage culverts are damaged in the course of trench excavation, the culverts shall be replaced.

3.2 WIDTH OF TRENCH

- A. Except where otherwise specifically noted or directed, excavation for pipelines and utilities shall be open-cut trenches, sides of trenches shall be vertical, shored as required, and shall be uniform width from top to bottom. Trenches shall be of a width as shown on the Drawings.
- B. If trench widths exceed those shown on the Drawings, install all additional stabilization material, special bedding and cover, backfill, base and paving or higher strength pipe in conformance with these specifications and as directed by the Engineer at no additional cost to the District.
- C. Subgrade: The surface of the subgrade after compaction shall be hard, uniform, smooth, self-draining, and true to grade and cross section.
- D. Trench Bottom: The pipe bedding shall be given a final trim establishing grade such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe. Rounding out the trench bottom or bedding to form a cradle for the pipe will not be allowed. The Contractor shall hand excavate for bell holes and fittings.

3.3 NOT USED

3.4 REMOVAL OF WATER

- A. Dewatering: Section 31 23 19 – Dewatering.
- B. Water disposal shall meet federal, state, and local requirements and as specified.

3.5 SHORING, SHEETING AND BRACING

- A. See Section 31 01 40 - Shoring and Trench Safety. The Contractor shall furnish and install all shoring, sheeting and bracing required to support adjacent earth banks and structures for the

protection and safety of all personnel working in the trench. All shoring, sheeting and bracing shall conform to the requirements of the State or local agents having jurisdiction over such matters. Remove shoring, sheeting and bracing in a manner that will protect the workman and prevent caving of banks and damage to the pipe, grade, sidewall support, bedding compaction, excavation, backfill or adjacent property.

3.6 OVER-EXCAVATION

- A. If the bottom of an excavation is found to consist of soft or unstable material that is incapable of properly supporting the pipe or structure, the Engineer shall be advised immediately.
- B. The Contractor shall obtain the Engineer's approval prior to performing any over-excavation. Any over-excavating and resultant backfill and compaction without such approval shall be at the Contractor's expense. The quantity of approved unsuitable material excavated and its replacement shall be paid for as extra work only with the authorization of the Engineer and in accordance with the Contract Documents.

3.7 ROCK EXCAVATION

- A. Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding deposits, and unstratified masses; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of solid rock.
- B. The Contractor shall obtain the Engineer's approval prior to performing any rock excavation. Any rock excavation and resultant backfill and compaction without such approval shall be at the Contractor's expense. The quantity of approved rock excavated and its replacement with suitable fill material shall be paid for as extra work only with the authorization of the Engineer and in accordance with the Contract Documents.
- C. Rock excavation is not anticipated for utility trenches this project. If the Contractor encounters rocks during earthwork activities, the Engineer shall be advised immediately.
- D. Explosives and Blasting: Use of Explosives and Blasting will not be permitted.

3.8 TRENCH BACKFILL IN THE PIPE ZONE

- A. The Contractor shall backfill the pipe zone with the bedding and cover materials specified to the dimensions shown on the Drawings. The trench shall be final-graded by hand to provide a secure bedding full length with hand excavation made for bells or collars.
- B. Trench backfill in the pipe zone shall be moisture conditioned to within 2 percent of the ASTM D1557 optimum moisture content and compacted to achieve a minimum relative compaction of 90 percent of the ASTM D1557 maximum dry density, unless noted otherwise on the Drawings.
- C. Additional backfill shall then be installed and the sides of the pipes moisture conditioned to within 2 percent of the ASTM D1557 optimum moisture content. Backfill on the sides of the pipe shall be shovel sliced to remove voids and tamped to not less than 90 percent compaction to secure full-length bedding and proper pipe wall support. After this, cover material shall be added and mechanically compacted to a relative compaction not less than 90 percent.

3.9 TRENCH BACKFILL IN THE TRENCH ZONE

- A. Comply with Mendocino County Department of Transportation Encroachment Permit requirements and Caltrans encroachment permit requirements for trench backfill within the public Right-of-Way.

- B. The Contractor shall backfill the trench zone with the trench cover materials specified to the dimensions shown on the Drawings. The trench shall be final-graded by hand to provide a secure bedding full length with hand excavation made for bells or collars.
- C. Trench backfill in the trench zone shall be moisture conditioned to within 2 percent of the ASTM D1557 optimum moisture content, placed in maximum 8 inch thick loose lifts prior to compacting, and compacted to achieve a minimum relative compaction of 95 percent of the ASTM D1557 maximum dry density.
- D. Trench backfill within 12 inches of subgrade in non-vehicular areas shall be moisture conditioned to within 2 percent of the ASTM D1557 optimum moisture content, placed in maximum 6 inch thick loose lifts prior to compacting, and compacted to achieve a minimum relative compaction of 95 percent of the ASTM D1557 maximum dry density.
- E. Trench backfill within 12 inches of subgrade in vehicular areas shall be moisture conditioned to within 2 percent of the ASTM D1557 optimum moisture content, placed in maximum 6 inch thick loose lifts prior to compacting, and compacted to achieve a minimum relative compaction of 95 percent of the ASTM D1557 maximum dry density.
- F. Slurry cement backfill may be used for trench backfill provided there is a minimum of 12 inches of bedding separating the slurry cement backfill and the pipe bedding. If slurry cement backfill is used there shall also be a minimum of 12 inches of sand bedding installed between utilities and drainage culverts if encountered within the trench.

3.10 PLACING AND SPREADING OF BACKFILL MATERIALS

- A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around nor upon any structure for a minimum of 72 hours or until the concrete has attained sufficient design strength to withstand the loads imposed, whichever is greater.
- B. Backfill materials shall be placed and spread evenly in horizontal layers.
- C. During spreading each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer and uniformity of moisture throughout backfill materials. Pipe Zone backfill materials shall be manually spread around the pipe so that when compacted, the Pipe Zone backfill will provide uniform bearing and side support.
- D. Where the backfill material moisture content is below the optimum moisture content water shall be added before or during spreading until the proper moisture content is achieved.
- E. Where the backfill material moisture content is too high to permit the specified degree of compaction, the material shall be dried or replaced until the moisture content is satisfactory.
- F. Backfill shall be mechanically compacted by means of tamping rollers, sheepsfoot rollers, pneumatic tire roller, vibrating rollers, or other mechanical tampers. All such equipment shall be of a size and type subject to review by the Engineer. Impact-type pavement breakers (stompers) will not be permitted. Permission to use specific compaction equipment shall not be construed as guaranteeing or implying that the use of such equipment will not result in damage to adjacent ground, existing improvements, or new improvements. The Contractor shall make its own determination in this regard.
- G. Material for mechanically compacted backfill shall be placed in lifts which, prior to compaction, shall not exceed the thickness specified below for various types of equipment:
 - 1. Vibratory equipment, including vibratory plates, vibratory smooth-wheel rollers, and vibratory pneumatic-tired rollers - maximum lift thickness of 1 foot.
 - 2. Rolling equipment, including sheepsfoot (both vibratory and non-vibratory), grid, smooth-wheel (non-vibratory), pneumatic-tired (non-vibratory), and segmented wheels - maximum lift thickness of 1 foot.

3. Hand-directed mechanical tampers-maximum lift thickness of 4 inches.

H. Mechanically compacted landfill shall be placed in horizontal layers of thickness not exceeding those specified above, compatible to the material being placed and the type of equipment being used. Each layer shall be evenly spread, moistened or dried, if necessary, and then tamped or rolled until the specified relative compaction has been attained.

3.11 COMPACTION OF BACKFILL MATERIALS

A. Specification Section 31 00 00 - Earthwork. Each layer of backfill material as defined herein, shall be mechanically compacted to the specified percentage of maximum density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content range.

B. Flooding, ponding, or jetting shall not be used.

C. Equipment weighing more than 10,000 pounds shall not be used closer to structure walls than a horizontal distance equal to the depth of the fill against the structure wall at that time or 5-feet, whichever is greater. Hand operated power compaction equipment shall be used where use of heavier equipment is impractical or restricted due to weight limitations.

D. Trench Backfill Requirements:

1. The Contractor shall maintain the specified trench width up to a horizontal plane lying 12 inches above the top of the pipe.
2. If, at any location under said horizontal plane, the Contractor slopes the trench walls or exceeds the maximum trench widths indicated the Pipe Zone backfill shall be "improved" or the pipe class improved at no additional cost to the District. "Improved" backfill shall mean Slurry Cement Backfill or other equivalent materials acceptable to the Engineer.

3.12 COMMUNICATIONS/ELECTRICAL

A. Bed and backfill in accordance with the Drawings.

3.13 STEEL PLATE

A. General: When backfilling operations of an excavation in the traveled way, whether transverse or longitudinal, cannot be properly completed within a work day, steel plate bridging with a non-skid surface and shoring may be required to preserve unobstructed traffic flow.

B. When steel plate bridging is required, the following conditions shall apply:

1. Steel plates used for bridging must extend a minimum of 12 inches beyond the edges of the trench.
2. Steel plate bridging shall be installed to operate with minimum noise.
3. The trench shall be adequately shored to support the bridging and traffic loads.
4. Bridging shall be secured against displacement by using adjustable cleats, shims or other devices.

C. Steel plate bridging should not exceed 4 consecutive working days in any given week.

3.14 TESTING

A. Relative compaction shall be to the densities specified and referenced herein. Contractor shall perform Quality Control testing:

1. One compaction test consisting of at least three readings shall be made for each trench less than 100 feet long.
2. For trenches longer than 100 feet a compaction test shall be performed every 100 feet of backfilled trench.

3. Compaction tests shall be representative of all levels within the trench above the pipe zone.
 4. Areas with failing test results shall be reworked and retested at the Contractor's expense until passing results are obtained.
 5. Copies of all compaction test results shall be furnished to the Engineer within 2 working days of completing the test.
- B. Quality Assurance testing will be performed by the District.

END OF SECTION

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SECTION 31 23 19

DEWATERING

PART 1 GENERAL

1.1 DESCRIPTION

- A. Groundwater is anticipated in this project. The Contractor is advised that groundwater may be present in some of the proposed excavations, depending on site location, depth of excavation, soil conditions and time of year. As necessary, the Contractor shall keep excavations free from water during construction.
- B. Provide all labor, materials, and equipment necessary to dewater trench and structure excavations, in accordance with the requirements of the Contract Documents, to enable the pipes and structures to be installed in excavations that are free from standing or flowing water that may be due to groundwater, surface water, stormwater or precipitation.
- C. The preferred disposal method for water removed from trenches and other excavations is through discharge to the sanitary sewer.
- D. Obtain all permits and fees associated with dewatering operations and discharges including permits for construction of dewatering wells.
- E. Develop an excavation dewatering plan in accordance with paragraph 1.5.A of this Section.
- F. Qualitatively monitor for odor or visual discrepancies indicative of hydrocarbon contamination in groundwater during dewatering operations. The Contractor shall notify the Owner immediately if potential contamination is encountered.
- G. Dewatering operations shall not interfere with vehicle or pedestrian traffic. Under no circumstances shall dewatering water be allowed to flood streets and cause hazardous conditions for vehicular or pedestrian traffic. Dewatering pump noise shall be mitigated, especially at night. Any mitigating measures taken to conform to these requirements shall be at no extra expense to the Owner.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02 01 00 - Site Conditions
- B. Section 31 01 40 - Shoring and Trench Safety
- C. Section 31 23 00 - Trench Excavation and Backfill

1.3 DEFINITIONS

- A. Dewatering: Practices that manage the discharge of groundwater and accumulated precipitation from a work location so that construction work may be accomplished.

1.4 DISCHARGE TO COLLECTION SYSTEM

- A. Contractor shall obtain a permit, pay all fees and comply with all conditions necessary for any discharges to the Mendocino City Community Services District sanitary sewer collection system.

- B. No water shall be discharged into sanitary sewers without the prior written consent of the Engineer and 24 hours advance notice to the Mendocino City Community Services District.
- C. If the turbidity requirements above are not met by tank settling alone, a filter must be employed to remove soil particles from the groundwater prior to discharge.
- D. Testing of water samples for turbidity shall be performed and documented daily for the first week, then at weekly intervals during the remaining period of discharge. Water shall only be discharged if the sample test results meet the specified turbidity requirements. A log of the monitoring and sampling results shall be maintained.
- E. The Contractor shall coordinate groundwater discharge into the collection system with the Owner, including verifying water quality requirements, discharge flow limitations into the collection system, and location of discharges into the collection system. Discharged flows into the collection system shall be limited to 100 gpm.
- F. In no case shall the Contractor's groundwater disposal operation surcharge the collection system (i.e., full pipe flow).
- G. The costs associated with any damage caused as a result of Contractor's groundwater disposal operation surcharging the collection system shall be the Contractor's sole responsibility.

1.5 SUBMITTALS

- A. Submit all plans, product data, shop drawings, laboratory test results, material source information, and certificates of compliance listed in this Section under a single submittal cover for review. Incomplete submittals will not be reviewed.
- B. Dewatering Plan
 - 1. Dewatering systems shall be designed and maintained by the Contractor and shall be coordinated with the design of shoring specified in Section 31 01 40, "Shoring and Trench Safety." The plans should contain at a minimum the sizes of pumps, tanks, filtration devices, and the points of disposal. The plan should also include alternate (contingent) systems, and the Contractor should be prepared to alter the initial dewatering or shoring systems to meet the specified requirements.
 - 2. The plan shall also include the water quality requirements specified herein.
 - 3. Section 01 33 00 – Submittals.
- C. Product Data: Submit data for each of the following:
 - 1. Dewatering Pumps: Indicate sizes, capacities, priming methods, and engine or motor characteristics.
 - 2. Pumping equipment for control of discharge.
 - 3. Size of tank(s) used for storage.
 - 4. Specifications and size and type of filters and any other materials used for filtration.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 33 00 – Submittals.
- B. Once the storage tank(s) are no longer needed, clean and remove from the site and return the area to original condition.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 – Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this Section.

1.8 SEQUENCING

- A. Section 01 10 00 – Summary of Work: Requirements for sequencing.

1.9 COORDINATION

- A. Coordinate work to permit the following construction operations to be completed on stable substrate.
 - 1. Excavation for structures and pipelines as specified in Section 31 23 00 “Trench Excavation and Backfill.”
- B. Coordinate with the Engineer prior to the commencement of any soil excavation and groundwater discharge.
- C. All dewatering operations shall be adequate to assure the integrity of the finished project.

PART 2 PRODUCTS

2.1 DEWATERING EQUIPMENT

- A. Select dewatering equipment to meet specified performance requirements.

PART 3 EXECUTION

3.1 DEWATERING OPERATIONS

- A. Install dewatering system in accordance with the approved Dewatering Plan.
 - 1. Secure District approved areas for siting of groundwater storage tanks and treatment systems. Locate system components to allow continuous dewatering operations without interfering with the excavation work.
 - 2. Install the dewatering system in accordance with State, local and Unified Building Code standards.
- B. Remove water from the excavation in accordance with the approved Dewatering Plan.
 - 1. Keep excavations free from water during construction.
 - 2. Draw down the static water level a minimum of 2 feet below the bottom of excavations to maintain the undisturbed state of natural soils and allow the placement of any fill to the specified density.
 - 3. Operate dewatering systems continuously until backfill has been completed to 1-foot above the normal static groundwater level.
 - 4. Control the release of groundwater to its static level to prevent disturbance of the natural foundation soils or compacted fill and to prevent floatation or movement of structures and pipelines.
 - 5. Control groundwater to prevent softening of the bottom of excavations, or formation of “quick” conditions. Dewatering systems shall not remove natural soils.
 - 6. At all times, site grading shall promote drainage away from excavations. Surface runoff shall be diverted from excavations.

7. Dewatering in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.
 8. Control surface runoff to prevent entry or collection of water in excavations.
- C. Notify the Engineer and stop excavation work should the dewatering system not adequately control water within the excavation.
1. Supplement or modify dewatering system and provide other remedial measures to control water within excavation.
 2. Demonstrate dewatering system operation complies with performance requirements before resuming excavation operations.
- D. Notify the Engineer and stop excavation work if potentially contaminated groundwater is encountered.
1. Upon notification from the Contractor regarding potential groundwater contamination, the District will sample and analyze to verify the existence and extent of contamination.
- E. Notify the Engineer and stop excavation work if settlement or ground movement is detected.
1. Contractor shall control the rate and effect of the dewatering in such a manner as to avoid all settlement and subsidence.
 2. Where critical structures or facilities exist immediately adjacent to areas of proposed dewatering, reference points shall be established and observed at daily intervals to detect any settlement or ground movement that may develop. The Contractor shall conduct the dewatering operation in a manner that protects adjacent structures and facilities. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the Contractor.
- F. Maintain all equipment in an operable state.
1. Inspect equipment daily and repair or replace as needed.
 2. Clean accumulated sediment from tanks as needed.
- G. Remove dewatering systems after dewatering operations are discontinued.
1. The Contractor shall be responsible for sampling and disposal of sediments collected in storage tanks, as well as other waste materials related to groundwater discharge.
 2. Repair damage caused by dewatering systems or resulting from failure of systems to protect property.

END OF SECTION

SECTION 31 25 00
EROSION CONTROL

PART 1 GENERAL

1.1 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. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - a. ASTM D 4439-14 Standard Terminology for Geosynthetics
 - b. ASTM D 4491-14 Water Permeability of Geotextiles by Permittivity
 - c. ASTM D 4533-11 Trapezoid Tearing Strength of Geotextiles
 - d. ASTM D 4632-13 Grab Breaking Load and Elongation of Geotextiles
 - e. ASTM D 4751-12 Determining Apparent Opening Size of a Geotextile
 - f. ASTM D 4873-09 Identification, Storage, and Handling of Geosynthetic Rolls
- B. California Department of Transportation, Standard Specifications, Section 13 Water Pollution Control.
- C. California Department of Transportation, Field Guide for Construction Site Dewatering.
- D. California Department of Transportation, Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual (June 2011).
- E. California Department of Transportation, Construction Site Best Management Practices (BMP) Manual.
- F. California Department of Transportation, Construction Site Monitoring Program (CSMP) Guidance Manual.
- G. Manuals and templates are available at Caltrans Division of Construction website:
<http://www.dot.ca.gov/hq/construc/stormwater/>.

1.2 GENERAL

- A. A Storm Water Pollution Prevention Plan (SWPPP) document is not required for this project.
- B. The Contractor shall prepare a Water Pollution Control Plan (WPCP) for review and approval by the Engineer and implement water pollution prevention measures outlined in the approved WPCP, specified in this specification section, in Standard Specification Section 13, and the requirements of the National Pollution Discharge Elimination System (NPDES).
- C. The Contractor shall become fully informed of, and comply with the applicable Federal, State and local regulations that govern the Contractor's operations and storm water discharges from both the project site and areas of disturbance outside the project limits during construction.
- D. Unless arrangements for disturbance of areas outside the project limits are made by the District and made part of the contract, it is expressly agreed that the District assumes no responsibility to the Contractor or property owner whatsoever with respect to any arrangements made between the Contractor and property owner to allow disturbance of areas outside the project limits.

- E. The Contractor shall be responsible for the costs and for any liability imposed by law as a result of the Contractor's failure to comply with the requirements set forth in this section including, but not limited to, compliance with the applicable provisions of Federal, State and local regulations. For the purposes of this paragraph, costs and liabilities include but are not limited to fines, penalties and damages whether assessed against the State or the Contractor, including those levied under the Federal Clean Water Act and the State Porter Cologne Water Quality Act.
- F. Conformance with the requirements of this section "Erosion Control," shall not relieve the Contractor from the Contractor's responsibilities, as provided in Section 5-1.36, "Property and Facility Preservation," Section 7-1.05, "Indemnification," and Section 7-1.06, "Insurance," of the Standard Specifications.
- G. Earthwork construction activities shall be limited to summer months from May 15 through October 15.
- H. Heavy equipment shall be placed outside of drainage channels except when necessary to perform the Work.
- I. Upon completion of construction activities, drainage channels shall be restored and re-contoured as nearly as practicable to pre-project conditions, and shall match adjacent natural channel contours.
- J. All cleared and grubbed materials shall be removed from the project sites and disposed of by the Contractor. Refer to Specification Section 02 41 10 "Demolition, Salvage, and Abandonment" for additional details and requirements.

1.3 EROSION AND SEDIMENT CONTROLS

- A. The controls and measures required by the Contractor include but are not limited to the items below.
 - 1. Structural Practices: Structural practices shall be implemented to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Structural practices shall be implemented in a timely manner during the construction process to minimize erosion and sediment runoff. Structural practices shall include the following devices.
 - a. Silt Fences. The Contractor shall provide silt fences as a temporary structural practice to minimize erosion and sediment runoff. Silt fences shall be properly placed and installed to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing and grubbing, excavation, embankment, and grading). Silt fences shall be installed in the locations indicated on the drawings. Final removal of silt fence barriers shall be upon approval by the Owner.
 - b. Fiber Rolls (sediment logs or wattles): Contractor shall provide fiber rolls as temporary structural practice to minimize erosion and sediment runoff. Fiber rolls shall be properly placed and installed to effectively retain sediment immediately after completing each phase of work (e.g., clearing and grubbing, excavation, embankment, and grading) in each independent runoff area (e.g., after clearing and grubbing in an area between a ridge and drain, fiber rolls shall be placed as work progresses; fiber rolls shall be removed/replaced/relocated as needed for work to progress in the drainage area). Areas where fiber rolls are to be used are shown on the drawings. Final removal of fiber roll barriers shall be upon approval by the Owner. Fiber Rolls shall be provided as follows:
 - c. Along the downhill perimeter edge of all areas disturbed.
 - d. Along the top of the slope or top bank of drainage ditches, channels, swales, etc. that traverse disturbed areas.

- e. Along the toe of all cut slopes and fill slopes of the construction areas.
- f. Perpendicular to the flow in the bottom of existing drainage ditches, channels, swales, etc. that traverse disturbed areas or carry runoff from disturbed areas. Rows shall be spaced a maximum of 100 feet apart.
- g. Perpendicular to the flow in the bottom of new drainage ditches, channels, and swales. Rows shall be spaced a maximum of 100 feet apart.
- h. At the entrance to culverts that receive runoff from disturbed areas.
- i. Diversion Dikes. Diversion dikes shall have a maximum channel slope of 2 percent and shall be adequately compacted to prevent failure. The minimum height measured from the top of the dike to the bottom of the channel shall be 18 inches. The minimum base width shall be 6 feet and the minimum top width shall be 2 feet. The Contractor shall ensure that the diversion dikes are not damaged by construction operations or traffic. Diversion dikes shall be located as shown on the drawings.
- j. A stabilized vehicular entrance/exit at the Well #9 site shall be provided in accordance with Stabilized Construction Entrance/Exit Detail TC-1 of the Caltrans Construction Site Best Management Practices Manual. (Caltrans Storm Water Quality Handbooks, Construction Site Best Management Practices Manual, March 1, 2003).

1.4 SUBMITTALS

- A. Prepare and submit a Water Pollution Control Plan, including a minimum of one (1) 11"x17" figure showing the details of the water pollution control measures and Best Management Practices (BMPs) that will be implemented.
 - 1. As part of the water pollution control work, a Water Pollution Control Program, hereafter referred to as the "WPCP," is required for this contract. The WPCP shall conform to the requirements in Section 13-2, "Water Pollution Control Program," of the Standard Specifications, the requirements in the Caltrans manuals, and these Construction Details.
 - 2. No work having potential to cause water pollution, as determined by the Engineer, shall be performed until the WPCP has been approved by the Engineer.
 - 3. Within 30 calendar days after the approval of the contract, the Contractor shall submit 3 copies of the WPCP to the Engineer. The Contractor shall allow 10 days for the Engineer to review the WPCP. If revisions are required, as determined by the Engineer, the Contractor shall revise and resubmit the WPCP within 7 days of receipt of the Engineer's comments and shall allow 7 days for the Engineer to review the revisions. Upon the Engineer's approval of the WPCP, 3 additional copies of the WPCP incorporating the required changes shall be submitted to the Engineer. Minor changes or clarifications to the initial submittal may be made and attached as amendments to the WPCP. In order to allow construction activities to proceed, the Engineer may conditionally approve the WPCP while minor revisions or amendments are being completed. The objectives of the WPCP shall be to identify pollution sources that may adversely affect the quality of storm water discharges associated with the project and to identify, construct, implement and maintain water pollution control measures, hereafter referred to as control measures, to reduce to the extent feasible pollutants in storm water discharges from the construction site during construction under this contract.
 - 4. The WPCP shall incorporate control measures and minimum requirements in the following categories:
 - a. Soil stabilization practices;
 - b. Sediment control practices;
 - c. Wind Erosion Control practices;
 - d. Tracking control practices;
 - e. Non-storm water management and waste management and materials disposal control practices.

5. Specific objectives and minimum requirements for each category of control measures are contained in the Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual.
 6. The Contractor shall consider the objectives and minimum requirements presented in the SWPPP-WPCP Preparation Manual for each of the above categories. When minimum requirements are listed for any category, the Contractor shall incorporate into the WPCP and implement on the project, one or more of the listed minimum controls required in order to meet the pollution control objectives for the category. In addition, the Contractor shall consider other control measures presented in the SWPPP-WPCP Preparation Manual and shall incorporate into the WPCP and implement on the project the control measures necessary to meet the objectives of the WPCP. The Contractor shall document the selection process in accordance with the procedure specified in the SWPPP-WPCP Preparation Manual.
 7. The following contract items of work, as shown on the project Plans, shall be incorporated into the WPCP as critical temporary control measures:
 - a. During construction and as part of the erosion control measures:
 - 1) Place silt fence 1' minimum beyond all grading limits.
 - 2) Place fiber rolls around all soil stock piles and at the grading limits.
 - 3) Place straw bales or rock bags around all storm drain inlets.
 - 4) The Contractor shall consider other control measures to supplement these critical temporary control measures when necessary to meet the pollution control objectives of the WPCP.
 8. The Contractor shall maintain and protect the temporary control measures throughout the duration of the project and shall restore these controls to the lines and grades shown on the Plans prior to acceptance of the project.
 9. The WPCP shall include, but not be limited to, the following items as described in the Handbook:
 - a. Project description and Contractor's certification;
 - b. Project information;
 - c. Pollution sources, control measures, and water pollution control drawings; and
 - d. Amendments, if any.
 10. The Contractor shall amend the WPCP, graphically and in narrative form, whenever there is a change in construction activities or operations which may affect the discharge of significant quantities of pollutants to surface waters, ground waters, municipal storm drain systems, or when deemed necessary by the Engineer. The WPCP shall also be amended if the WPCP has not achieved the objective of reducing pollutants in storm water discharges. Amendments shall show additional control measures or revised operations, including those in areas not shown in the initially approved WPCP, which are required on the project to control water pollution effectively. Amendments to the WPCP shall be submitted for review and approval by the Engineer in the same manner specified for the initially approved WPCP. Amendments shall be dated and attached to the on-site WPCP document.
 11. The Contractor shall keep a copy of the WPCP, together with updates, revisions and amendments at the project site.
- B. Submit all product data, laboratory test results, material source information, and certificates of compliance listed in this Section under a single submittal cover for review. Incomplete submittals will not be reviewed.
- C. Product Data:
1. Submit data for erosion control materials listed in this section indicating properties, test methods, and manufacturer's installation instructions.
- D. Material Source: Submit name of imported fill materials supplied.

- E. Manufacturer's Certificate: Submit Certifications that products meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 TEMPORARY CONSTRUCTION FENCE

- A. General:
 - 1. Fence height shall be 4 feet located from top of ground to top of fence.
 - 2. Fence shall extend from the top of ground. No gaps between the fence and the top of ground shall be permitted.
- B. Fabric:
 - 1. Fence material shall be plastic.
 - 2. Fence material shall be orange in color.
 - 3. Fence material shall be resistant to temperature change and shall be UV protected.
- C. Framing and Accessories:
 - 1. Provide posts and accessories necessary to erect fence in location desired.
 - 2. Posts shall be either fiberglass or steel, specifically made for the installation of fencing.
 - 3. Fencing shall be secured to the posts through the use of nylon ties or nylon wire (minimum 12 gauge). Steel wire shall not be used.

2.2 TEMPORARY SILT FENCES

- A. The filter fabric shall meet the requirements of Section 88-1.02E of the State Standard Specifications.
 - 1. Type: Woven.
- B. Mill Certificate or Affidavit. A mill certificate or affidavit shall be provided attesting that the fabric and factory seams meet chemical, physical, and manufacturing requirements specified above.
- C. The Contractor may use either wooden stakes or steel posts for silt fence construction. Wooden stakes utilized for silt fence construction, shall have a minimum cross section of 2 inches by 2 inches when oak is used and 4 inches by 4 inches when pine is used. Steel posts (standard "U" or "T" section) utilized for silt fence construction, shall have a minimum weight of 1.33 pounds per linear foot.

2.3 TEMPORARY FIBER ROLLS (sediment logs or wattles)

- A. Standard Specifications, Section 21-1.02P Fiber Rolls.
 - 1. Type A or Type B
 - 2. 8 – 10 inches in diameter, 10 – 20 feet long.
- B. Standard Specifications, Section 13-6.03E Temporary Fiber Rolls.
- C. The Contractor shall use wooden stakes for fiber roll installation. Wooden stakes utilized for fiber roll installation, shall have a minimum cross section of 1 inch by 2 inches, or as suggested by the fiber roll manufacturer.

2.4 EROSION CONTROL BLANKETS

- A. Standard Specifications, Section 21-1.02O Jute Mesh or Netting.

2.5 TEMPORARY COVERS

- A. Standard Specifications, Section 13-5.02F Temporary Covers.
- B. Standard Specifications, Section 88-1.02H Temporary Covers.

2.6 GRAVEL-FILLED BAGS

- A. Standard Specifications, Section 13-5.02G Gravel-Filled Bags.
- B. Standard Specifications, Section 88-1.02F Gravel-Filled Bags.

2.7 SEDIMENT FILTER BAGS

- A. Standard Specifications, Section 88-1.02G Sediment Filter Bag.

2.8 TEMPORARY HYDRAULIC MULCH

- A. Standard Specifications, Section 13-5.03E Temporary Hydraulic Mulch (Bonded Fiber Matrix).
- B. Standard Specifications, Section 13-5.03F Temporary Hydraulic Mulch (Polymer-Stabilized Fiber Matrix).

2.9 TEMPORARY TACKED STRAW

- A. Standard Specifications, Section 13-5.03H Temporary Tacked Straw.

2.10 TEMPORARY HYDROSEED

- A. Standard Specifications, Section 13-5.03I Temporary Hydroseed.

PART 3 EXECUTION

3.1 GENERAL

- A. Upon approval of the WPCP, the Contractor shall be responsible throughout the duration of the project for installing, constructing, inspecting and maintaining the control measures included in the WPCP and any amendments thereto and for removing and disposing of temporary control measures. Unless otherwise directed by the Engineer or specified in these construction details, the Contractor's responsibility for WPCP implementation shall continue throughout any temporary suspension of work ordered in accordance with Section 8 1.06, "Suspensions," of the Standard Specifications. Requirements for installation, construction, inspection, maintenance, removal and disposal of control measures are specified in the Handbook and these construction details.
- B. Soil stabilization practices and sediment control measures, including minimum requirements, shall be provided throughout the duration of the project.
- C. Implementation of soil stabilization practices and sediment control measures for soil-disturbed areas of the project site shall be completed prior to the start of any other construction activities.
- D. Throughout the winter season, the active, soil-disturbed area of the project site shall be no more than 0.04 acres. The Engineer may approve, on a case-by-case basis, expansions of

the active, soil-disturbed area limit. The Contractor shall demonstrate the ability and preparedness to fully deploy soil stabilization practices and sediment control measures to protect soil-disturbed areas of the project site before the onset of precipitation. The Contractor shall maintain a quantity of soil stabilization and sediment control materials on site equal to 30 percent of that sufficient to protect unprotected, soil-disturbed areas on the project site and shall maintain a detailed plan for the mobilization of sufficient labor and equipment to fully deploy control measures required to protect unprotected, soil-disturbed areas on the project site prior to the onset of precipitation. The Contractor shall include a current inventory of control measure materials and the detailed mobilization plan as part of the WPCP.

- E. Soil-disturbed areas of the project site shall be considered to be non-active whenever soil disturbing activities are expected to be discontinued for a period of 10 or more days and the areas are fully protected. Areas that will become non-active shall be fully protected with soil stabilization practices and sediment control measures within 5 days of the discontinuance of soil disturbing activities or prior to the onset of precipitation, whichever is first to occur.
- F. Active soil-disturbed areas of the project site shall be fully protected at the end of each day with soil stabilization practices and sediment control measures unless fair weather is predicted through the following work day. The weather forecast shall be monitored by the Contractor on a daily basis.
- G. The National Weather Service (<http://www.weather.gov/>) forecast shall be used. If precipitation is predicted prior to the end of the following work day, construction scheduling shall be modified, as required, and the Contractor shall deploy functioning control measures prior to the onset of the precipitation.
- H. The Contractor shall implement, year-round and throughout the duration of the project, control measures included in the WPCP for sediment tracking, wind erosion, non-stormwater management and waste management and disposal.
- I. The Engineer may order the suspension of construction operations which create water pollution if the Contractor fails to conform to the requirements of this section "Erosion Control" as determined by the Engineer.

3.2 INSTALLATION OF TEMPORARY CONSTRUCTION FENCE

- A. Posts:
 - 1. Posts shall be installed plumb and in straight alignment.
 - 2. Posts shall be spaced every 6.5 feet maximum, unless otherwise approved by the Engineer.
- B. Fabric:
 - 1. Fabric shall be stretched taut between fence posts. Equal tension shall be applied so that fence remains straight and taut between posts.
 - 2. Install fabric on security side of fence and anchor to posts so that fabric remains in tension after pulling force is released.
 - 3. Fasten fabric to posts with nylon ties or nylon wire spaced 12 inches maximum.
- C. Maintenance:
 - 1. Fence shall not be allowed to be in disrepair. All breaks or tears in the fence fabric will be repaired immediately.
 - 2. All posts shall remain plumb and in straight alignment. All fallen posts shall be reset immediately.
 - 3. Contractor shall maintain temporary construction fencing in such a manner as to protect Work from damage and to protect the safety of the general public.

4. No Contractor personnel or equipment shall be allowed outside of the fenced construction easement area.

3.3 INSTALLATION OF SILT FENCES

- A. Silt fences shall extend a minimum of 16 inches above the ground surface and shall not exceed 34 inches above the ground surface. Filter fabric shall be from a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, filter fabric shall be spliced together at a support post, with a minimum 6 inch overlap, and securely sealed. A trench shall be excavated approximately 4 inches wide and 4 inches deep on the upslope side of the location of the silt fence. The 4-inch by 4-inch trench shall be backfilled and the soil compacted over the filter fabric. Silt fences shall be removed upon approval by the Owner
- B. Maximum spacing for post supports shall be 6 feet on center. Posts shall be buried 12 inches minimum and shall not exceed 36-inches above the ground surface.

3.4 INSTALLATION OF FIBER ROLLS (sediment logs or wattles)

- A. Fine grade the subgrade by hand dressing where necessary to remove local deviations and to remove larger stones or debris that will inhibit intimate contact of the fiber roll with the subgrade. Prior to roll installation, contour a concave key trench 2 to 4 inches deep along the proposed installation route. Soil excavated in trenching should be placed on the uphill or flow side of the roll to prevent water from undercutting the roll.
- B. Place fiber rolls into the key trench and stake on both sides of the roll within 6 feet of each end. Spacing for stakes shall be 3 to 5 feet. Stakes are typically driven in on alternating sides of the roll. Stakes shall be buried 12 inches minimum.
- C. When more than one fiber roll is placed in a row, the rows should be abutted securely to one another to provide a tight joint, not overlapped. Fiber rolls shall be placed in a single row, lengthwise on the contour, with ends of adjacent rolls tightly abutting one another.

3.5 INSTALLATION OF OTHER SEDIMENT AND EROSION CONTROLS

- A. Install other sediment and erosion controls in accordance with project SWPPP and Standard Specification Section 13.

3.6 MAINTENANCE

- A. The Contractor shall maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. The following procedures shall be followed to maintain the protective measures.
 1. Silt Fence Maintenance. Silt fences shall be inspected in accordance with paragraph INSPECTIONS. Any required repairs shall be made promptly. Close attention shall be paid to the repair of damaged silt fence resulting from end runs and undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, the fabric shall be replaced promptly. Sediment deposits shall be removed when deposits reach one-third of the height of the barrier. When a silt fence is no longer required, it shall be removed. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall be re-vegetated.

2. Fiber Roll Maintenance. Fiber roll barriers shall be inspected in accordance with paragraph INSPECTIONS. Close attention shall be paid to the repair of damaged rolls, end runs and undercutting beneath rolls. Necessary repairs to barriers or replacement of rolls shall be accomplished promptly. Sediment deposits shall be removed when deposits reach one-half of the height of the barrier. Roll rows used to retain sediment shall be turned uphill at each end of each row. When a fiber roll barrier is no longer required, it shall be removed. The immediate area occupied by the roll and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall be re-vegetated.

3.7 INSPECTIONS

- A. General. The Contractor shall inspect disturbed areas of the construction site, areas used for storage of materials that are exposed to precipitation that have not been finally stabilized, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every seven (7) calendar days, within two (2) calendar days of forecasted rains, and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Where sites have been finally stabilized, such inspection shall be conducted at least once every month.
- B. Inspections Details. Disturbed areas and areas used for material storage that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control measures identified in the Storm Water Pollution Prevention Plan or Water Pollution Control Plan shall be observed to ensure that they are operating correctly. Discharge locations or points shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles exit the site shall be inspected for evidence of offsite sediment tracking.
- C. Inspection Reports. For each inspection conducted, the Contractor shall prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the Storm Water Pollution Prevention Plan, maintenance performed, and actions taken. The report shall be furnished to the Engineer within 24 hours of the inspection as a part of the Contractor's work. A copy of the inspection report shall be maintained on the job site.

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HOT MIX ASPHALT PAVING

PART 1 GENERAL

1.1 DESCRIPTION

- A. Work included: Work covered in this section consists of performing all operations necessary for producing and placing hot mix asphalt (HMA) by mixing aggregate and asphalt binder at a mixing plant and spreading and compacting the HMA mixture.
- B. General intent: All roadway trench surfaces shall be repaired in a manner which will result in a surface equal to or better than that existing prior to the trenching operations and conforms with County of Mendocino Department of Transportation and Public Works requirements. HMA shall be replaced with a minimum thickness equal to the existing plus 1 inch, or 3 inches total, whichever is greater. See details on the Drawings.
- C. Section Includes:
 - 1. Quality Control Plan.
 - 2. Quality Control Testing.
 - 3. Acceptance Testing.
 - 4. Asphalt Binder and Tack Coat.
 - 5. Aggregate Materials.
 - 6. Hot Mix Asphalt.
- D. HMA shall be provided in accordance with the Standard HMA construction process and conform to the latest Caltrans Section 39 of the 2025 Standard Specifications and County of Mendocino Standards and as detailed on the Plans and in this specification.
- E. Related Work described elsewhere:
 - 1. Section 31 00 00 - Earthwork
 - 2. Section 31 23 00 - Trench Excavation and Backfill
- F. References
 - 1. AMERICAN ASSOCIATION OF STATE HIGHWAY TRANSPORTATION OFFICIALS (AASHTO)
 - a. M 17 (2011) Standard Specification for Mineral Filler for Bituminous Paving Mixtures
 - b. M 323 (2017) Standard Specification for Superpave Volumetric Mix Design
 - c. R 30 (2002) Standard Practice for Mixture Conditioning of Hot Mix Asphalt (HMA)
 - d. R 59 (2011) Standard Practice for Recovery of Asphalt Binder from Solution by Abson Method
 - e. T 27 (2020) Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
 - f. T 49 (2015) Standard Method of Test for Penetration of Bituminous Materials
 - g. T 59 (2016) Standard Method of Test for Emulsified Asphalts
 - h. T 164 (2014) Standard Method of Test for Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA)
 - i. T 176 (2017) Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
 - j. T 209 (2020) Standard Method of Test for Theoretical Maximum Specific Gravity (G mm) and Density of Asphalt Mixtures

- k. T 269 (2014) Standard Method of Test for Percent Air Voids in Compacted Dense and Open Asphalt Mixtures
 - l. T 275 (2017) Standard Method of Test for Bulk Specific Gravity (Gmb) of Compacted Asphalt Mixtures Using Paraffin-Coated Specimens
 - m. T 283 (2021) Standard Method of Test for Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage
 - n. T 304 (2017) Standard Method of Test for Uncompacted Void Content of Fine Aggregate
 - o. T 305 (2014) Standard Method of Test for Determination of Draindown Characteristics in Uncompacted Asphalt Mixtures
 - p. T 308 (2021) Standard Method of Test for Determining the Asphalt Binder Content of Asphalt Mixtures by the Ignition Method
 - q. T 312 (2019) Standard Method of Test for Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor
 - r. T 313 (2019) Standard Method of Test for Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)
 - s. T 315 (2020) Standard Method of Test for Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)
 - t. T 324 (2019) Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures
 - u. T 329 (2015) Standard Method of Test for Moisture Content of Asphalt Mixtures by Oven Method
 - v. T 335 (2009) Standard Method of Test for Determining the Percentage of Fracture in Coarse Aggregate
2. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
- a. ASTM B117 (2019) Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - b. ASTM D36 (2020) Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus).
 - c. ASTM D92 (2018) Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
 - d. ASTM D150 (2018) Standard Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation.
 - e. ASTM D217 (2021) Standard Test Methods for Cone Penetration of Lubricating Grease
 - f. ASTM D297 (2019) Standard Test Methods for Rubber Products—Chemical Analysis
 - g. ASTM D445 (2021) Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
 - h. ASTM D412 (2021) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension.
 - i. ASTM D822 (2018) Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
 - j. ASTM D1856 (2021) Standard Test Method for Recovery of Asphalt from Solution by Abson Method
 - k. ASTM D2007 (2019) Standard Test Method for Characteristic Groups in Rubber Extender and Processing Oils and Other Petroleum-Derived Oils by the Clay-Gel Absorption Chromatographic Method
 - l. ASTM D2041 (2019) Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.
 - m. ASTM D2074 (2019) Standard Test Methods for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
 - n. ASTM D2240 (2021) Standard Test Method for Rubber Property—Durometer Hardness

- o. ASTM D2995 (2014) Standard Practice for Estimating Application Rate and Residual Application Rate of Bituminous Distributors
 - p. ASTM D4791 (2019) Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
 - q. ASTM D5329 (2020) Standard Test Methods for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphalt Pavements and Portland Cement Concrete Pavements
 - r. ASTM D7741 (2018) Standard Test Method for Measurement of Apparent Viscosity of Asphalt-Rubber or Other Asphalt Binders by Using a Rotational Handheld Viscometer
3. State of California, Business and Transportation Agency, Department of Transportation (Caltrans), Standard Specifications, 2018 edition excluding measurement and payment items.

1.2 QUALITY CONTROL PLAN

- A. Establish, implement and maintain a Quality Control Plan (QCP) to ensure materials and work comply with the specifications and the corrective actions required to control the quality of work. The QCP shall comply with these specifications and Section 39-2 "Hot Mix Asphalt" of the Caltrans Standard Specifications.
- B. Attend a pre-paving conference with the Engineer to discuss methods of performing the production and paving work and how quality control will be performed throughout.
- C. Notify the County of Mendocino Department of Transportation and Public Works a minimum of two weeks (14 calendar days) prior to the placement of any HMA of which asphalt plant will be used to supply the HMA. HMA shall be supplied from a single plant.
- D. In place Nuclear Gage density tests field test may be performed during HMA operations to meet compaction requirements per Standard Specifications. The frequency of testing shall be in accordance with Caltrans Standards.
- E. Qualifications of workers: Provide sufficient skilled workers and supervisors who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of construction involved and the materials and techniques specified.
- F. Codes and standards:
 - 1. Wherever a test method is referenced in this section, it shall be made in accordance with the most current test method in use by the California Department of Transportation (Caltrans) in the State Standard Specifications, latest edition, regardless of references included in this specification.
 - 2. For references made to the Standard Specifications, reference shall mean State of California, Business and Transportation Agency, Department of Transportation (Caltrans), Standard Specifications, latest edition, excluding measurement and payment items.

1.3 SUBMITTALS

- A. Submit all product data, shop drawings, laboratory test results, material source information, and certificates of compliance listed in this Section under a single submittal cover for review. Incomplete submittals will not be reviewed.
- B. The Contractor shall provide the Engineer with the following information a minimum of 10 days prior to commencing the Work:

1. Hot mix asphalt job mix formula (JMF) in accordance with Caltrans Standard Specifications.
 - a. Proposed JMF on Form CEM-3511.
 - 1) Include percentage of reclaimed asphalt pavement (RAP)
 - b. Mix design documentation, data and aggregate quality on Form CEM-3512 dated within 12 months of submittal.
 - c. JMF verification on Form CEM-3513, if applicable
 - d. JMF renewal on Form CEM-3514, if applicable
 - e. Materials Safety Data Sheets (MSDS) for:
 - 1) Asphalt binder
 - 2) Supplemental fine aggregate except fines from dust collectors
 - 3) Antistrip additives
 2. Written confirmation from the supplier that the JMF to be supplied meets all specified requirements.
- C. Tack Coat
1. Submit asphalt binder tack coat and asphaltic emulsion tack coat.
- D. The Contractor shall develop and submit a Quality Control (QC) Plan for the project in accordance with Section 39-2.01A(3)(c) and Section 39-202A(4)(b). The Contractor shall not begin hot mix asphalt production or placement without written approval from the Engineer of the QC Plan and an approved JMF. Approval of the QC Plan and JMF by the Engineer does not relieve the contractor of responsibility for quality control or work methods.
1. Quality control sampling and acceptance testing shall be performed by the Contractor in accordance with Section 39-2.01A(4)(h) and Section 39-202A(4)(b).

1.4 ENGINEER'S ACCEPTANCE

- A. In addition to the QC Plan, the Engineer may perform independent quality assurance to perform independent sampling and acceptance testing in accordance with Section 39-2.01A(4) of the Standard Specifications.
- B. Start-up evaluation will be performed in accordance with the Standard Specifications. Sampling and testing may occur at a minimum for the following:
1. Aggregate
 2. Asphalt binder
 3. RAP
 4. HMA
- C. Acceptance testing (Quality Assurance) may be performed by the Engineer.
- D. In place Nuclear Gage density field test may be performed during HMA operations by the Engineer to meet compaction requirements per Standard Specifications.

1.5 PRODUCT HANDLING

- A. All products described herein shall be handled in conformance to the applicable provisions of the Standard Specifications.

1.6 PROJECT CONDITIONS

- A. Weather Limitations:
1. No HMA shall be placed when weather conditions prevent the proper handling, finishing, or compaction of the mixtures.
 2. Do not apply when underlying surface is muddy, frozen or wet.

3. Do not place tack coat when temperature is below 45° F.
 4. Do not place hot mix asphalt when air temperature is below 45° F and surface temperature is below 50° F.
- B. Traffic Striping and Pavement Markers
1. Do not apply pavement marking paint within 8 hours of fog or rain or when below 40 Degrees F.
 2. Contractor shall guarantee that all traffic lane pavement markers be in place and adhered to the pavement for a period of not less than 90 days from the date of acceptance of the work by the City.
 3. All new traffic striping and pavement markings shall be thermoplastic, unless otherwise shown on the Drawings.
 4. No pavement markings shall be applied to any roadway surface until new hot mix asphalt surface has cured for a minimum of seven (7) days when hot melt bituminous adhesive is used, and not less than 14 days when epoxy adhesive is used.

PART 2 PRODUCTS

2.1 TACK COAT

- A. Tack Coat, Grade PG 64-16, conforming to the provisions of Sections 39 and 92 of the Standard Specifications shall be used between layers of each lift of HMA, and on curbs, gutters and construction joints.

2.2 PRIME COAT AND TACK COAT

- A. Prime coat shall consist of either SC-70 or MC-70 grade liquid asphalt as directed by the Engineer and shall be furnished and applied in accordance with the provisions in Section 93, "Liquid Asphalts" of the Caltrans Standard Specifications.
- B. Tack coat shall be diluted SS1 or CSS1, or undiluted RS-1 or CRS-1 type asphalt emulsion.

2.3 ASPHALT BINDER

- A. Asphalt binder to be mixed with aggregate for asphalt concrete surface, leveling or open graded courses shall be AR-4000, conforming to the provisions of Sections 39 and 92 of the Standard Specifications and Mendocino County Standard Road Specifications.

2.4 AGGREGATE

- A. Aggregate shall be clean and free from deleterious substances and conform to the following gradings in accordance with Section 39 of the Standard Specifications.
1. Surface Course: Type A 1/2 inch or 3/4 inch
 2. Leveling Course: Type A 3/4 inch
 3. Asphalt Concrete Base: Type A or B 3/4 inch
 4. Open Graded: 3/8 inch

2.5 HOT MIX ASPHALT

- A. HMA batch plant shall be Department-qualified under the Department's Materials Plant Quality Program of the Standard Specifications.
- B. Reclaimed asphalt pavement shall be acceptable in accordance with the Standard Specifications not exceeding 15.0 percent of the aggregate blend.

PART 3 EXECUTION

3.1 .PROTECTION OF EXISTING STREET SURFACE

- A. During the entire construction period, the Contractor shall take care to protect existing pavement or sealed surfaces. Backhoes and trenchers must have street pads. Grossers or metal tipped pads will not be allowed. Surfaces scarred by cleanup or excavation equipment shall be repaired in a manner satisfactory to the Engineer. Any and all damage caused by the Contractor's operations to existing roads and streets shall be repaired by the Contractor to at least the original condition and to the satisfaction of the Engineer, at no additional cost to the City.
- B. If pavement is damaged (excessive loading, grouser marking, scarring/scraping of pavement, etc.) in adjacent lanes, a full lane width grinding and overlay will be required as directed by the City. If pavement is damaged due to excessive loading near the trench wall causing openings in the pavement, full depth structural section replacement will be required as directed by the City. If pavement restoration comes to within 4 feet from the edge of the pavement or lip of gutter/curb, pavement shall be replaced to the lip of gutter/curb.

3.2 PAVING REMOVAL

- A. Sawcutting shall be required for all roads. See Section 31 23 00 "Trench Excavation and Backfill" for paving removal requirements.
- B. Subgrade shall be compacted to a firm and unyielding condition prior to placement of HMA.
- C. Grade tolerance shall be in accordance with Section 39-1.04 of the Mendocino County Standard Road Specifications.
- D. Clean and dry subgrade area prior to commencing with placement of HMA.

3.3 AGGREGATE BASE

- A. Aggregate base shall be spread and compacted according with Section 26 of the Standard Specifications. Compact to 95 percent relative compaction.

3.4 PRIME COAT AND TACK COAT

- A. Ensure the area is clean and dry. All material accumulations which would interfere with the adhesion of the tack coat or with the placing and performance of the HMA shall be removed, including dust, loose aggregate, soil, leaves, and pieces or lumps of other foreign material deposited on the surface.
- B. A tack coat shall be applied to existing pavement including planed surfaces, between HMA layers, and to vertical surfaces of curbs, gutters and construction joints at the minimum residual rates specified in Section 39 of the Standard Specifications and Section 39 of the Mendocino County Standard Road Specifications.
- C. Before placing HMA, a tack coat shall be furnished and applied uniformly to contact surfaces of all cold pavement joints, curbs, gutters, pavement reinforcing fabric and all existing pavement to be surfaced in conformance with Section 39 of the Standard Specifications.
- D. Tack coat shall be applied to any course in advance of spreading the next course unless the surface temperature is at least 140 °F.

- E. Hot mix asphalt shall not be placed until tack coat has cured.
- F. Immediately in advance of placing HMA, apply additional tack coat to damaged areas or where loose or extraneous material is removed.
- G. Close areas receiving tack coat to traffic. Do not track tack coat onto pavement surfaces beyond the job site.
- H. The cost of applying tack coat will be considered included in the Contract Price and no additional compensation will be allowed therefore.

3.5 TRANSPORTING HOT MIX ASPHALT

- A. From mixing site in trucks having tight, clean compartments.
- B. Coat hauling compartments with lime-water mixture to prevent sticking.
- C. Elevate and drain compartment of excess solution before loading mix.
- D. Provide covers over asphalt concrete mixture to protect from weather and to prevent loss of heat.
- E. During periods of cold weather or for long distance deliveries, pre-insulation around entire truck bed surfaces.
- F. Do not use petroleum products such as kerosene or diesel fuel to release HMA from trucks, spreaders, or compactors.

3.6 HOT MIX ASPHALT

- A. HMA surfacing shall conform to the provisions of Section 39 of the Standard Specifications. Placing HMA shall be done under suitable weather conditions for such operations. Rain, snow or other inclement weather will be cause for discontinuing paving Work. The Engineer shall have the authority for determining whether weather conditions are sufficient cause to postpone work.

3.7 SPREADING AND COMPACTING

- A. Spreading and compacting shall be performed in accordance with Section 39 of the Standard Specifications and Section 39-1.07, Section 39-1.08 and Section 39-1.10 of the Mendocino County Standard Road Specifications.
- B. Longitudinal joints in the top layer must match specified lane edges shown on the striping plans. Longitudinal joints in lower HMA layers shall be offset at least 0.5 feet from each side of the specified lane edges.
- C. Finish rolling shall be completed before pavement surface temperature is below 150 degrees F.
- D. Traffic shall not be allowed on HMA until mid-depth temperature is below 160 degrees F and the pavement surface temperature is below 140 degrees F.

3.8 SMOOTHNESS AND DRAINAGE

- A. Verify smoothness and drainage using a water truck. Spray sufficient quantity of water to cause surface runoff from the entire newly paved surface. Any puddles and birdbaths deeper than 1/4 inch shall be corrected by sawcutting, removing and replacing HMA a sufficient distance from puddles and birdbaths to correct them, or by grinding. All smoothness and drainage corrections to HMA shall be at the Contractor's expense and to the satisfaction of the Engineer.

3.9 TRENCH PATCHING

- A. All trench patches shall be limited to the width of the trench plus 6 inches on either side of the trench.

3.10 STREET MAINTENANCE

- A. Until the permanent pavement is placed, the base rock or temporary asphaltic plant mix at the surface of the trench shall be maintained at all times at a grade level with the adjacent street. Continuous inspection and maintenance of the trench area will be required. Lights and barriers shall be maintained on all Work that is not safe for travel until such time as is made safe.

3.11 CONTRACTOR'S RESPONSIBILITY

- A. Settlement of replaced pavement over trenches within the warranty period shall be considered the result of improper or inadequate compaction of the subbase or base materials. The Contractor shall promptly repair all pavement deficiencies noted during the warranty period.

END OF SECTION

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SECTION 32 39 13

BOLLARDS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal bollards.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete and manufacturer instructions for installing anchor bolts, steel pipe sleeves, wedge-type inserts and other items cast into concrete.

1.2 REFERENCES

- A. ASTM A312 – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.

1.3 SUBMITTALS

- A. Show fabrication and installation details for metal fabrications.
- B. Product Data: Provide for each type of bollard, component, finish, and accessory specified.
- C. Color Samples: Submit sample of color specified.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 33 00 - Submittals: Requirements for submittals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect bollards and accessories during delivery, storage, and handling.

1.6 WARRANTY

- A. Provide standard warranty against defects in materials and workmanship.
 - 1. Warranty Period: Five years from date of invoice, except as otherwise indicated.
 - 2. Coatings: Two years, against peeling, cracking, or significant color change.

PART 2 PRODUCTS

2.1 METAL BOLLARDS

- A. Size: as shown on plans.
- B. Fabricate metal bollards from Schedule 40 galvanized steel pipe, filled with concrete.
- C. Provide threaded end-cap.
- D. Color coating: White rust-inhibiting paint

- E. Paint yellow. Provide 2" yellow reflective tape on bollard as shown on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine paving, condition of substrate, and other conditions affecting installation, placement, and location of bollards.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Fill bollards solidly with concrete and allow concrete to cure seven days before installing.
- B. Anchor bollards in place with concrete footings. Center and align bollards in holes 6 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation.
- C. Support and brace bollards in position until concrete has cured.
- D. Damaged, cracked, chipped, deformed, or marred bollards are not acceptable.

END OF SECTION

SECTION 33 05 17

PRECAST CONCRETE METER AND VALVE BOXES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Meter boxes.
 - 2. Vaults.
 - 3. Valve boxes.
- B. Related Sections:
 - 1. Section 33 11 00 – Recycled Water Utilities.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
 - 2. ASTM A185/A185M - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
 - 3. ASTM A536 - Standard Specification for Ductile Iron Castings.
 - 4. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 5. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 6. ASTM C150 - Standard Specification for Portland Cement.
 - 7. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 - 8. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 9. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - 10. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
 - 11. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
 - 12. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
 - 13. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joints Sealants.
 - 14. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 15. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 16. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 17. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
 - 18. ASTM D4104 - Standard Test Method (Analytical Procedure) for Determining Transmissivity of Nonleaky Confined Aquifers by Overdamped Well Response to Instantaneous Change in Head (Slug Test)

1.3 DESIGN REQUIREMENTS

- A. Design Criteria:

1. Watertight precast reinforced air-entrained concrete structures designed to ASTM C890 AASHTO HS-20 live loading and installation conditions, and manufactured to conform to ASTM C913.
2. Minimum 28-day Compressive Strength: 5,000 psi.
3. Honeycombed or re-tempered concrete is not permitted.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittals: Requirements for submittals.
- B. Shop Drawing: Indicate plan, location and inverts of connecting piping.
- C. Product Data: Submit design data on valve vaults and meter boxes.
- D. Manufacturer's Certificates: Submit Statement of Compliance, supporting data, from materials suppliers attesting that precast concrete valve vaults and meter boxes provided meet or exceed ASTM Standards and specified requirements.
- E. Manufacturer's Installation Instructions: Submit special procedures for precast concrete valve vaults and meter boxes installation.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Project Closeout: Requirements for close out submittals.
- B. Project Record Documents: Accurately record actual locations and inverts of buried pipe, components and connections.

1.6 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation Meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Transport and handle precast concrete units with equipment designed to protect units from damage.
- C. Do not place concrete units in position to cause overstress, warp or twist.

1.8 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate work with District and utilities within construction area.

PART 2 PRODUCTS

2.1 WATER SERVICE METER BOX & LID

- A. Manufacturer:
 - 1. Oldcastle Precast Christy N-36 or B1730 with traffic-rated cover.
 - a. Body Materials: reinforced concrete with composite or steel frame.
 - b. Lid Materials: Steel, concrete or composite with reader door.
 - 2. Approved equivalent.
 - 3. Substitutions: Section 01 60 00 - Product Requirements.

2.2 FLOW METER AND CHECK VALVE VAULTS & ACCESS COVERS

- A. Provide pre-cast vault as shown on Drawings.
 - 1. Concrete shall be minimum 5,000 psi compressive strength
 - 2. Reinforcing shall be ASTM A-615, Grade 60
 - 3. Vault shall be designed to meet AASHTO HS-20 loading
 - 4. Provide shop drawings and calculations stamped/signed by a California licensed civil or structural engineer.
 - 5. Manufacturer:
 - a. Old Castle Precast
 - 6. Substitutions: Section 01 60 00 - Product Requirements.
- B. Vault Access Cover:
 - 1. Type 316 stainless steel hardware, hinges and slam lock.
 - 2. Diamond-pattern tread plate cover reinforced for H-20 wheel loading.
 - 3. Extruded aluminum channel frame with 1-1/2" drain coupling for pipe connection.
 - 4. Mill finish aluminum with bituminous coating applied to exterior frame.
 - 5. Single leaf or double leaf (per Plan).
 - 6. Engineered lift assistance using compression spring operators enclosed in telescopic tubes for smooth, easy one-hand door operation.
 - 7. Automatic hold-open arm locks with release handle to ensure safe egress
 - 8. Constructed with corrosion resistant materials.
 - 9. Heavy-duty construction and positive latching mechanism help to prevent unauthorized access.
 - 10. Aluminum fall protection grating with powder coat paint finish in safety yellow or safety orange designed to meet requirements of OSHA standard 29 CRF1926.502(c) and equipped with a hold open device to lock in open position.
 - 11. Warranty: Minimum 5 year manufacturer's warranty against defects in materials and workmanship.
 - 12. Manufacturer:
 - a. Bilco Type J AL or JD-AL
 - b. USF Fabrication UEZ-180
 - c. Halliday Series H
 - 13. Substitutions: Section 01 60 00 - Product Requirements.

2.3 VALVE BOXES

- A. Valve boxes:
 - 1. Manufacturer: Christy Model G5 Traffic Box.
 - 2. Substitutions: Section 01 60 00 - Product Requirements.

2.4 BEDDING AND BACKFILL

- A. Install bedding and backfill as shown on the Drawings and as described in the Specifications.

- B. Maintain optimum moisture content of bedding material to attain required compaction density.

2.5 FABRICATION AND MANUFACTURE

- A. Fabricate precast reinforced concrete structures in accordance with ASTM C913, to dimensions indicated on Drawings, and to specified design criteria.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify piping connection, size, location, and invert as indicated on Drawings.

3.2 PREPARATION

- A. Ream pipe ends and remove burrs.
- B. Remove scale and dirt from components before assembly.
- C. Establish invert elevations for each component in system.
- D. Hand trim excavation to suit valve vaults and meter boxes. Remove stones, roots or other obstructions.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Request inspection by Engineer prior to placing aggregate cover over piping.

3.4 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Project Closeout: Protecting finished work.

END OF SECTION

SECTION 33 05 23.13

HORIZONTAL DIRECTIONAL DRILLING

PART 1 GENERAL

1.1 REQUIREMENTS

- A. This section specifies minimum design and performance requirements for the construction of a potable water pipeline by the horizontal directional drilling (HDD) method.
- B. Furnish all designs, tools, equipment, materials and supplies, and perform all labor required to complete the Work as indicated on the Contract Drawings and specified herein.
- C. Select, furnish, and maintain the drilling and ancillary equipment in proper and safe working order.
- D. Comply with all California Department of Transportation and County of Mendocino Encroachment Permit conditions.
- E. Successfully complete final acceptance testing of the installed potable water pipeline as specified in Section 33 11 00 and Section 33 11 13.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Comply with the applicable reference Specifications:
 - 1. Section 01 11 00 - Summary of Work
 - 2. Section 01 30 00 - Administrative Requirements
 - 3. Section 01 33 00 - Submittals
 - 4. Section 01 70 00 - Project Closeout
 - 5. Section 01 74 19 - Construction Waste Management
 - 6. Section 02 01 10 - Existing Utilities and Underground Structures
 - 7. Section 31 09 13 - Geotechnical Instrumentation and Monitoring
 - 8. Section 31 00 00 - Earthwork
 - 9. Section 31 23 19 - Dewatering
 - 10. Section 33 11 00 - Recycled Water Utilities
 - 11. Section 33 11 13 - Fusible PVC Pipe
 - 12. Comply with the following industry standards effective at time of bid:
 - a. NSF/ANSI Standard 60 – Drinking Water Chemicals Health Effects

1.3 DEFINITIONS

- A. Bent Sub: A specially manufactured piece of drill steel behind the drilling tools that is inclined at an angle of one to three degrees from the axis of the bore in the desired direction of steering. The bent sub is used for steering of the drilling tools.
- B. Conductor/Surface Casing: A steel casing pipe installed at the entry and/or exit locations of the borehole to stabilize the borehole. Drilling Fluid/Mud: A mixture of water, bentonite, and/or polymers continuously pumped to the drilling tool or bit to facilitate the removal of soil cuttings and the stabilization of the bore. These fluids also cool the drilling tools, cool the drill steel, cool the guidance electronics, and lubricate the pipe string.
- C. Drill Steel: Specialty manufactured steel drill rod segments used to provide forward thrust and rotation to the drill tool. The drill rod is extended, as the excavation process advances, by

joining the individual drill rod segments to become the drill string. The drill string also transports drilling fluids from the surface to the point of excavation. The drill string is pushed upon during pilot bore drilling and forward reaming and is pulled upon during back-reaming, swabbing, and pipe pullback.

- D. Drilling Mud: An engineered fluid mixture of water, with bentonite, and/or polymer additives, used in a closed loop system for transporting spoil and counterbalancing earth and groundwater pressures during the HDD process.
- E. Drilling Tool/Bit: Any rotating tool or system of tools on a common support which excavates and/or provides directional control.
- F. Entry Pit: Location where the pilot bore begins with the drill tool entering the ground.
- G. Exit Pit: Location where the pilot bore ends with the drill tool exiting the ground.
- H. Horizontal Directional Drilling (HDD): A guided, steerable drilling system used for the trenchless installation of pipes, conduits, and cables. A pilot bore path is excavated in a shallow arc from a surface-launched drill rig. Excavation takes place with fluid assisted cutting from a drilling tool on the drill string. The pilot bore is directed by the positioning of a bent sub. The bore is filled with drilling mud/fluid for stabilization. The bore path is enlarged with subsequent reaming passes until the desired diameter is achieved. As a final step, the carrier pipe, conduit, or cable is pulled into the fluid-stabilized bore.
- I. Hydrolock: A condition that occurs when the drilling fluid in the bore becomes trapped behind the reamer and/or casing and exerts counter pressure during pullback to the extent where it cannot be overcome by the pulling force and the pullback cannot be advanced.
- J. Inadvertent Returns: The loss of drilling fluid, including slurry and lubrication, from the slurry or lubrication system. A special form of inadvertent return, where the fluid exceeds the strength and confining pressure of the ground and reaches the surface or waterway, is called a hydrofracture or "frac-out."
- K. Mud Motor: Motor located on the drilling tool that uses pressurized drilling mud introduced through the drill steel to provide rotational power to the cutting drill tool.
- L. Pilot Bore: The action of creating the first guided pass of the HDD process which is then reamed in one or more passes to the size required to allow pullback of the carrier pipe.
- M. Pullback: That part of a horizontal directional drilling process in which the drill string and carrier pipe are pulled back through the bore to the entry.
- N. Pullback Loads: The tensile load (force) applied to a drill string and carrier pipe during the pullback process.
- O. Pre-Reaming/Reaming: The HDD operational sequence where the pilot bore is being enlarged. Back reaming has the operational forces exerted towards the HDD equipment in a "pulling" manner and forward reaming has the operational forces exerted away from the HDD equipment in a "pushing" manner. Reaming can also be accomplished by two HDD rigs connected to the same drill steel pushing and pulling in unison.
- P. Spoil: Earth, rock, and other materials excavated during the HDD process.

- Q. Swab: An HDD operational sequence where the hole is stabilized and cleared by the passing of a special hole-sized tool. This step is typically performed just before the pullback. This operation typically has the operational forces exerted towards the HDD equipment.

1.4 DESIGN REQUIREMENTS

- A. Provide HDD systems with the following:
1. Directional control to construct the carrier pipe within the design tolerances.
 2. Down-hole surveying equipment with pitch, roll, depth, and azimuth information for real time monitoring, tracking, and surveying of the drill head. Provide guidance system with a minimum accuracy of ± 0.40 degree of azimuth and ± 0.10 degree of inclination.
 3. Provide HDD rig with pulling capacity equal to or greater than 1.5 times the static weight of the entire assembled pipe string including ballast.
 4. Provide HDD rig with torque capacity at least 20 percent greater than the maximum anticipated torque calculated for each pass.
 5. Provide a spoil separation plant sized to accommodate 120 percent of the maximum allowable instantaneous excavation rate and solids tonnage based upon 120 percent of the maximum allowable instantaneous advance rate, and anticipated ground conditions for each drilling pass.
- B. Locate the entry and exit points and drill the entrance and exit angles as indicated on the Contract Drawings, unless otherwise accepted by the Engineer.
- C. Conductor casing:
1. Construct conductor as shown on the Contract Drawings.
 2. Construct the conductor casing until firmly embedded in the identified formation or intended depth.
 3. Construct the conductor casing to the designed entry or exit angle as shown on the Contract Drawings.
 4. The conductor casing shall remain in place during pilot bore drilling, reaming, and pullback operations.
 5. Methods used to construct and remove the conductor casing shall prevent ground settlement and heave.
- D. Size each reaming pass so as not to exceed 80 percent of the maximum torque of the drill rigs.
- E. Calculate the maximum anticipated construction loads acting on the conductor casing and demonstrate that the anticipated loads are implemented in the manufacturer's design of the conductor casing, subject to the Engineer's review. Provide a minimum factor of safety of 2.0.
- F. Calculate the maximum anticipated construction loads acting on the casing and carrier pipe and show that the anticipated loads are implemented in the manufacturer's design of the casing and carrier pipe, subject to the Engineer's review. Provide a minimum factor of safety of 2.0.
- G. State as-built to plan or prepare and provide HDD calculations using industry accepted methods such as ASTM or API, or other standard acceptable to the Engineer. Use conservative assumptions. Confirm assumptions with Engineer.
- H. All process water shall be removed and legally disposed of.

1.5 PERFORMANCE REQUIREMENTS

- A. Directional tolerances of the pilot bore:

1. Provide a minimum of 6.0 feet separation from existing utilities and other obstacles including property, right-of-way and easement boundaries.
- B. Guidance System Tolerance:
 1. Vertical Tolerance shall not exceed ± 3.0 percent of depth.
 2. Horizontal Tolerance shall not exceed ± 3.0 percent of depth.
- C. At no location shall the pilot bore create a path that locates the carrier pipe or excavates in violation of any permit or easement.
- D. The carrier pipe shall be capable of meeting the design flow.
- E. Drill a radius of curvature no less than that shown on the Contract Drawings, unless otherwise accepted by the Engineer. The minimum drill radius shall be calculated over three continuous drill steel segments or 30 feet, whichever is less.
- F. Ground movements above the alignment shall not exceed those specified in Sections 31 09 13.

1.6 QUALITY CONTROL

- A. Requirements outlined below shall be met at the time of bid and remain in force through completion of the project. Subcontracted work does not qualify as experience.
 1. The Contractor shall have demonstrated experience in constructing pipelines with similar pipe diameters, installation lengths, and depths using HDD. At least four (4) years of recent experience constructing HDD projects is required in similar ground conditions, as measured by soil type, N value and hydrostatic head, as anticipated for this project. The Contractor shall have demonstrated experience using similar HDD equipment proposed for use on this project.
 2. The Contractor shall employ skilled, experienced superintendent(s), drill rig operator and drilling fluid and separation plant specialist. The project superintendent shall have completed at least five (5) projects of 18-inch diameter (or greater) with pull lengths of 300 feet (or greater) in similar soil conditions, as measured by soil type, N value and hydrostatic head, as anticipated on this project, in the last five (5) years. The drill rig operator must have completed at least three (3) projects of 18-inch diameter (or greater) with pull lengths of 300 feet (or greater) in similar ground conditions, as measured by soil type, N value and hydrostatic head, as anticipated on this project, in the last five (5) years. The drilling fluid and separation plant specialist must have at least five (5) years of experience in the design of drilling fluid mixes and separation plants based on anticipated ground conditions. The drilling fluid and separation plant specialist must have completed at least three (3) projects of 14-inch diameter (or greater) with pull lengths of 300 feet (or greater) in similar ground conditions, as measured by soil type, N value and hydrostatic head, as anticipated on this project, in the last five (5) years.
 3. Contractor's HDD engineer, if required by HDD design, shall be a Professional Engineer registered in the State of California. Experience shall include HDD design calculations on five (5) HDD projects with reaches over 300 feet long within the last five (5) years.
 4. Contractor's surveyor shall be a Professional Land Surveyor registered in the State of California.
 5. Experience records shall list the five (5) most recent HDD projects, including all HDD projects completed for the District, and all projects demonstrating the specified experience. The experience record shall include name of project; owner of the project; names of contacts including all contact information; pilot bore diameter, carrier pipe diameter, ground conditions as measured by soil type, N value, and hydrostatic head; longest reach planned and completed; and total footage planned and completed.

6. The Engineer will be the sole judge in determining if the prospective contractor, HDD project superintendent, HDD operator and surveyor meet the work and project experience requirements.
- B. If an automated data acquisition system is provided with the system operate the automated data acquisition system for the duration of the project.
- C. Surveying:
 1. Establish survey control points sufficiently far from the HDD excavation so as not to be affected by ground movement or damaged by any Work on the project.
 2. The position of the drill head shall be continuously tracked capable of maintaining the design tolerances specified herein.
 3. All surveying equipment shall be inspected and calibrated by the equipment manufacturer prior to use on the Project.

1.7 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with Section 01 33 00 and as specified herein.
- B. HDD submittals shall be coordinated with all relevant submittals, assembled, and submitted as a single, comprehensive submittal.
- C. Where calculations are required to be submitted, they shall be signed and sealed by a Professional Civil Engineer registered in the State of California. Calculations shall clearly identify all parameters used, state all assumptions made in the calculation, and identify all sources of information.
- D. All shop drawings shall be legible with dimensions accurately shown and clearly marked in English.
- E. Pre-Construction Submittals:
 1. Submit qualifications and experience records for the following:
 - a. HDD contractor performing the Work;
 - b. HDD project superintendent;
 - c. HDD and guidance operator;
 - d. Drilling fluid and separation plant specialist;
 - e. Contractor's Engineer and
 - f. Contractor's Surveyor.
 2. Provide HDD Work Plan including set-up of equipment, guidance set-up, number of passes, size and type of tooling for each pass etc.
 3. Provide detailed method of conductor casing installation.
 4. At least 15 workdays prior to mobilization, provide detailed schedule for the HDD installation showing all major construction activities and durations, with starting and completion dates shown. The schedule shall be updated weekly, or as directed by the Engineer, and shall include:
 - a. "One call" utility locate requests and visual confirmation of all crossing utilities and all parallel utilities within 20 feet laterally of the bore centerline.
 - b. Site preparation.
 - c. Rig mobilization and setup.
 - d. Installation of conductor casing.
 - e. Pilot bore drilling.
 - f. Pre-reaming and reaming.
 - g. Layout and thermal butt fusing of carrier pipe.
 - h. Pressure testing of pipe prior to pullback.
 - i. Filling the pipe with water during pullback.
 - j. Final reaming and pullback of pipe.

- k. Pressure testing of pipe after installation.
 - l. Cutting of conductor casing stick-out into drill rig pit.
 - m. Annulus grouting of conductor casing.
 - n. Mandrel/pig test.
 - o. Cleanup, surface restoration, and demobilization.
5. Provide plan of entry and exit sites including pit, set-up of all HDD and ancillary equipment, spoils handling, carrier pipe and conductor casing staging area, and methods of maintaining and protecting the jobsite.
 6. Provide a profile shop drawing showing the lift height for the carrier pipe during pullback including any overhead conflicts and safe separation at a scale acceptable to the Engineer.
 7. Provide any proposed deviations from the design geometry as shown on the Contract Drawings, Proposed deviations are subject to acceptance by the Engineer.
 8. HDD equipment manufacturer's preprinted specifications and data sheets or letter from manufacturer demonstrating that HDD rig meets minimum pullback and torque requirements as specified herein.
 9. Provide HDD Work Plan including set-up of equipment, guidance set-up, number of passes, size, and type of tooling for each pass etc.
 10. Provide detailed method of conductor casing installation.
 11. A complete list of all drilling fluid additives that will be on site with material safety data sheets (MSDS) and manufacturer's description and warranties.
 12. Provide drilling fluid mixture and content of additives including mixing instructions for each ground type to be encounter along the HDD profile.
 13. Plan for monitoring alignment control to design.
 14. Plan for monitoring for inadvertent returns.
 15. Provide a sample of daily HDD report and HDD operator's manual log.
 16. Provide a sample of driller fluid mixing and batching report.
 17. Provide a sample of surveyor's location and alignment report.
 18. Provide a sample of the automated data acquisition record, in English, with information available for recording, variations in data acquisition frequency, and available formats for Engineer to select operating parameters for automated recording.
 19. Method statement for filling the carrier pipe with potable water prior to pullback. Identify the source of potable water.
 20. Provide electrical system, lighting system, and onsite power generation details.
 21. Contingency Plans addressing the following:
 - a. Spoils do not settle/separate with the spoils separation equipment on site.
 - b. Drill steel or carrier pipe cannot be advanced or retrieved with the drill rig onsite.
 - c. Drill tool becomes lost in the hole.
 - d. Guidance control system fails to provide accurate information.
 - e. Loss of steering or inability to steer.
 - f. Installation forces start to increase rapidly, raising concerns about completing the pipe pull back installation.
 - g. Swivel breaks during carrier pipe installation.
 - h. Frac-Out and Surface Spill Contingency Plan: Describe procedures for preventing drilling fluid losses or spills and/or fluid returns to the surface. The plan shall address roles and responsibilities of involved parties, monitoring, prevention, containment, cleanup, and documentation procedures, and observations to be made and plans for containment and cleanup, if spills or hydrofracture occur. The plan will address changes that will be made to Contractor's operations to avoid recurrences. Containment and cleanup equipment shall be provided at both entry and exit locations and shall include at a minimum:
 - 1) Heavy weight plastic gravel filled and sealed bags.
 - 2) Geotek filter bags.
 - 3) Splash board.
 - 4) Several 5-gallon hard plastic pails.
 - 5) Heavy duty push brooms and several flat blade shovels.

- 6) Silt fence and T-post or straw bales.
 - 7) Straw logs.
 - 8) Portable pumps.
 - 9) Hose.
 - 10) Vacuum truck available for response within one (1) hour of a frac-out event.
 - i. Obstructions encountered.
 - j. Utility strike.
 - k. Loss of drill fluid circulation.
 - l. Deviation from design bore path exceeds tolerances.
 - m. Pipe collapses or pipe deformations exceed maximum allowable tolerances.
 - n. Hydrolock.
- F. Construction Submittals to be submitted as construction progresses:
- 1. Notifications:
 - a. All notifications are to be provided in writing and within one workday unless otherwise specified herein.
 - b. Immediately notify the Engineer when the HDD pilot bore is out of design tolerance by 75 percent of the maximum allowed. Include written description of the operational changes being made to avoid attaining the maximum allowed.
 - c. Immediately stop drilling and notify the Engineer when the HDD pilot bore is out of design tolerance by 100 percent of the maximum allowed. Include written description of the operational changes being made and acceptable to the Engineer before the resumption of drilling.
 - d. Immediately notify the Engineer upon encountering an object that impedes advancement during HDD operations. Notify the Engineer of proposed measures to attempt to advance past the object, prior to initiating the attempt.
 - e. Immediately notify the Engineer upon implementation of any contingency plan.
 - 2. Provide daily HDD reports with the following information for each shift:
 - a. Date;
 - b. Project name;
 - c. Printed name and signature of operator.
 - d. Start and finish times for each crew each workday.
 - e. Start time of each activity;
 - 3. Provide HDD operator's manual log:
 - a. One recorded measurement for every drill rod or every 30-foot advance, whichever is more frequent. For each of the recording points, record the following measurements along with the unit of measure:
 - 1) Time of measurement.
 - 2) Surface station.
 - 3) Drilling length.
 - 4) Drill rod lengths.
 - 5) Drilling time required for each drilling rod.
 - 6) Advance rate.
 - 7) Maximum force and direction of force, push or pull.
 - 8) Maximum torque.
 - 9) Drilling fluid pressures and flow rates.
 - 10) Drilling fluid losses.
 - 11) Pitch.
 - 12) Inclination.
 - 13) Roll.
 - 14) Azimuth.
 - 15) Any instances of retraction and re-drilling.
 - 4. Provide drilling fluid mixing and batching report: Measure and record drilling fluid viscosity and density (mud weight) with no more than 2 hours between readings, using calibrated Marsh funnel and mud balance, also include types and quantities of additives used.

5. For automated data recording, provide the operating parameters selected by the Engineer for recording. At a minimum, include the operating parameters specified for manual recording.
 6. Perform and record results of 360-degree test roll of the guidance system in the drill string before initiation of drilling operations.
 7. Surveying:
 - a. Record the position of the drill bit every drill rod or every 30-foot advance or every 30 minutes, whichever is more frequent.
 - b. Submit plot of the actual location of the bore path at the end of the shift by 9 AM the following workday, or as directed by the Engineer.
 - c. Submit as-built location of the pilot bore within 24 hours of completion of the pilot bore at a scale acceptable to the Engineer.
 - d. Submit survey reports in both hard copy and electronic format acceptable to the Engineer.
 8. Provide hydrostatic pre-test record of carrier pipe performed prior to pullback.
- G. Post-Construction Submittals:
1. Provide as-built survey of the installed pipe in both tabular format and AutoCAD format acceptable to the Engineer. Scale to be acceptable to the Engineer.
 2. Provide final acceptance test records.

1.8 PROJECT CONDITIONS

- A. A soil and subsurface investigation was conducted for the trenchless pipeline crossing under State Route 1, and the results and recommendations are contained in the following report:
1. Title: Final Geotechnical Investigation and Geologic Hazards Report, MUSD Recycled Water System HDD Crossing, Mendocino, California.
Date: September 29, 2021.
Author: Crawford and Associates, Inc.
Technical Data: Geotechnical boring logs and laboratory test results.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Carrier pipe:
1. Provide Fusible PVC pipe in accordance with Section 33 11 13.
 2. Pipe thickness and strength shall be as shown on the drawings and Specified in Section 33 11 13. Pipe thickness shall conform to the conservative design with respect to anticipated construction and operational loads.
- B. Conductor casing:
1. Provide Fusible PVC pipe in accordance with Section 33 11 13.
- C. Drilling fluid:
1. High yield sodium bentonite.
 2. Water furnished from a potable water source or recycled water source in compliance with Title 22.
 3. Test all water for pH and treat with soda ash, or accepted equal, to adjust the pH of the water as required in the accepted mix design(s).
 4. Bentonite, polymers, and additives, other than soda ash, shall be NSF/ANSI Standard 60 compliant.
- D. Cementitious backfill grout for casing:
1. Provide Type V Portland cement conforming to ASTM C150.

2. Provide sand that conforms to ASTM C144, except for the following grading requirements:

Sieve Sizes	Percentage Passing by Weight
No. 8	100
No. 16	95 - 100
No. 30	60 - 85
No. 50	20 - 50
No. 100	10 - 30
No. 200	0 - 5

3. Provide potable water.

2.2 EQUIPMENT

A. HDD equipment:

1. Provide directional drilling rig with all ancillary equipment, including drill pipe, drilling fluid, drilling tools, reaming bits, swivels, expanders, motors, generator, pumps, hoses, mixing equipment, drilling fluid processing equipment (cuttings separation equipment), fluid pressure and flow rate monitoring equipment, spare parts, pipe handling equipment, crane, backhoe, roller, side boom tractors, control cabin, control equipment, and office equipment.

B. Spoil Separation Equipment:

1. Adequately separate the spoil from drilling fluid so that drilling fluid within the operating parameters can be returned to the drilling tool and hole for reuse. Use a mechanical separation plant, including scalping screens, shaker screens, de-sanding cones, de-silting cones, and centrifuge as deemed necessary by the operating parameters.
2. Monitor the composition of the drilling fluid to maintain the drilling fluid weight, gel strength, and viscosity limits defined by the operating parameters.

C. Guidance Control System:

1. Provide active steering information to the operator showing the three-dimensional position of the drill tool in relation to the designed alignment.
2. Maintain alignment to the tolerances specified herein.

D. Provide and maintain a bore tracking system that locates the position of the drill head in the x, y, and z axis during the pilot bore.

E. Provide a common grounding system to the HDD rig to prevent electrical shock in the event of high voltage underground cable strike. The grounding system shall connect all pieces of interconnecting machinery to a common ground. The drill rig shall be equipped with an "electrical strike" audible and visual warning system that notifies the system operators of an electrical strike.

F. Provide all temporary fittings and pressure testing heads and work necessary to complete pressure testing of the pipe string as assembled for pullback and post installation. All tests shall be 100 percent passing for all required inspections before commencing pullback.

PART 3 EXECUTION

3.1 GENERAL

- A. Perform all work in accordance with accepted submittals.

- B. Do not commence any HDD operation until all submittals, including submittals for all related work specified elsewhere, are reviewed and accepted by the Engineer.
- C. Maintain a copy of the Contract Documents on site.
- D. Provide the Engineer and District with full access during HDD operations.
- E. Locate all utilities in accordance with Section 02 01 10 before commencing with HDD required excavation.
- F. No excavation deeper than four (4.0) feet shall be permitted within 100 feet of the HDD alignment until after the HDD work is completed, except:
 - 1. Entry and exit pits required for HDD.
 - 2. Potholing to locate utilities or other subsurface features.
 - 3. Geotechnical monitoring instrumentation as specified in Section 31 09 13.
- G. Protect in-place or relocate existing utility. Remove and replace in-kind any damaged utility.

3.2 WORK AREA PREPARATION AND MAINTENANCE

- A. Limit staging and work operations to the staging areas shown on the Contract Drawings.
- B. Organize work area to always enable safe and proper operation and minimize impacts to property owners.
- C. Contain separated spoils and drilling fluid for removal from the site.
- D. Combustible materials (fuel, oil, lubricants, etc.) shall be stored off-site or in a well-ventilated storage facility removed from the immediate vicinity of the drilling area by at least 20 feet.
- E. Provide a suitable containment basin made of plastic lining and sandbags for any equipment operating with fuel, hydraulic, or lubrication oils.
- F. Maintain and keep all equipment in working order. All oil, hydraulic, or fuel leaks shall be repaired upon discovery. Any leaking equipment shall not be used until repaired. Any fluid shall be contained and cleaned up upon discovery.
- G. The exit area shall have a drilling fluid pit lined to prevent fluid seepage into the ground and for containing drilling fluids and cuttings
- H. Provide temporary drainage facilities during construction.
- I. Treat and dispose of all water in accordance with the requirements specified in Section 31 23 19.

3.3 INSTALLATION

- A. Alignment Establishment:
 - 1. Perform surveying in accordance with Section 01 30 00 and as specified herein.
 - 2. Contractor's surveyor shall check line and grade shown on the Contract Drawings before commencing HDD operations and immediately report any errors or discrepancies to the Engineer.
 - 3. Use the line and grade shown on the Contract Drawings to furnish and maintain reference control lines and grades for the potable water pipe construction.
 - a. Line and grade are shown as center line based upon the pilot pass.

- B. Establish and maintain constant communication between the entry and exit locations once pilot bore drilling has commenced and until the carrier pipe is completely pulled into place.
- C. Complete a full proof ream/swab pass prior to pullback.
- D. Perform hydrostatic water pressure test prior to pullback in accordance with Section 33 11 00.
- E. Isolate pipe from excessive torsional and axial stresses by a swivel device with a pre-established breakaway tensile capacity that is lower than the allowable tensile strength of the pipe.
- F. Fill pipe with potable water as it enters the bore during pullback.
- G. Provide adequate supports and rollers along the lay-down and carrier pipe build-up space to support the pipe during assembly and installation to prevent damage.
- H. Handle the carrier pipe in accordance with accepted submittals and as specified herein. Lift all piping using fabric slings with sufficient strength and width to safely pick up the pipe without strap failure and without causing scrapes or cuts to damage the pipe. Lifting with cable or chain shall not be permitted. Lifting one end of the pipe and dragging the pipe into position shall not be permitted. Protect the carrier pipe from impact and abrasion.
- I. Cease pullback operations if the pipe is damaged and remove pipe from the bore. Repair pipe using the manufacturer's recommended procedure or replace the damaged pipe before resuming installation.
- J. Remove the top portion of the conductor casing following carrier pipe installation.
- K. Backfill grout, as a minimum, the remaining top 5.0 feet of the conductor casing with cementitious material as specified herein.
- L. Do not cut the ends of the installed carrier pipe for at least 24 hours following completion of the pullback and relaxation of the tensile load.
- M. Perform final acceptance testing of the completed pipeline in accordance with Sections 33 11 00.
- N. If an object is encountered that impedes the advancement of HDD operations, make all diligent and reasonable efforts to advance past the object by drilling slowly through the object, pulling back, and drilling along a new bore path that avoids the object, or excavating and exposing and removing the object, and all other reasonable attempts to continue the bore. If attempt is made to pullback and re-drill, adhere to line and grade tolerances, unless the Engineer accepts the variance in writing, prior to the attempt. The Contractor and Engineer shall investigate the cause and together determine an appropriate response. Appropriate response to address, at a minimum, the following subject matter; revisions to equipment and methods, retraction and re-drilling of a portion of the bore, and abandonment of the hole. If abandonment is deemed necessary, the Contractor shall recover, to the extent practicable, any drill pipe, product pipe, and tools in the bore, and properly abandon the bore, unless otherwise directed in writing by the Engineer. If the bore is abandoned, pressure-grout the abandoned bore with a lean cement-sand grout mixture, or other accepted material. If the bore is abandoned, begin a second attempt to install the pipeline at an alternate location subject to acceptance, in writing, by the Engineer. Take all reasonable actions to complete the installation with minimal delays. The extra costs and payments associated with encountering a confirmed obstruction will be negotiated between the Owner and Contractor, based on reasonable time and materials.

3.4 DISPOSAL

- A. Spoils and waste drilling fluids are to be disposed of legally with weight tickets and commercial receipts.
 - 1. Provide Engineer with the location and owner contact information of the disposal site
 - 2. Provide Engineer with a complete list of drilling fluid additives contained in the spoils and waste drilling fluids to be disposed of.
- B. All other materials are to be disposed in accordance with 01 74 19 Construction Waste Management. Provide copy of disposal site approval letter prior to disposal of spoils or drilling fluid.

3.5 SITE RESTORATION

- A. Remove all equipment, materials, drilling fluids, muck, waste, and debris from the site and restore the site to its original condition upon completion of the installation. Restoration shall be completed by the Contractor as specified within Section 31 00 00. Restore disturbed areas in accordance with Section 01 70 00.

END OF SECTION

SECTION 33 11 00

RECYCLED WATER UTILITIES

PART 1 GENERAL

1.1 DESCRIPTION

- A. Section includes: The Contractor shall provide all materials, equipment, and labor necessary to furnish and install all water pipe with all necessary fittings and coupling systems and all appurtenant work, complete and operable, including all connections as shown on the Drawings and as specified herein.
- B. All recycled water piping materials, equipment and installation shall be in accordance with the AWWA Standards.
- C. Section includes:
 - 1. Water Main Piping.
 - 2. Storm Drain Piping.
 - 3. Couplings.
 - 4. Dismantling Joints.
 - 5. Flexible Expansion Joints.
 - 6. Restrained Joints for DI Piping.
 - 7. Restrained Joints for PVC Piping.
 - 8. Service Meters.
 - 9. Fire Hydrants.
 - 10. Tracer Wire.
 - 11. Detectable Pipe Warning Tape.
 - 12. Bedding and Cover Materials.
 - 13. Gate Valves.
 - 14. Valve Wrench.
 - 15. Check Valves.
 - 16. Pressure Reducing Valves.
 - 17. Air Release / Vacuum Valves.
 - 18. Bronze Ball Valves.
 - 19. PVC Ball Valves.
 - 20. Bolts for Underground Piping and Valves.
 - 21. Bolts for Aboveground Piping and Valves.
 - 22. Pipe Hangers, Supports and Stem Guides.
 - 23. Flange Insulation Kits.
 - 24. Mechanical Seals and Water Stops.
 - 25. Non-shrink Grout.
 - 26. Pressure Gauges.
 - 27. Sampling Tap.
 - 28. Recycled Water System Labeling.

1.2 RELATED WORK

- A. Contract General Conditions.
- B. Section 03 05 00 - Basic Concrete Materials.
- C. Section 31 01 40 - Shoring and Trench Safety.

D. Section 31 23 00 - Trench Excavation and Backfill.

E. Section 31 23 19 - Dewatering.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. American Public Works Association (APWA)

1. Uniform Color Code for Marking of Underground Utility Locations.

B. American Society of Testing and Materials (ASTM)

1. ASTM A193 – Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
2. ASTM A194 – Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
3. ASTM A536 – Standard Specification for Ductile Iron Castings
4. ASTM D2737 – Standard Specification for Polyethylene (PE) Plastic Tubing
5. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

C. American Water Works Association (AWWA)

1. AWWA C104 – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. AWWA C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems
3. AWWA C110 – Standard for Ductile-Iron and Gray-Iron Fittings
4. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5. AWWA C153 – Standard for Ductile-Iron Compact Fittings for Water Service
6. AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service
7. AWWA C550 – Protective Interior Coatings for Valves and Hydrants
8. AWWA C600 – Installation of Ductile Iron Water Mains and their Appurtenances.
9. AWWA C901 – Standard for Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) through 3 In. (76 mm), for Water Service – PE material designations PE 2708, PE 3608, and PE 4710.

D. National Fire Protection Association (NFPA):

1. 24 95 Installation of Private Fire Service Mains and Their Appurtenances
2. 291-01 Fire Flow Testing and Marking of Hydrants

E. NSF International:

1. 61-02 Drinking Water System Components-Health Effects (Sections 1-9)

F. American Welding Society (AWS):

1. A5.8 04 Brazing Filler Metal

G. Foundation for Cross-Connection Control and Hydraulic Research-2005

H. Copper Development Association's Copper Tube Handbook-2005

1.4 QUALITY ASSURANCE

A. Standards: The materials and work performed in this Section shall conform to the applicable standards of:

1. The American National Standards Institute (ANSI).
2. The American Society for Testing and Materials (ASTM).
3. American Water Works Association Inc. (AWWA).
4. The National Sanitation Foundation (NSF).
5. The American Society of Mechanical Engineers, Boiler and Pressure Vessel Code (ASME).

6. Plumbing and Drainage Institute (PDI).
 7. Underwriters Laboratories Inc. (UL).
 8. Uniform Plumbing Code (UPC).
 9. National Fire Protection Association (NFPA).
 10. Factory Mutual Research Corporation (FMRC).
- B. Tests: All materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA and NSF-61, and the referenced standards, as applicable, in addition to national, local, and state codes.
- C. Contractor shall coordinate with and provide a minimum 48 hour notice to the District for all inspections.
- D. All costs of inspection and tests shall be borne by the Contractor.
- E. The pipe shall be subjected to the specified hydrostatic strength tests, flexure tests, and crushing tests. The crushing tests shall be made on samples taken from the center of full-length sections of pipe.
- F. The Contractor shall verify with the pipe manufacturer all connection details.
- G. Qualification of manufacturers:
1. The material shall be the product of a supplier regularly engaged in the manufacturing of pipe and plumbing products.
 2. All materials shall be new and of current manufacture and shall be guaranteed against defects or workmanship in accordance with the General Conditions.
- H. Qualification of installers:
1. For the actual assembly, installation, and testing of the work in this Section, use only thoroughly trained and experienced personnel who are completely familiar with the requirements for this work and with the installation recommendations of the manufacturers of the specified items.
 2. In acceptance or rejection of installed materials, no allowance will be made for lack of skill on the part of installers.

1.5 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 00, "Submittal Procedures". Submit complete shop drawings including layouts, elevations, and details to the Engineer.
- B. Submit all product data, shop drawings, laboratory test results, material source information, and certificates of compliance listed in this Section under a single submittal cover for review. Incomplete submittals will not be reviewed.
- C. Material List:
1. In accordance with the provisions of Section 01 33 00 "Submittal Procedures" of the Specifications, submit with the shop drawings a complete list of all materials and equipment proposed to be furnished and installed under this portion of the work, giving manufacturer's name, catalog number, and catalog cuts for each item where applicable.
- D. Manufacturers' Literature and Data (Submit all items as one submittal package for review):
1. Ductile Iron Pipe shall be in accordance with ANSI/AWWA C151/A21.51; and shall be provided to Engineer for approval.
 2. C900 PVC Pipe.
 3. Schedule 80 PVC Pipe.

4. Piping.
5. Gaskets.
6. Valves.
7. Check Valves.
8. Service line products.
9. Valve boxes.
10. Joint restraint.
11. Coupling.
12. Disinfection products.
13. Detection Wire

- E. Testing Certifications:
1. Hydrostatic Testing.
 2. Certification of Disinfection, including free chlorine residuals, and bacteriological examinations.
- F. Temporary Water Supply Plan: Submit plan outlining the steps that the Contractor will take to provide water to properties where the water supplies have been disrupted.
- G. Manufacturer's recommendations:
1. Accompanying the materials list and shop drawings, submit four copies of the manufacturer's current recommended method of installation.
- H. Certificates of Compliance: Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.
- I. Refer to Section 09 90 00 for paint and coating submittal requirements.

1.6 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate the Work with termination of water connections inside and outside building, trenching, connection to municipal water system, and connection to treatment and backwash system.

1.7 DELIVERY, STORAGE, AND HANDLING:

- A. Coated pipe shall be shipped on bunks, and secured with nylon belt tied down straps or padded banding located approximately over braces. Coated pipe shall be stored on padded skids, sand or dirt berms, sand bags, old tires or other suitable means so that coating will not be damaged. Coated pipe shall be handled with the wide belt slings, padded forks, or other means that will not damage the pipe or coating. Chains, cables or other equipment likely to cause damage to the pipe or coating shall not be used. Prior to shipment, the pipe shall be visually inspected for damage to the coating. Any damaged areas shall be repaired at the Contractor's expense in accordance with the standard to which the coating was applied.
- B. Deliver and store valves and other materials and appurtenances in shipping containers with labeling in place.

PART 2 PRODUCTS

2.1 GENERAL

- A. These Specifications are intended to be standard specifications and they may therefore contain specifications for materials not required for this project or allowed on any or various parts of it. Certain materials, which are applicable for only one portion or a small portion, may be shown on the plans and not particularly specified herein.
- B. All materials shall conform to sizes, capacity, quality and quantities as shown on the drawings or described in these Specifications. Materials shall be from new stock, delivered in good condition. No damage to stock shall be used.
- C. Where no method of tests for materials is specified, the latest applicable test specified by ASTM or AWWA shall be followed.
- D. After delivery to the site, all materials shall be carefully unloaded, protected against breakage, rusting, accumulation of foreign matter, disintegration, and injury. The Contractor shall be responsible for all lost or damaged material supplied and work done under this contract.

2.2 RECYCLED WATER MAIN PIPING

- A. Polyvinyl Chloride (PVC) Pipe:
 - 1. Size: As shown on plans.
 - 2. Color: Purple
 - 3. Pipe: Less than 4": Schedule 80 PVC
 - a. Fittings: Schedule 80 PVC
 - b. Joints: Solvent weld, use heavy duty PVC cement and primer.
 - 4. Pipe: 4" through 12": AWWA C900 DR 18 Pressure Class 235, Cast-Iron Pipe Size
 - a. Fittings: See Ductile Iron Fittings
 - b. Joints:
 - 1) ASTM D3139 and ASTM F477 PVC flexible elastomeric seals. Solvent-cement couplings are not permitted, except in sizes less than 3" in diameter.
 - 2) All joints shall be integral, bell, and spigot gasketed joints or plain end with rubber ring couplings.
 - 3) All joints shall be supplied from the manufacturer with an assembly mark for use in installation so joints are not over-stabbed.
 - 4) When the spigot end of pipe is to be inserted into a mechanical joint fitting, the beveled end of the pipe shall be removed prior to insertion.
- B. Ductile Iron Pipe (DIP):
 - 1. Size: As shown on plans.
 - 2. Pipe: ANSI/AWWA C151/A21.51, Pressure Class 350.
 - 3. Below Grade Pipe:
 - a. Mechanical Joint Pipe.
 - b. Restrained Joints:
 - 1) Boltless, push-on type, joint restraint independent of joint seal.
 - 2) Gaskets: rubber ring type push-on TYTON gasketed joints.
 - 3) Jackets: ANSI/AWWA C105/A21.5 polyethylene jacket.
 - a) Color: Purple
 - b) Provide a polyethylene encasement around pipe, fittings, and valves.
 - c) Make provisions to keep the polyethylene from direct exposure to sunlight prior to installation. Backfill following installation without delay to avoid exposure to sunlight.
 - c. Interior Lining:
 - 1) Cement mortar lining interior in accordance with ANSI/AWWA C104/A21.4.

- d. Exterior Coating:
 - 1) Asphaltic coating in accordance with ANSI/AWWA C151/A21.51.
- e. Manufacturer:
 - 1) U.S. Pipe.
 - 2) American.
 - 3) Clow Water Systems Co.
 - 4) Approved equivalent.
- 4. Above Grade Pipe and Fittings:
 - a. Flanged Joints: AWWA C115.
 - b. Gaskets: rubber gasketed joints, 1/8 inch thick.
 - c. Interior Lining: Fusion-bonded epoxy in accordance with ANSI/AWWA C116/A21.16.
 - d. Exterior Coating: Fusion-bonded epoxy in accordance with ANSI/AWWA C116/A21.16.
- C. Ductile Iron Fittings (below grade):
 - a. Ductile iron: ANSI/AWWA C110/A21.10.
 - b. Compact fittings ANSI/AWWA C153/A21.53.
 - c. Coating and Lining:
 - 1) Above Ground: Cement-mortar lining in accordance with AWWA-C104 and fusion-bonded epoxy coating in accordance with ANSI/AWWA C116/A21.16. Provide a polyurethane top coat on all above ground piping not made of stainless steel.
 - 2) Below Ground: Cement-mortar lining in accordance with AWWA-C104, and an exterior bituminous coating in accordance with AWWA C203
 - 3) Jackets for Below Ground: ANSI/AWWA C105/A21.5 polyethylene jacket.

2.3 STORM DRAIN PIPING

- A. AWWA C900, DR 18, Pressure Class 235
 - a. Fittings: AWWA C111, ductile iron with AWWA C-116 fusion-bonded epoxy coating and lining on interior and exterior.
 - b. Joints: ASTM F477, PVC flexible elastomeric seals. Solvent-cement couplings are not permitted.

2.4 COUPLINGS

- A. Restrained Coupling
 - 1. Type: AWWA C219, NSF 61 listed.
 - 2. Body:
 - a. Ductile Iron; ASTM A536
 - b. Carbon Steel; ASTM A513, ASTM A53 or ASTM A283C
 - 3. Gaskets: Virgin Styrene Butadiene Rubber (SBR) for water services; ASTM D2000 MBA 710
 - 4. Bolts: 316 stainless steel.
 - 5. Coating: Fusion-bonded epoxy in accordance with ANSI/AWWA C116/A21.16, or approved equivalent.
 - 6. Pressure rating: meet or exceed adjacent piping system rating.
 - 7. System compatible with connecting pipe; verify connecting pipe O.D.
- B. Restrained Flange Coupling Adaptor
 - 1. System: restrain plain end of pipe to a flange, conforming to AWWA C110.
 - 2. Body:
 - a. Ductile Iron; ASTM A536
 - b. Carbon Steel; ASTM A513, ASTM A53 or ASTM A283C
 - 3. Gaskets: Virgin Styrene Butadiene Rubber (SBR) for water services; ASTM D2000 MBA 710

4. Bolts: 316 stainless steel,
5. Coating: Fusion-bonded epoxy in accordance with ANSI/AWWA C116/A21.16, or approved equivalent.
6. Pressure rating: meet or exceed adjacent piping system rating.
7. System compatible with connecting pipe; verify connecting pipe O.D.

C. Reducing Coupling

1. System: restrain plain end of pipe to a flange, conforming to AWWA C110.
2. Body:
 - a. Ductile Iron; ASTM A536
 - b. Carbon Steel; ASTM A513, ASTM A53 or ASTM A283C
3. Gaskets: Virgin Styrene Butadiene Rubber (SBR) for water services; ASTM D2000 MBA 710
4. Bolts: 316 stainless steel,
5. Coating: Fusion-bonded epoxy in accordance with ANSI/AWWA C116/A21.16, or approved equivalent.
6. Pressure rating: meet or exceed adjacent piping system rating.
7. System compatible with connecting pipe; verify connecting pipe O.D.

D. Manufacturers:

1. ROMAC Industries, Inc.
2. Smith-Blair
3. Approved Equivalent

2.5 DISMANTLING JOINTS

A. Use: Potable water.

B. Type:

1. Flange Spool (3-12 inch): AWWA Class D steel ring flange, compatible with ANSI Class 125 and 150 bolt circles. Pipe is STD Weight Class per ASTM A53.
2. End Ring & Body (3-12 inch): ASTM A536 65-45-12 ductile iron.
3. Gaskets: NBR gaskets in accordance with ASTM D 2000 MBA810Z.
4. Bolts & Nuts: ASTM A588 HSLA bolt material.
5. Tie-Rods: High tensile steel per ASTM A193 grade B7.
6. Coating: Fusion bonded epoxy, NSF 61 certified.
7. Pressure (3-12 inch): Maximum rating, AWWA Class D 175 psig.

C. Size: Per plan.

D. Manufacturer:

1. Romac Industries, Inc. Model DJ400
2. Smith-Blair, Inc.
3. Substitutions: Section 01 60 00 - Product Requirements.

2.6 FLEXIBLE EXPANSION JOINTS

A. Material: EDPM tube and cover, reinforced with a woven fabric and Type 304 SST rings support. Expansion joints ends shall be flanges drilled to 150# class standards, and be full rubber faced and integral to the body. Split flange backing rings of Type 304 SST shall be provided.

B. Size: Per plan

- C. Function: Each flexible expansion joint shall be a rubber spool type of a triple, open wide arch design, having a minimum compression, extension, lateral displacement and rotation meeting the specified manufacturer product, or approved equivalent.
 - 1. Axial compression: 4 inches (min).
 - 2. Axial extension: 2 inches (min).
 - 3. Lateral displacement: 2 inches (min).
 - 4. Angular rotation: 20 degrees (min).
- D. Coatings: Exterior surfaces shall be coated with a minimum of 6 mils of high solids; two component aliphatic polyurethane.
- E. Provide polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, for direct buried applications. Bed in a minimum of 3 inches of pea gravel all around.
- F. Manufacturer:
 - 1. Flexicraft Industries, Ultraspool Triple Model.
 - 2. Redflex Expansion Joint Triple Arch Model.
 - 3. Substitutions: Section 01 60 00 - Product Requirements.

2.7 RESTRAINED JOINTS FOR DUCTILE IRON PIPING

- A. Materials: Ductile Iron, ASTM A536.
- B. Coating: Thermoset epoxy coating with heat cure, or approved equivalent.
- C. Pressure rating: minimum working pressure rating equivalent to the pipe.
- D. Bell Restraint Harness for Ductile Iron Pipe:
 - 1. EBAA Iron, Inc., Series 1700.
 - 2. Romac Industries, Inc., 600 Series, Style 611.
 - 3. StarGrip Series 3100S or 3100P.
 - 4. Approved Equivalent.
- E. Mechanical Joint Fittings for Ductile Iron:
 - 1. EBAA Iron - Series 1100.
 - 2. StarGrip Series 3000.
 - 3. Romac Industries, Inc. - Romagrip.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.

2.8 RESTRAINED JOINTS FOR POLYVINYL CHLORIDE PIPING

- A. Bell Restraint Harness for C900:
 - 1. EBAA Iron, Inc., Series 1600.
 - 2. Romac Industries, Inc., 600 Series, Style 611.
 - 3. StarGrip Series 4100P.
 - 4. Approved Equivalent.
- B. Mechanical Joint Fittings for C900 and C905:
 - 1. EBAA Iron, Inc., Series 2000PV.
 - 2. Romac Industries, Inc., PVC – RomaGrip.
 - 3. StarGrip Series 4000.
 - 4. Approved Equivalent.

2.9 SERVICE PIPING AND FITTINGS

- 1. Brass Piping and Associated Fittings:

- a. Pipe, ASTM B43/, lead free.
 - b. Fittings, ASTM B584, ANSI/ASME B16.15, lead free. Compression or threaded.
2. Copper Tubing: Type K; ASTM B280, ASTM B306, ASTM B819, ASTM B88
3. Insulating Joints:
 - a. Joints between pipe of dissimilar metals shall have a suitable approved type of insulating joint prevent metal-to-metal contact between adjacent sections of piping.
4. Service Saddles:
 - a. Materials: Bronze and stainless steel nylon coated of the double strap type.
 - b. Saddle shall be stamped for use with ductile iron or PVC pipe.
 - c. Manufacturer:
 - 1) Romac 202N.
 - 2) Mueller BR2B or BR2S.
 - 3) Substitutions: Approved Equivalent
5. Tapping Sleeves:
 - a. Material: Stainless steel
 - b. Sleeve must be compatible with pipe type.
 - c. Manufacturers:
 - 1) Dresser: Style 630.
 - 2) Ford: FTSS
 - 3) JMC: 415, 432
 - 4) Mueller: H-615, H-616 or H-667
 - 5) American Flow Control: MJ Split Tapping Sleeve
 - 6) Smith-Blair: 664-665
 - 7) APAC Tapping Sleeve
 - 8) Clow Corp: MJ, F-5093 or F-5205
 - 9) M&H Valve and Fitting Co.: Catalog 52, Style 974
 - 10) U.S. Pipe: Smith Dual Compression Seal Tapping Sleeve.
 - 11) Substitutions: Approved Equivalent
6. Corporation Stops:
 - a. Materials: Bronze conforming to AWWA C800 and ASTM B62.
 - b. Manufacturer:
 - 1) Ford FB500, FB1000-6-Q-NL
 - 2) Jones J1943, E19375SG
 - 3) McDonald 74701BQ.
 - 4) Mueller B-25008N.
 - 5) Substitutions: Approved Equivalent.
7. Angle Meter Ball Valve:
 - a. Materials: Bronze conforming to AWWA C800 and ASTM B62.
 - b. Manufacturer:
 - 1) Ford
 - 2) Jones
 - 3) McDonald
 - 4) Mueller
 - 5) Substitutions: Approved Equivalent.
8. Water Meters:
 - a. Size: Size per plan.
 - b. Type: Disc
 - c. Material: Cast Bronze.
 - d. Accessories: Strainer.
 - e. Connection: NPT Threaded.
 - f. Gage: Gallons
 - g. Manufacturer: BadgerMeter, Inc.
 - h. Model: Recordall
 - i. Substitutions: Require approval of the Engineer.
9. Water Meter Boxes and Lids:
 - a. Manufacturer: Oldcastle Precast per Section 33 05 17.

- b. Size: As required to provide 6 inches clear around meter or other appurtenance.
- c. Substitutions: Approved Equivalent.

2.10 FIRE HYDRANTS

- A. Provide only wet-barrel type hydrants, AWWA C503 or UL 246 compliant.
- B. Hydrant shall have factory-applied prime coat of paint and a field-applied polyurethane top coat.
- C. Hydrants shall have 6 inch inlet, one 4-1/2 inch pumper connection and two, 2-1/2 inch hose connections.
- D. Pumper connection and hose connections shall be individually valved with independent nozzle gate valves.
- E. Each outlet shall be independently valved with 1-1/8 inch pentagon operating nut on the valve cap.
- F. Hydrant shall be complete with 6-inch bury length (bury to suit depth of water main connection as indicated on the Drawings).
- G. Hydrants shall be supplied with 'break-away' type bolts at hydrant base connection to the break-off check valve.
- H. Bolts shall be oriented such that nut is on the top side of the hydrant flange.
- I. Hydrant shall be equipped with a break-off check valve.
 - 1. Clow Model LP619
 - 2. Approved Equivalent.
 - 3. Substitutions: Section 01 60 00 - Product Requirements.
- J. Hydrant Manufacturers:
 - 1. Clow Model 950 or 960.
 - 2. Approved Equivalent.
 - 3. Substitutions: Section 01 60 00 - Product Requirements.

2.11 TRACER WIRE

- A. Manufacturers:
 - 1. Pro-Line
 - 2. Substitutions: Section 01 60 00 - Product Requirements.
- B. Characteristics:
 - 1. Type: THWN
 - 2. Gage: No. 12
 - 3. Materials: Copper conductor, PVC insulation, nylon jacket.

2.12 WARNING TAPE

- A. Tape shall be an inert plastic film (non-metallic) formulated for prolonged underground use that will not degrade when exposed to alkalies, acids and other destructive substances commonly found in soil.
- B. Tape shall be puncture-resistant and shall have an elongation of two times its original length before parting.

- C. Tape shall be installed with the printed side up and run continuously along the entire length of the utility intended for identification. Tape shall be installed on the main piping and all appurtenant laterals, including blowoffs, air valve assemblies, fire hydrants, and services. Tape splices shall overlap a minimum of twenty-four (24) inches for continuous coverage.
- D. Tape shall be colored blue to identify the waterline with printed message: "Caution: Waterline Buried Below". Ink used to print messages shall be permanently fixed to tape and shall be black in color with message printed continuously throughout.
- E. Tape shall be minimum 0.004 inches (or 4 mil) thick x six (6) inches wide with a printed message on one side. Tape used with the installation of onsite potable shall be a minimum of three (3) inches wide.

2.13 BEDDING AND COVER MATERIALS

- A. Unless otherwise specified or shown, all material used for pipe embedment shall be as specified in Section 31 23 00, "Trench Excavation and Backfill."
- B. For pipe bedding and backfill, refer to Section 31 00 00, "Earthwork."

2.14 GATE VALVES

- A. Resilient Wedge Gate Valves: AWWA C509.
 - 1. Body Material: ductile iron.
 - 2. Working Pressure: 250psig.
 - 3. Seat: Resilient.
 - 4. Stem: Non-rising bronze stem.
 - 5. Underground Installation: Operating Nut: 2-inch square; open counterclockwise unless otherwise indicated.
 - 6. Aboveground Installation: Hand wheel.
 - 7. Ends: Mechanical joint end connections for underground installation. Flanged joint end connections for aboveground installation.
 - 8. Coating: 12-mil holiday-free epoxy AWWA C550; interior/exterior.
 - 9. Bolting: 304 stainless steel
- B. Manufacturers:
 - 1. Mueller Company
 - 2. Clow Eddy - Iowa
 - 3. American Flow Control
 - 4. Substitutions: Section 01 60 00 - Product Requirements.

2.15 VALVE WRENCH

- A. Requirement: Provide one (1) manual valve operating wrench.
- B. Material: Powder-coated carbon steel.
- C. Size: 5 ft to 5.6 ft (minimum) adjustable for 2" AWWA valve operation nut
- D. Manufacturer:
 - 1. Mueller
 - 2. Pipeline Products SW-510
 - 3. Reed Valve
 - 4. Approved Equivalent

2.16 CHECK VALVE

- A. Check Valves: AWWA C508
 - 1. Body Material: ductile iron.
 - 2. Pressure Class: 300 psi.
 - 3. Operation: Hydraulically operated non-slam.
 - 4. Trim: Bronze.
 - 5. Disc: Buna-N Rubber.
 - 6. Diaphragm: Nylon Reinforced Buna-N Rubber
 - 7. Ends: Flanged.
 - 8. Stem, Nut & Spring: Type 316 Stainless Steel
 - 9. Coating: 12-mil holiday-free epoxy AWWA C550; interior/exterior.
 - 10. Bolting: 316 stainless steel
- B. Manufacturer:
 - 1. Cla-Val Co., Model No. 81-02
 - 2. Substitutions: Section 01 60 00 - Product Requirements.

2.17 PRESSURE REDUCING VALVE

- A. Pressure Reducing Valve:
 - 1. Body Material: ductile iron.
 - 2. Working Pressure: 300psig.
 - 3. Trim: Bronze
 - 4. Disc: Buna-N Rubber
 - 5. Ends: Flanged.
 - 6. Diaphragm: Nylon Reinforced Buna-N Rubber
 - 7. Stem: Stainless Steel
 - 8. Coating: 12-mil holiday-free epoxy AWWA C550; interior/exterior.
 - 9. Bolting: 304 stainless steel
- B. Manufacturer:
 - 1. Cla-Val Co., Model No. 90-01 PBDY
 - 2. Substitutions: Section 01 60 00 - Product Requirements.

2.18 AIR RELEASE / VACUUM VALVE

- A. Size: Per plan.
- B. Well Service Air Valves, Hydrostatically tested to ANSI/AWWA C512 standards.
- C. Stainless steel floats, cast iron body and cover, Buna-N seat, stainless steel needle.
- D. Stainless steel protection screens.
- E. NSF/ANSI 61 Certified.
- F. Enclosure:
 - 1. Material: 14 gauge steel with 10 gauge steel top with one expanded metal face, 2-3 mil powder coated.
 - 2. Base Frame made from 2"x 2" angle, 3/16" thick.
 - 3. Stainless steel internal hinges. No exterior hinges or anchor fasteners.
 - 4. Stainless steel recessed single lock hasp for security.
 - 5. Exterior handles for accessibility.
 - 6. Full access service ability.

7. Top surfaces crowned for drainage.
8. Manufacturer:
 - a. Placer Waterworks, Inc. R-Model.
 - b. Approved Equivalent.

- G. Manufacturers:
1. ValMatic 800 Series.
 2. APCO clean water air release valve.
 3. Substitutions: Section 01 60 00 - Product Requirements.

2.19 BRONZE BALL VALVES

- A. Materials:
1. Body: Bronze no-lead alloy conforming to AWWA C800 and ASTM B62.
 2. Ball: Stainless steel.
 3. Seats and Seals: Teflon.
 4. 1/4 turn.
 5. Suitable for potable water.
- B. Handle: Straight lever handle, where shown on Drawings.
- C. Manufacturer:
1. Mueller.
 2. Ford.
 3. Jones.
 4. McDonald.
 5. Watts.
 6. Substitutions: Section 01 60 00 - Product Requirements.

2.20 PVC BALL VALVES

- A. Materials:
1. Body: Schedule 80 PVC
 2. Pressure Rating: 235 psi
 3. Suitable for potable water.
- B. Handle: Straight lever handle
- C. Manufacturer:
1. Spears.
 2. Substitutions: Section 01 60 00 - Product Requirements.

2.21 BOLTS FOR UNDERGROUND PIPING AND VALVES

- A. Bolts: ASTM A307, Grade B heavy hex head.
- B. Nuts: ASTM A563, heavy hex nuts.
- C. Plastic washers and sleeves for dielectric joints shall be provided.
- D. All nuts and bolts shall have a fluoropolymer coating. Fluoropolymer coating for bolts and nuts shall be applied at a nominal thickness of 1 mil. and baked on. Coating shall have a minimum kinetic friction coefficient of 0.08. Coating shall be Tripac 2000 Blue Coating System, or approved equivalent.

2.22 BOLTS FOR ABOVEGROUND PIPING AND VALVES

- A. Bolts for exposed flanged ductile iron and steel pipe shall be type 304 stainless steel bolting with the heavy duty type 304 stainless steel nuts (only).

2.23 PIPE HANGERS, SUPPORTS AND STEM GUIDES

- A. Components:
 - 1. Pipe Supports: provide pipe support with saddle, U-bolt, gusset, pipe adjuster, base stand, expansion anchor bolts, and all other required installation hardware.
 - 2. Brackets and Stem Guides: provide brackets, stem guides, supports, bolts pipe clamps, and all other required installation hardware.
 - 3. Material: stainless steel.
 - 4. Provide copper clad for support of copper piping that is not insulated.
 - 5. Use padded hangers for piping that is subject to scratching.
- B. Manufacturer:
 - 1. B-Line.
 - 2. Waterman.
 - 3. Substitutions: Section 01 60 00 - Product Requirements.

2.24 FLANGE INSULATION KITS

- A. The Contractor shall provide a flange insulation kit for flanged connections between metallic pipes of dissimilar materials. Flange insulation kits shall be of the full face gasketed type for use with potable or non-potable water.
- B. Manufacturer:
 - 1. Calpico, Inc.
 - 2. Substitutions: Section 01 60 00 - Product Requirements.

2.25 MECHANICAL SEALS AND WATERSTOPS

- A. Mechanical Seals:
 - 1. Description: Shall be modular, mechanical type for core drilled applications, consisting of inter-locking synthetic elastomeric rubber links shaped to continuously fill the annular space between the pipe and the wall opening.
 - 2. Seal Element: EPDM.
 - 3. Pressure Plates: Reinforced Nylon Polymer
 - 4. Bolts, Nuts and Hardware: 316 Stainless Steel.
 - 5. Manufacturer: Link-Seal.
 - 6. Substitutions: Section 01 60 00 - Product Requirements.
- B. Silicone Sealants: High-performance waterproof silicone sealant specifically designed for below grade and submerged applications.
- C. Waterstops:
 - 1. See Section 03 30 00.
 - 2. Substitutions: Section 01600 - Product Requirements.

2.26 NON-SHRINK GROUT

- A. Pre-mixed ready for use formulation requiring only addition of water; non-shrink, non-corrosive, non-metallic, non-gas forming, no chlorides.

- B. Properties: Certified to maintain initial placement volume or expand after set and meet the following minimum properties when tested in accordance with CRD-C621, for Type D non-shrink grout:

Property	Test	Time	Result
Setting Time	ASTM C191	Initial	2 hours (Approx)
		Final	3 hours (Approx)
Expansion			0.10% - 0.4% Maximum
Compressive Strength	CRD-C621	1 day	4,000 psi
		7 days	7,000 psi
		28 days	10,000 psi to 10,800 psi

2.27 PRESSURE GAUGES

- A. Provide on sampling taps.
- B. Lead free brass/bronze wetted parts.
- C. Stainless steel case material.
- D. Size: 1/4"
- E. Manufacturer:
 - 1. Winters Model PFQ804LF.
 - 2. Substitutions: Section 01 60 00 - Product Requirements.

2.28 SAMPLING TAPS

- A. Non-threaded for the purpose of obtaining water for laboratory examination
- B. Brass with chrome-plated finish.
- C. Size: 1/2"
- D. Manufacturer:
 - 1. USA Bluebook Model 47393.
 - 2. Substitutions: Section 01 60 00 - Product Requirements.

2.29 RECYCLED WATER SYSTEM LABELING

- A. Below Grade Pipe:
 - 1. Pipe Color: Purple
 - 2. Pipe Label: "RECYCLED WATER - DO NOT DRINK"
 - 3. Label Location: Opposite sides of the pipe.
 - 4. Where purple pipe cannot be used, the pipes shall be installed with warning tape. The plastic warning tape shall be an inert plastic film specifically formulated for prolonged underground use and shall be prepared with black printing on a purple field having the words, "RECYCLED WATER - DO NOT DRINK". The minimum thickness shall be 4 mils and the overall width of the tape shall be a minimum of 3-inches.
- B. Above Grade Pipe:
 - 1. All above grade recycled water mains shall be coated in accordance with Section 09800, "Protective Coatings."

2. Pipe Color Coding: Purple
 3. Pipe Label: "RECYCLED WATER - DO NOT DRINK".
 - a. Color: Black
 - b. Stenciled letters: 2-inches in height.
 - c. Location: Top and bottom of the pipe at 5-foot intervals.
- C. Enclosures:
1. Coating: Section 09800 - Protective Coatings.
 2. Color: Purple
 3. Label: "RECYCLED WATER - DO NOT DRINK".
 4. Stenciled letters: 2-inches in height.
- D. Identification Tags and Labels:
1. Material: Permanent inert material specifically formulated for prolonged exposure to weather, UV, and immersion without fading or deterioration
 2. Label: Black printing on a purple field with the words: "WARNING - RECYCLED WATER - NOT FOR DRINKING" on one side and "AVISO - NO ES PARA BEBER" on the other side.
 3. Size: The minimum height of letters shall be 1/2-inch. The minimum tag thickness shall be 4 mils for adhesive backed labels and 10 mils for tag type labels. Tag type labels shall have reinforced tie holes.
 4. Submit sample of each label type to Engineer for approval prior to procuring labels.
 5. The type of label, location and attachment method shall be as follows and subject to acceptance by the Engineer:

Item	Label Type	Label Location	Attachment Method
Valve (below grade)	Tag	Top of riser pipe	Heavy-duty nylon fasteners
Valve (above grade)	Tag	Hand wheel	Heavy-duty nylon fasteners
Valve Box	Lettering	Top of cover	Factory Cast
ARV	Tag	Front of cabinet	Rivets or bolts
Blow-off	Tag	Top of riser pipe	Heavy-duty nylon fasteners
Blow-off Box	Lettering	Top of cover	Factory Cast
Meter Box	Lettering	Top of cover	Factory Cast
Angle Meter Valve	Tag	Valve body	Heavy-duty nylon fasteners
Backflow Assembly	Tag	Valve body	Heavy-duty nylon fasteners

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify existing utility water main size, location, and inverts are as indicated on Drawings.

3.2 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Use only equipment specifically designed for pipe cutting. Use of chisels or hand saws will not be permitted. Grind edges smooth with beveled end for push-on connections.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.3 BEDDING AND BACKFILL

- A. For pipe bedding and backfill, refer to Section 31 00 00, "Earthwork."
- B. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

- A. Install pipe in accordance with manufacturer's installation instructions. Provide copy of manufacturer's installation instructions to Engineer.
- B. Install ductile iron pipe in accordance with manufacturer's instructions and AWWA C600.
- C. Install PVC pipe in accordance with manufacturer's instructions and AWWA C900.
- D. Maintain separation from potable water main in accordance with State of California Department of Public Health and Division of Drinking Water code.
- E. Install pipe to indicated elevation to within tolerance of 5/8 inches.
- F. Install tracer wire on the top of the installed pipe. Tape tracer wire to pipe at minimum 10 foot intervals.
- G. Route pipe in straight line.
- H. Curvature of PVC pipe shall be accomplished through longitudinal bending of the pipe barrel only. Deflection of joints is not allowed.
- I. When curving pipe, do not deflect joints in PVC pipe. Joints in DIP may be deflected within allowable limits specified by manufacturer.
- J. When stabbing bell and spigot pipe, verify that the manufacturer's assembly mark on the pipe joint is flush with the end of the bell.
- K. Install pipe with no high points, except where shown on Plans. If unforeseen field conditions arise which necessitate high points, install air release valves as directed by Engineer.
- L. Install pipe to have bearing along entire length of pipe. Excavate bell holes to permit proper joint installation. Do not lay pipe in wet or frozen trench.
- M. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- N. Close pipe openings with watertight plugs during work stoppages.
- O. Install access fittings to permit disinfection of water system.
- P. Form and place concrete for thrust restraints at each elbow or change of direction of pipe main.
- Q. Establish elevations of buried piping with not less than 4 feet of cover. Measure depth of cover from final surface grade to top of pipe barrel.
- R. Install pipe warning tape continuous over top of pipe buried 12 inches below finish grade, above pipe line.

3.5 INSTALLATION - VALVES

- A. Gate Valves: Install valves per Plan.
- B. Set valves on solid bearing compacted soil.
- C. Center and plumb valve box over valve. Set box cover flush with finished grade.
- D. Install tracer wire from pipe on both sides of valve into PVC riser and to within 2 inches of the top of the valve box.

3.6 POLYETHYLENE ENCASEMENT

- A. Encase ductile iron pipe fittings in polyethylene to prevent contact with surrounding backfill material.
- B. Install in accordance with AWWA C105.
- C. Terminate encasement 3 to 6 inches above ground where pipe is exposed.

3.7 PIPE SLEEVES:

- A. Install where water lines pass through retaining walls, building foundations and floors. Seal with modular mechanical type link seal. Install piping so that no joint occurs within a sleeve. Split sleeves may be installed where existing lines pass through new construction.

3.8 THRUST RESTRAINT

- A. Install clamps, set screw retainer glands, or restrained joints. Protect metal restrained joint components against corrosion by applying a bituminous coating, or by concrete mortar encasement of metal area. Do not encase pipe and fitting joints to flanges.
- B. Install thrust blocks as shown on the Drawings. Concrete for thrust blocks shall be in accordance with Section 03 05 00 Basic Concrete Materials.

3.9 WATER METERS

- A. Install water meter box and water meter per Drawings.

3.10 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

3.11 PRESSURE TESTING

- A. Prior to acceptance of the Work by the District, the Contractor shall perform pressure testing on potable water distribution systems in accordance:
 - 1. AWWA C600 for ductile iron pipe.
 - 2. AWWA C605 for PVC pipe.
 - 3. AWWA C901 for Polyethylene pressure pipe.
- B. Prior to acceptance and initial operation, inspect and test the piping system to ensure that the design, materials, fabrication, and installation are in accordance with these specifications.

- C. Test piping prior to being enclosed, covered-up, or treated externally with insulation, tape wrapping, mastic coating, and like treatments, unless noted otherwise in other sections.
- D. When existing water mains are used to supply test water, they shall be protected from backflow contamination by temporarily installing a double-check-valve assembly between the test and supply main or by other approved means. Before pressure testing, the temporary backflow protection shall be removed and the main under test isolated from the supply main.
- E. Notify the Engineer at least 48 hours prior to testing, and conduct tests in the presence of Engineer.
- F. Piping systems shall show no pressure loss, unless noted otherwise, while being tested in accordance with this section. When leakage or other defects are located, repair or replace the affected portion of the piping system and retest. In the event repairs, replacement, or additions are made following the pressure test, retest the affected piping. In the case of very minor repairs, replacement, or additions, the Engineer may, solely at its discretion, omit retesting provided precautionary measures are taken to assure sound construction.
- G. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at the Contractor's expense.
- H. General Test Procedures:
 - 1. All valves shall be in full-open position during the test. Do not include components (gauges, relief valves, instrumentation, and like items) as part of the tests that are not rated for the testing pressure.
 - 2. Do not attempt to modify a piping system when it is pressurized, including tightening leaking joints. Do not repair, replace, or retighten leaking joints or components until the pressure has been reduced to ambient level.
 - 3. Measure test pressure with a manometer or with a pressure-measuring device designed and calibrated to read, record, or indicate the maximum test pressure. Record pressure loss due to leakage during the pressure test period while the system is pressurized but isolated from the pressure source.
 - 4. Test at a minimum of 150 percent of their maximum sustained working pressure using clean water. The test allowance shall not be less than the amount determined using AWWA C605 for any segment of pipe tested. The Engineer must witness hydrostatic testing. The test pressure shall be not less than the following values, irrespective of the design maximum allowable working pressure:
 - a. Maximum Sustained Working Pressure: 167 psi
 - b. Test Pressure: 250 psi (minimum)
 - c. Test duration: 2 hours (minimum)
 - 5. Prepare test records of inspection and tests performed. Indicate which portions of the piping system are in accordance these specifications. Briefly document test procedures, instruments and media used, and test pressures. Before requesting final approval of a piping installation, submit copies of test records for Engineer's approval.

3.12 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Compaction Requirements: In accordance with Section 31 23 00.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at the Contractor's expense.

END OF SECTION

SECTION 33 11 13

FUSIBLE PVC PIPE

PART 1 GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the Work as indicated in the Contract Documents.
- B. The Contractor shall furnish, install, and test fusible polyvinylchloride (FPVC) pipe, fittings, and appurtenances of the dimensions and to the lines and grades shown on the Contract Documents.
- C. This section covers the furnishing and installation of fusible polyvinylchloride pipe as carrier pipe and casing pipe and fittings for recycled water pipelines, as specified and shown in the Contract Documents.
- D. All FPVC joints shall be de-beaded as specified herein.
- E. Excavation and backfill, including the pipe bedding, shall conform to the provisions of Section 33 00 00, Earthwork, of these Specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01 10 00 Summary of Work
 - 2. Section 31 00 00 Earthwork
 - 3. Section 31 09 13 Geotechnical Instrumentation and Monitoring
 - 4. Section 33 05 23.13 Horizontal Directional Drilling
 - 5. Section 33 11 00 Recycled Water Utilities

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.
- B. Comply with the current provisions of the following codes and standards.

AWWA C900-22	Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inch through 60 inch. (100 mm through 1,500 mm)
AWWA M23	AWWA Manual of Supply Practices PVC Pipe - Design and Installation, Third Edition
ASTM D1784	(2020) Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	(2021) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2152	(2017) Standard Test Method for Adequacy of Fusion of Extruded

ASTM D2241	Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion (2020) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D3034	(2016) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM F679	(2016) Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
SSPWC	(2021) "Green Book", Standard Specifications for Public Works Construction

C. Comply with the applicable reference specifications as directed in the General Conditions.

1.4 CONTRACTOR SUBMITTALS

A. Submittals shall be made in accordance with the Standard Specifications, General Conditions and Special Conditions and as specified herein.

B. The following product data is required from the pipe supplier and/or fusion provider:

1. Pipe Size
2. Dimensionality
3. Pressure Class per applicable standard
4. Color
5. Recommended Minimum Bending Radius
6. Recommended Maximum Safe Pull Force
7. Fusion technician qualification indicating conformance with this Specification.
8. Recommendations for shipping, handling, lifting, fusing, surface testing, and final testing
9. Recommendations for HDD installation including maximum scouring and gouging of the sidewall during installation.
10. Manufacturer's technical data showing complete information on material composition, physical properties, pressure rating and dimensions of the HDPE pipe. Manufacturer's recommendations for transport, handling, storage, and repair of the HDPE pipe shall be included.
11. Specifications of fusing machine and fusing procedures and restrictions, including machine cut sheet.
12. Fusion machine data logger with temperature, date and pressure recording elements.
13. Submittals shall include complete design calculations for each pipe size and pipe DR to be furnished.
14. Pipe manufacturers' joint assembly procedure including cool down time and data logger equipment.
15. Detailed Pipe Laying Schedule.
16. FPVC fusion technician's experience and qualifications demonstrating conformance with Quality Assurance requirements.
17. Written certification from the FPVC pipe fusion equipment supplier that the fusion technician has received training in the proper use of the fusion equipment and the manufacturer's recommended fusion equipment.
18. Fusion Data (heater plate temperature, hydraulic cylinder interface pressures, time/duration, etc.) shall be submitted to the Engineer within two days following the completion of any joint.
19. Shop drawings and cut sheets providing information on fittings, including dimensions, compliance with standards and pressure rating.
20. Information on pipe accessories, including but not limited to special adaptors for connections to ductile iron fittings
21. FPVC pipe manufacturer shall furnish an affidavit of compliance that all delivered materials comply with the requirements of these specifications.
22. Contractor preconstruction submittals for HDD installation

C. Certifications: The Contractor shall furnish a certified affidavit of compliance for all pipe and other

products or materials furnished under this section, as specified in the referenced standards and the following supplemental requirements:

1. Hydrostatic test reports.
2. Three-edge bearing strength test reports.

1.5 CARE AND HANDLING

- A. All pipe shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the Engineer.
- B. Pipe shall be loaded, off-loaded, and otherwise handled in accordance with AWWA M23, and all of the pipe supplier's guidelines shall be followed.
- C. Any scratch or gouge greater than 10% of the wall thickness will be considered significant and can be rejected unless determined acceptable by the Engineer.
- D. Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.
- E. The Contractor shall not store pipe upon the roadway or parkway of residential streets for more than 5 days or upon commercial streets for more than 3 days.
- F. Pipe shall be stored and stacked per the pipe supplier's guidelines.

1.6 QUALITY ASSURANCE

- A. General
 1. All piping shall be made from PVC compound conforming to cell classification 12454 per ASTM D1784.
 2. Fusion Technician shall be qualified by the pipe supplier to fuse fusible polyvinyl chloride pipe of the type(s) and size(s) being used. Qualification shall be current as of the actual date of fusion performance on the project.
 3. Fusible polyvinyl chloride pipe shall be used as manufactured under the trade names Fusible C-900®, and FPVC®, for Underground Solutions, Inc., Poway, CA, (858) 679-9551 or Engineer approved equal. Fusion process shall be as patented by Underground Solutions, Inc., Poway, CA, Patent No. 6,982,051.
 4. The pipe shall be warranted for one year per the pipe supplier's standard terms.
 5. In addition to the pipe warranty, the fusion services shall be warranted for one year per the fusion service provider's standard terms.

PART 2 PRODUCTS

2.1 FUSIBLE POLYVINYLCHLORIDE PIPE

- A. Fusible polyvinyl chloride pipe for recycled water shall conform to AWWA C900, ASTM D2241 or ASTM D1785 as applicable. Testing shall be in accordance with the referenced AWWA standards for all pipe types.
- B. Fusible polyvinyl chloride pipe for recycled water shall conform to AWWA C900, AWWA ASTM D2241 or ASTM D1785 for standard dimensionality, as applicable. Testing shall be in accordance with the referenced AWWA standards.

- C. Fusible polyvinyl chloride pipe for recycled water pipeline shall conform to ASTM D3034, ASTM F679, AWWA C900, ASTM D2241, or ASTM D1785 for standard dimensions as applicable. Testing shall be in accordance with the applicable standard used.
- D. Fusible polyvinyl chloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.
- E. Fusible polyvinyl chloride pipe shall be manufactured in a standard 40' nominal length or custom lengths as specified.
- F. Fusible polyvinyl chloride pipe shall be purple in color for recycled water pipeline application.
- G. Pipe generally shall be marked per AWWA C900, ASTM D2241, or ASTM D1785 as applicable, and shall include as a minimum:
 - 1. Nominal pipe size
 - 2. FPVC
 - 3. Dimension Ratio, Standard Dimension Ratio or Schedule
 - 4. AWWA pressure class or standard pressure rating for non-AWWA pipe
 - 5. AWWA standard designation number or pipe type for non-AWWA pipe
 - 6. Extrusion production-record code
 - 7. Trademark or trade name
 - 8. Cell Classification 12454 and/or PVC material code 1120 shall be included
- H. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.
- I. The Contractor shall coordinate the requirements of this Specification with the requirements of Section 33 05 23.13, Horizontal Directional Drilling.

2.2 FUSION JOINTS

- A. Unless otherwise specified, fusible polyvinylchloride pipe lengths shall be assembled in the field with butt-fused joints. The fusion technician shall follow the pipe supplier's guidelines for this procedure. All fusion joints shall be completed as described in this Specification.
- B. Casing pipe joint fusion beads, internal and external, shall be de-beaded according to manufacturer's written recommendations
- C. Carrier pipe joint fusion beads, external, shall be de-beaded according to manufacturer's written recommendations.

2.3 FUSIBLE POLYVINYL CHLORIDE FITTINGS

- A. All fittings shall be ductile iron pipe fittings of the same pressure class as the pipe with appropriate coating to resist corrosion. Fittings shall conform to the same sizing convention, diameter, dimensional tolerances, and pressure class of the pipe being joined.
- B. All fittings shall not be greater than 22.5 degrees with a straight section of FPVC not less than 2.0 times the pipe OD in length on both sides of the fitting.

2.4 CONNECTIONS

- A. Fusible polyvinylchloride pipe shall be connected to other structures to provide a leak-free, properly graded transition.

- B. Connections to existing manholes and structures shall be as indicated in the construction documents.
 - 1. For a cored or drilled opening provide a flexible, watertight connection that meets and/or exceeds ASTM C923.
 - 2. For a knock out opening, provide a watertight connection (waterstop or other method) meeting the material requirements of ASTM C923 that is securely attached to the pipe with stainless steel bands or other means.
 - 3. Grout opening in manhole wall with non-shrink grout. Pour concrete collar around pipe and outside manhole opening. Provide flexible pipe joint or flexible connector within 2 feet of the collar.
- C. Connections to a new manhole or structure shall be as indicated in the construction documents.
 - 1. A flexible, watertight gasket per ASTM C 923 shall be cast integrally with riser section(s) for all precast manhole and structures.
 - 2. Drop connections shall be required where shown on drawings.
 - 3. Grout internal joint space with non-shrink grout.

2.5 BEDDING AND ENCASEMENT MATERIALS

- A. All bedding and encasement materials shall be as shown on the Contract Drawings and in Section 31 00 00, Earthwork, of these Specifications.

PART 3- EXECUTION

3.1 GENERAL

- A. Pipe shall be off loaded, loaded, installed, handled, stored and stacked per the pipe supplier's guidelines. These guidelines include compliance with the minimum recommended bend radius and maximum safe pull force for the specific pipe being used.
- B. The general best practices of the industry per AWWA M23 shall also be observed.
- C. Trench excavation, bracing methods, foundation preparation, pipe bedding, trench backfill, and related operations shall be in accordance with the requirements of Section 31 00 00, Earthwork.
- D. The recycled water pipeline shall be constructed to the alignment and grade shown. The grade line shown on the profile is the centerline of the pipe. The excavation shall be made a sufficient distance below the grade line to allow for placing the recycled water pipeline and the supporting bedding if such bedding is shown. Should the trench be excavated to a depth greater than required, the Contractor shall refill such excess excavation with the same fill material as specified for the overlying fill or bedding and compacted as required for such overlying fill or bedding.
- E. Recycled water pipeline shall never be used as drains for removing water that has infiltrated into the trenches.
- F. Field Pressure testing procedure shall be per Manufacturer's written recommendations or as follows:
 - 1. Fill line slowly with water. Maintain flow velocity less than 2.0 feet per second.
 - 2. Expel air completely from the line during filling and again before applying test pressure. Air shall be expelled by means of taps at points of highest elevation.
 - 3. Apply initial test pressure and allow to stand without makeup pressure for two to three hours, to allow for diametric expansion or pipe stretching to stabilize.
 - 4. After this equilibrium period, apply the specified test pressure and turn the pump off. The final test pressure shall be held for one to three hours.

- G. Upon completion of the test, the pressure shall be bled off from a location other than the point where the pressure is monitored. The pressure drop shall be witnessed by the resident project representative at the point where the pressure is being monitored and shall show on the recorded pressure read-out submitted to the Engineer.
- H. Factory Witnessed Testing
 - 1. Notify Engineer of start date and location of pipe manufacture at least 30 days prior to commencing pipe production. Should the Owner elect to witness the manufacture of specific pipes during any phase of the manufacturing process, the manufacturer shall provide the Owner with at least 30 days advance notice of when and where the production of those pipes will take place. If Owner elects to witness pipe production or testing provide the following for the Owner's use:
 - 2. Notify Engineer of start date and location of pipe manufacture at least 30 days prior to commencing pipe production. Should the Owner elect to witness the manufacture of specific pipes during any phase of the manufacturing process, the manufacturer shall provide the Owner with at least 30 days advance notice of when and where the production of those pipes will take place. If Owner elects to witness pipe production or testing provide the following for the Owner's use:
 - a. A work desk including telephone and computer with internet access near the manufacturing line.
 - b. Free access to the manufacturing line to witness production, and the testing facilities to witness testing.
 - c. Free access to manufacturing controls and instrumentation.
 - d. Free access to testing tools and instrumentation.
 - e. Access to take random samples for testing by an outside testing laboratory.
 - f. Certified lab data upon request to verify the physical properties of the witnessed pipe.
 - 3. Costs for Owner and Engineer shall be borne by the Contractor and shall be included in the Contract Price. Such costs shall include travel and subsistence for four people excluding salaries. Assume that travel to the factory shall be from Victorville, California. Include costs for:
 - a. Witnessing by one person for the entire run of pipe manufacturing, which shall include:
 - 1) Weekly round trip air fare for one.
 - 2) Five days per week of lodging at a AAA three diamond or better facility.
 - 3) Five days per week of per diem reimbursement for food and incidentals at the current US General Services Administration per diem rate.
 - 4) A mid-size or larger rental car for the entire run.
 - b. Witnessing by three additional people during two separate three-day trips. For each trip provide a rental car for three days. For each person and each trip provide:
 - 1) Round trip air fare.
 - 2) Three days of lodging at a AAA 3 diamond or better facility, providing a minimum of two rooms for the three people.
 - 3) Three days of per diem reimbursement for food and incidentals at the current US General Services Administration per diem rate. Test results shall be submitted to the Engineer.
 - 4) Factory Test Data: Signed, dated, and certified factory test data for each pipe segment shall be submitted before shipment of materials. No materials shall be shipped until the test data have been approved by the Engineer.
 - 4. Markings
 - a. Marking shall include the following:
 - 1) Each pipe shall also have the pipe number designation referenced on the laying diagram.
 - 2) Pipe ID, OD and DR.
 - 3) Cell classification.
 - 4) Standard specification pipe was built to AWWA C900.

- 5) All markings shall be legible and indelible.
- 6) Any factor performed test reference numbers and dates.

3.2 FUSION PROCESS

- A. Fusible polyvinyl chloride pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.
- B. Fusible polyvinyl chloride pipe will be fused by qualified fusion technicians holding current qualification credentials for the pipe size being fused, as documented by the pipe supplier.
- C. Pipe supplier's procedures shall be followed at all times during fusion operations.
- D. For each set up, the Contractor shall provide a sample joint and conduct testing to verify fusion.
- E. Each fusion joint shall be recorded and logged by an approved electronic monitoring device (data logger) connected to the fusion machine, which utilizes a current version of the pipe supplier's recommended and compatible software.
- F. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. This includes requirements for safety, maintenance, and operation with modifications made for PVC.
- G. The FPVC shall not be placed in tension or compression for installation until the pipe has cooled to within 5°F of the ambient pipe temperature.
- H. Internal and external rolled up beads formed at joints during fusion process shall be removed from the inside and outside of the casing pipe and outside of the carrier pipe. Removal shall take place immediately after welding is complete. Contractor shall exercise caution to avoid damage to the joint and pipe while removing the bead and shall be responsible for repairs and/or replacement of any damaged joint or pipe.

3.3 GENERAL INSTALLATION

- A. Installation guidelines from the pipe supplier shall be followed for all installations.
- B. The fusible polyvinyl chloride pipe will be installed in a manner so as not to exceed the recommended bending radius guidelines.
- C. Where fusible polyvinyl chloride pipe is installed by pulling in tension, the recommended maximum safe pulling force, established by the pipe supplier, shall not be exceeded.

3.4 FIELD WELDING QUALITY CONTROL

- A. General: Contractor shall be responsible for employing a rigorous quality control procedure for field welding quality control and documentation. All field-welding shall be accomplished with Engineer-Approved Equipment. Documentation of each field weld shall be submitted to the Engineer for record within two days of weld completion.
- B. Data Collector and Recording Device: Contractor shall utilize data collection and recording equipment to verify proper fusion procedures have been followed prior to installation. The Data collector shall consist of a rugged computer to record and report key weld parameters including the heater temperature and fusion pressure profile over time. Data Collector and Recording Devices shall be Datalogger™ as manufactured by McElroy, or Engineer-Approved Equal.

- C. Weld Quality Control Documentation: Contractor shall produce and submit field weld reports within two days of welding activity. Report shall provide the following information, at a minimum:
1. Date, time, and ambient temperature
 2. Joint Number that correlates to Project pipeline stationing
 3. Employee Identification that is unique to Project approved FPVC Fusion Technician
 4. Equipment Identification and specifications including piston area
 5. Pipe Data including material, size, Dimension Ratio
 6. Interfacial Pressure in pounds per square inch (psi) including Heat, Soak, Fuse, and Cool
 7. Recommended Gauge Pressures in pounds per square inch (psi) including Heat, Soak, Fuse, and Cool
 8. Recorded Data including Drag pressure, weld temperature
 9. Graphs of pressure and temperature over time. Provide one graph for the first five minutes of weld procedure and a summary plot of the entire weld and cool down process.

3.5 DAMAGED PIPE

- A. Pipe sections with gouges or cuts deeper than ten percent (10%) of the wall thickness shall be cut out, removed, and replaced. Undamaged pipe portions longer than 3 times the pipe's OD may be rejoined using butt-fusion joining methods. No three fused joints are to be within any continuous run of 10.0 feet.

3.6 TESTING AND ACCEPTANCE

- A. Pipeline testing shall be performed once fusion process is completed on the pipeline reach prior to installation while it is on the surface and again after the completion of the installation.
- B. General: It is the intent of the Contract Documents that the completed recycled water pipeline shall be watertight.
- C. Testing of FPVC pipelines shall be performed as specified in Section 33 11 00 Recycled Water Utilities system testing.
- D. F. Even though a section of recycled water pipeline may have previously passed the leakage or infiltration test, each section of pipe shall be tested subsequent to the last backfill compacting operation thereon. If, in the opinion of the Engineer, heavy compaction equipment or any of the operations of the Contractor may have affected the required watertight integrity of the pipe, structure, or appurtenances, additional leak testing is required. The Contractor shall furnish all materials required for the tests and bear all associated costs in connection therewith. Tests shall be made in the presence of the Engineer.

END OF SECTION

SECTION 33 11 14

FUSIBLE HDPE PIPE

PART 1 GENERAL

1.1. DESCRIPTION:

A. Scope:

1. Provide high density polyethylene pipe (PE 4710) (HDPE) as specified herein and all labor, equipment, materials, fittings, and incidentals to install an operational pipeline as shown on the contract drawings using horizontal directional drilling (HDD) in conformance with Section 33 05 23.13, Horizontal Directional Drilling.
2. Fusion weld, inspect, and pressure test HDPE as specified herein.

- B. Pipe Description: HDPE pipe sizes shall provide the equivalent minimum hydraulic capacity to that of AWWA C900 FPVC / PVC for the specified pressure class shown in the table below.

FPVC / PVC (DR 18, Press. Class 235)	HDPE (DR 9, Press. Class 250)
6"	8"
8"	10"
10"	12"
14"	20"

1.2. REFERENCE STANDARDS:

A. Referenced documents are a part of this section as specified and modified.

1. Referenced document containing references to other standards are included as references under this section as if referenced directly.
2. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.
3. Reference documents are effective as of the date of bid.
4. Discontinued documents shall mean the replacement.
5. Unreplaced documents shall use the last version of the document before it was discontinued.

B. Related Work Specified Elsewhere:

1. Section 31 09 14 Geotechnical Instrumentation and Monitoring
2. Section 33 05 23.13 Horizontal Direction Drilling.
3. Section 33 11 00 Recycled Water Utilities.

C. References

1. ASTM D2837-22 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.

2. ASTM D3035-21 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
3. ASTM D3350-21 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
4. ASTM F714-22 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.
5. ASTM F1962-22 – Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings.
6. AWWA C906-21 – Polyethylene (PE) Pressure Pipe and Fittings, 4 in. Through 65 in. (100 mm Through 1,650 mm), for Waterworks.
7. NSF 14 – Plastics Piping System Components and Related Materials.
8. NSF-61 – Drinking Water System Components--Health Effects. PPI TR-2 PVC Range Composition Listing of Qualified Ingredients.

1.3. QUALITY ASSURANCE:

- A. Specified Pipe Supplier: HDPE pipe shall be PE4710 manufactured for HDD in accordance with ASTM D2837, D3035, D3350, F714, and F1962.
- B. Fusion Data Recording Software acceptable to Pipe Supplier/Manufacturer.
- C. Warranty.
 1. The pipe shall be warranted for one year per the pipe supplier's standard terms.
 2. Fusion welding services shall be warranted for one year per the fusion welding service provider's standard terms.
- D. Experience Record Requirements:
 1. Trenchless Project list to include:
 - a. Project Name, Project Owner, and contact information.
 - b. Project location including nearest City, State.
 - c. Date of start and completion.
 - d. If subcontractor provide Contractor's name, Contact's name and contact information.
 - e. Type of trenchless installation listing pipe size and DIPS/IPS, DR, fusion welds planned and performed, and de-beading as specified herein.
 - f. All previous projects completed for this Owner.
 - g. Additional details as specified below.
 2. Fusion Welding Technician:

- a. Technician shall be qualified by the pipe supplier for the pipe size and DIPS/IPS, and DR being fused.
- b. Qualification shall be current as of the date of qualifying and fusing.
- c. Five (5) years' experience.
 - 1) 10 trenchless projects of at least 40 fusion welds per project.
 - 2) 50 fusion welds for trenchless installation of each size and DR proposed on this project.

1.4. SUBMITTALS:

A. Submittals: in accordance with Section 01 30 00 Submittals.

1. Qualifying Submittals:

- a. Fusion Welding Operator Experience Record.
- b. Pipe.
 - 1) Pipe Size by DR and DIPS/IPS and segment length.
 - 2) Manufacturer's certification of PE4710 compound property values and cell classification values.
 - 3) Color, OD, ID, W/T, and pounds per foot.
 - 4) Recommended Maximum Safe Pull Force.
 - 5) Recommended Minimum Bending Radius (Radius of Curvature).
 - 6) Pipe manufacturer's written handling procedure to cover shipping through installation.
 - 7) Pipe manufacturer's written fusion welding procedure for each unique pipe size including de-beading as specified herein.
- c. Fusion Welding Equipment
 - 1) Machine Manufacturer, Model, Year of Manufacture.
 - 2) Machine Size for specified pipe.
 - 3) Compatible Automated Data Recorder and fusion welding process software.
 - 4) Anticipated fusion weld duration in Hours.
 - 5) Fusion welding machine manufacturer's written fusion welding procedure including estimated durations for each step for each unique pipe size.

2. Pre-Construction Submittals

- a. Sample Fusion Welding Data Record in electronic and hard copy including:

- 1) Machine Size and Pipe Size by DR and DIPS/IPS.
 - 2) Project Name.
 - 3) Date of Work.
 - 4) Weather Conditions.
 - 5) Fusion Welding Technician Name.
 - 6) Fusion Welding Technician's Identification from Certification.
 - 7) Fusion Weld Joint Number.
 - 8) Fusion Weld Heating and Drag Pressure Settings.
 - 9) Heat Plate Temperature with Start and Stop Time Stamp.
 - 10) Heating and Cool Down Time of fusion weld with Start and Stop Time Stamp.
 - 11) Ambient Temperature with Time Stamp.
- b. Work plan for pressure tests.
 - 1) Surface pressure test.
 - 2) In ground pressure test.
- c. Work plan for inspection for 10-foot test section.
 - 1) Sample report.
 - 2) Photographs noting damage.
3. Construction Submittals: Submit within one workday.
 - a. Submit as built Fusion Welding datalogger reports.
 - b. Provide data on unsuccessful fusion welds including.
 - 1) Removal length.
 - 2) Disposition of removed pipe.
 - c. Results of surface pressure test.
 - d. Results of in ground pressure test.
4. Post-Construction Submittals: Submit before requesting Final Payment.
 - a. Submit as built drawing mark-ups including Contractor's notes.
 - b. Submit all photograph and records of construction.
 - c. Submit results of inspection for 10-foot test section.

PART 2 PRODUCTS

2.1. HDPE PRESSURE PIPE FOR POTABLE WATER:

- A. HDPE pipe shall conform to AWWA C906, ASTM F714 or ASTM D3035 for standard dimensions, as applicable.
- B. Testing shall be in accordance with the referenced AWWA standards for all pipe types.
- C. HDPE pipe shall be:
 - 1. Manufactured with polyethylene compounds that have hydrostatic design basis (HDB) ratings at 73 degrees F and at 140 degrees F, and hydrostatic design stresses (HDS) rating at 73 degrees F, determined in accordance with ASTM D2837 and PPI TR-3.
 - 2. Polyethylene compounds used in potable water applications shall be classified as Oxidative Resistance Category CC3 per ASTM D3350, Section 10.1.11. See also Table 1 in AWWA C906-21 for required PE4710 compound property values and cell classification values.
 - 3. Extruded with plain ends.
 - 4. Manufactured with ends that are square to the pipe and free of any bevel or chamfer.
 - 5. Manufactured with no bell or gasket.
 - 6. Manufactured in a standard 40-foot nominal length, or custom lengths as specified.
- D. HDPE pipe shall be black in color with a purple stripe for recycled water use.
- E. Pipe shall be marked as follows:
 - 1. Nominal pipe size and DIPS/IPS.
 - 2. HDPE 4710.
 - 3. Dimension Ratio (DR) 9, Standard Dimension Ratio, or Schedule.
 - 4. AWWA pressure class, or standard pressure rating for non-AWWA pipe, as applicable.
 - 5. AWWA standard designation number, or pipe type for non-AWWA pipe, as applicable.
 - 6. Extrusion production-record code.
 - 7. Trademark or trade name.
- F. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

2.2. FUSION WELDED JOINTS:

- A. Assembled in the field with butt-fused joints.
- B. Fusion welding shall be as required by pipe manufacturer and as specified herein.

- 2.3. PIPE PULL HEADS: Use HDPE pipe pull heads that employ a positive through-bolt design and as recommended by the pipe supplier.

PART 3 EXECUTION

3.1. HDPE PIPE HANDLING AND STORAGE:

- A. Pipe shall be handled, stored, and installed as specified herein and in accordance with the pipe manufacturer's written recommendations.
- B. All damaged or otherwise defective pipe, upon discovery shall be immediately removed from site.
- C. Pipe will be inspected upon delivery and during unloading.
- D. Pipe sizes shall be separated by use, pipe size, length, and DR.

3.2. FUSION WELDING PROCESS:

A. General:

- 1. Notify the Engineer in writing:
 - a. One workday before making any changes.
 - b. One workday after unacceptable fusion welding results.
 - c. Perform test fusion weld following unacceptable results and before resuming production fusion welding.
- 2. All fusion welding shall be performed in accordance with the accepted submittals.
- 3. HDPE pipe will be fusion welded by qualified fusion welding technicians.
- 4. Each operator shall perform a test fusion weld of each pipe size and type before commencing production fusion welding.
- 5. De-bead the exterior of each joint.
- 6. De-bead the interior of each joint unless fusion welding of sub-assemblies.
- 7. Each fusion welded joint shall be recorded, logged, and submitted within one workday in electronic and hard copy format.
- 8. Any fusion welded joint found unacceptable is to be cut out and immediately removed from the project site with fusion welding data report noted as "FAIL" and submitted.
- 9. Fusion welding shall only be performed using equipment in proper repair.

B. Fusion Welding Joint Data Recording:

- 1. Fusion welding report shall be reviewed by operator and signed.
- 2. Fusion welding report shall be reviewed and signed by qualified supervisor.
- 3. Submit dually signed fusion welding report within one workday in electronic and hard copy format.

3.3. PIPE AWAITING PULL-BACK:

- A. Pipe entry area shall be graded as needed to provide support for the pipe and to allow free movement into the bore hole.
- B. Pipe shall be fusion welding prior to insertion, if the site and conditions allow, into one continuous length.
- C. Damaged portions of the pipe shall be removed and replaced and submitted as previously noted.
- D. Pressure test pipe in as few sections as possible.
 - 1. Leave pipe under low pressure, 5 -10 psig to ensure pipe integrity until pullback commences.
 - 2. Relieve pressure and drain before pullback.
- E. See Section 33 05 23.13 HDD for installation.

3.4. FINAL TESTING:

- A. Allow HDPE pipe to rest for 24 hours without any end restraining force.
- B. On HDD rig side, remove the first 10 feet of pipe.
 - 1. Pipe has been pulled through the entire drill path.
 - 2. Inspect and note for gouges and other detrimental damage.
 - 3. Submit inspection and test report and allow two workdays for Engineer's review before final pressure testing and burial or making tie-ins.
 - 4. Pressure test as specified elsewhere.
 - 5. If left for future work, seal ends to prevent intrusion and inflow before burial.
 - 6. Provide in writing for each end of installed pipe, the coordinates and burial depth. Include detectable subsurface marker and surface marker acceptable to Engineer.

END OF SECTION

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SECTION 33 12 00

BACKFLOW PREVENTER ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Reduced pressure backflow preventer assemblies.
 - 2. Backflow insulation bag.
 - 3. Pipe supports.

1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- B. American Society of Sanitary Engineering:
 - 1. ASSE 1013 - Reduced Pressure Principle Backflow Preventers.
 - 2. ASSE 1047 - Reduced Pressure Detector Fire Protection Backflow Prevention Assemblies.
- C. ASTM International:
 - 1. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 - 2. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 - 3. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - 4. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
 - 5. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- D. American Water Works Association:
 - 1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - 2. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 3. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
 - 4. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
 - 5. AWWA C509 - Resilient-Seated Gate Valves for Water-Supply Service.
 - 6. AWWA C511 - Reduced-Pressure Principle Backflow Prevention Assembly.
 - 7. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water Distribution.
- E. American Welding Society:
 - 1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.3 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittals: Requirements for submittals.
- B. Approved double detector check backflow assemblies shall be as shown on the "List of Approved Backflow Devices" (latest edition) by the University of Southern California Foundation for Cross Connection Control and Hydraulic Research.
- C. Product Data:
 - 1. Submit data on backflow preventer assemblies.
 - 2. Piping: Submit data on pipe materials, fittings, and accessories.
 - 3. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 4. Supports: Submit manufacturers catalog information including load capacity.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Manufacturer's Instructions: Submit installation instructions for backflow preventer assemblies, valves, and accessories.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Project Closeout: Requirements for close out submittals.
- B. Project Record Documents: Record actual locations of backflow preventer assemblies.
- C. Operation and Maintenance Data: Submit spare parts list, exploded assembly views, and recommended maintenance intervals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Project Closeout: Requirements for maintenance materials.
- B. Extra Stock Materials:
 - 1. Furnish two sets of seals for each backflow preventer assembly.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept backflow preventer assemblies, valves, and equipment on site in shipping containers with labeling in place. Inspect for damage.
- C. Furnish cast iron and steel valves with temporary protective coating.
- D. Furnish pipe and fittings with temporary end caps and closures. Maintain caps and closure in place until installation.
- E. Protect backflow preventer assemblies from entry of foreign materials by temporary covers.
 - 1. Protect openings in sections of completed piping systems.
 - 2. Protect openings in piping systems when Work is not in progress.

1.9 EXISTING CONDITIONS

- A. Verify field measurements prior to fabrication. Indicate field measurements on shop drawings

1.10 WARRANTY

- A. Section 01 70 00 - Project Closeout: Requirements for warranties.
- B. Furnish five year manufacturer's warranty for backflow preventer assemblies.

PART 2 PRODUCTS

2.1 BACKFLOW PREVENTERS

- A. Manufacturers:
 - 1. Watts Water Technologies.
 - 2. Febco.
 - 3. Zurn Wilkins.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Reduced Pressure Backflow Preventers:
 - 1. Size: 3/4 inch to 2 inches.
 - 2. Comply with ASSE 1013 and AWWA C511.
 - 3. Bronze body, with bronze internal parts and stainless steel springs.
 - 4. Two independently operating, spring loaded check valves.
 - 5. Diaphragm type differential pressure relief valve located between check valves.
 - 6. Third check valve opening under back pressure in case of diaphragm failure.
 - 7. Furnish with two quarter-turn, full port resilient seated bronze, ball valves, strainer, and test cocks.

2.2 BACKFLOW INSULATION BAG

- A. 18 oz. vinyl coated polyester fabric with UV resistance.
- B. Color: green.

- C. Effective temperature range: - 40 degrees to 180 degrees F.
- D. Insulation: R-19.
- E. Approved by the State of California/ California Fire Marshal for fire resistance, waterproof, and polar insulation
- F. Manufacturer:
 - 1. Advanced Connections, LLC
 - 2. Polar Parka by The Source.
 - 3. Dekorra.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.

2.3 BACKFLOW PREVENTER ENCLOSURES/ SECURITY CAGES

- A. Mild Steel, Single Swing 1-1/4" to 1-1/2" Tubing, 1/8 Angle, 1/2 inch #13 Diamond Pattern Expanded Metal.
- B. Enclosure shall be equipped to secure onto concrete pad.
- C. Hot dipped galvanized and powder coated.
- D. Powder coat color: purple.
- E. Manufacturer:
 - 1. All-Spec Enclosures, Inc.
 - 2. BackFlow Protection
 - 3. Guardian Enclosures
 - 4. Substitutions: Section 01 60 00 - Product Requirements.

2.4 PIPE SUPPORTS

- A. Floor Support for Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- B. Copper Pipe Support: Carbon steel ring, adjustable, copper plate.

2.5 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 3 inches and Smaller:
 - 1. Ferrous pipe: Class 150 malleable iron threaded unions.
 - 2. Copper tube and pipe: Class 150 bronze unions with soldered joints.
- B. Pipe Size 1 inch and Larger:
 - 1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
 - 2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- C. Grooved and Shouldered Pipe End Couplings:
 - 1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
 - 2. Sealing gasket: "C" shape composition sealing- gasket.

- D. PVC Pipe:
 - 1. For connections to equipment and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or Schedule 80 threaded PVC pipe.
- E. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.6 UNDERGROUND PIPE MARKERS

- A. See Specification Section 33 10 00 - Recycled Water Utilities.

2.7 RECYCLED WATER LABELS

- A. See Specification Section 33 10 00 - Recycled Water Utilities.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Project Closeout: Requirements for installation examination.
- B. Verify excavations are to required grade, dry, and not over-excavate.
- C. Verify piping connection, size, location, and invert are as indicated on Drawings.

3.2 PREPARATION

- A. Section 01 70 00 - Project Closeout: Requirements for installation preparation.
- B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - PIPE SUPPORTS

- A. Pipe Supports:
 - 1. Install pipe supports in accordance with MSS SP 89.

3.4 INSTALLATION - BACKFLOW PREVENTER ASSEMBLIES

- A. Install backflow preventer of type, size, and capacity indicated.
- B. Install air-gap fitting on units with atmospheric vent connection.
- C. Do not install bypass around backflow preventer.
- D. Provide a 4 inch thick concrete pad extending 12 inches beyond backflow preventer on all sides.
- E. Install tracer wire to backflow preventer through concrete pad.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Control: Requirements for inspecting, testing.

3.6 CLEANING

- A. Section 01 70 00 - Project Closeout: Requirements for cleaning.
- B. Disinfect backflow preventer assemblies installation in accordance with Section 33 13 00.

END OF SECTION

SECTION 33 16 13

BOLTED STEEL TANK FOR RECYCLED WATER STORAGE

PART 1 GENERAL

1.1 SUMMARY

- A. Furnish all materials, equipment, tools, and labor necessary for the design, manufacture, erection, testing, cleaning, and disinfection of one bolted tank with a minimum storage capacity of 250,000 gallons for recycled water service.
- B. All required tank materials and principal appurtenances shall be supplied by the tank manufacturer. All materials, structures and appurtenances shall be new and not previously used.
- C. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Conceptual recycled water tank, foundation and appurtenance figures located at the end of this specification section.

1.2 PRICE AND PAYMENT

- A. Schedule B Base Bid Item: All tank materials and appurtenances shall be Type 304 stainless steel.
- B. Schedule I Alternate Bid Item: Tank shall be glass-fused-to-steel construction with passive cathodic protection system.

1.3 REFERENCES

- A. AWWA D103-19 – Bolted steel tank fabrication and erection
- B. AWWA D-106 – Sacrificial Design of Cathodic Protection Systems for Water Storage Tanks.
- C. 2022 California Building Code
- D. ASCE 7-16
- E. NACE International – Standard SP 03 88 Latest Revision Cathodic Protection for Above Ground Water Storage Reservoirs.

1.4 QUALITY ASSURANCES

- A. Qualification of Fabricators:
 - 1. The materials shall be furnished by one supplier who is regularly engaged in the manufacture of stainless steel water storage tanks and has experienced, factory-qualified representatives that can supervise the field assembly.
 - 2. All materials shall be new and of current manufacture and shall be guaranteed against defects in workmanship in accordance with other sections of these Specifications.
 - 3. The supplier/manufacturer of a glass-fused-to-steel tank shall offer a factory applied glass-fused-to-steel coated bolt together shop pre-fabricated sectional steel tank.
 - 4. Provide five-year manufacturer's warranty on the tank and appurtenances.

- B. Qualification of Installers:
 - 1. For the erection and testing of the work in this Section, use only thoroughly trained and experienced personnel who are completely familiar with the requirements for this work and with the installation recommendations of the manufacturer and these Specifications.
- C. Hydrostatic Testing and Disinfection
 - 1. Hydrostatic testing and disinfection shall be furnished in accordance with Section 33 13 00, "Disinfecting of Recycled Water Utilities". The District will furnish enough recycled water for one (1) filling of the tank for testing and disinfection. Test water will be supplied either through the new recycled water system if it is functional or can be obtained by Contractor at the WWTP. The Contractor shall continuously monitor the filling operation to control the rate and level to avoid overflow.

1.5 SUBMITTALS

- A. General:
 - 1. Make all submittals and resubmittals in strict accordance with the Contract Standard General Conditions Section 7.16 and Section 01 33 00 "Submittals."
 - 2. Make all submittals to fully describe what is to be furnished and/or installed under this Section.
 - 3. Submit to Engineer to check for compliance with the drawings and specifications prior to fabrication.
- B. Required Submittals:
 - 1. Proposed changes and substitutions: Within 30 days after award of contract submit shop drawings and products for any changes proposed to the design of the tanks and appurtenances.
 - 2. Shop drawings and calculations: Within 60 days after award of contract, submit complete Shop Drawings and structural calculations for the tank and foundation under one submittal cover for District review. Materials may be ordered and fabrication proceed following approval of submittals.
- C. Detailed shop drawings shall include:
 - 1. Concrete foundation, including rebar layout.
 - 2. Plate thickness and width.
 - 3. Number and size of structural members.
 - 4. Construction and erection details of all accessories and related work.
 - 5. Size and spacing of hold-down anchorages.
 - 6. Structural calculations for the tank and foundation.
 - 7. All other pertinent data concerning the construction of the tank.
 - 8. Materials list: Submit a complete list of all materials and equipment proposed to be furnished and installed under this portion of the work.
 - 9. Manufacturer's recommendations: Submit two copies of the manufacturer's current recommended method of installation for the work in this section.
 - 10. At the conclusion of the tank fabrication and erection work, the Contractor shall submit a written report containing the information outlined in the AWWA D103-19.
- D. Glass-Fused-to-Steel Tank Cathodic Protection System shop drawings and design:
 - 1. Design for galvanic Magnesium or Zinc Sacrificial Bolt-On Anode for glass-fused-to-steel tank. Cathodic protection system is not required for stainless steel tank.
 - 2. Design for water with a Specific Conductance of approximately 170 $\mu\text{ohm}/\text{cm}$.
 - 3. If within a period of Five (5) years from date of completion the tank structure or any part thereof, including tank coating system for glass-fused-to-steel, shall prove to be defective in material or workmanship upon examination by the manufacturer, the manufacturer will supply a replacement part and will repair.

1.6 PACKAGING AND SHIPPING

- A. All components that pass Factory Inspection and Quality Control checks shall be protected from damage prior to packing for shipment.
- B. Suitable nonabrasive packaging sheets shall be placed between each panel to eliminate sheet-to-sheet abrasion during shipment.
- C. Individual stacks of panels will be wrapped in heavy mil black plastic and steel banded to special wood pallets built to the roll-radius of the tank panels. This procedure minimizes contact or movement of finished panels during shipment.

PART 2 - MATERIALS

2.1 DESIGN CRITERIA

- A. General:
 - 1. The steel storage tank shall meet the requirements of AWWA Specification D103-19 and the 2022 California Building Code, and these shall be made a part of this Specification.
- B. Tank Criteria:
 - 1. The tank dimensions are as follows:
 - a. Inside diameter (ft): as shown on Drawings.
 - b. Total tank height (ft): as shown on Drawings.
 - 2. The overflow height and tank capacity:
 - a. Overflow (ft): as shown on Drawings.
 - b. Minimum tank capacity (gallons): 250,000
 - 3. Provide a self-supporting stainless steel roof with a slope of 1 inch in 12 inches. Provide a center column support if necessary.
 - 4. Provide an exterior ladder with top platform and safety railing. Provide an interior ladder.
 - 5. The tank details shall be designed to eliminate joints that will promote corrosion, pockets that will accumulate rainwater, and attachments to the shell which result in excessive localized stresses due to imposed loads.
 - 6. All tank material shall be Type 304 stainless steel plates and fasteners.
- C. Structural Design Criteria:
 - 1. Roof Live Load: 20 psf (no reduction allowed)
 - 2. Wind Velocity: 115 miles per hour
 - 3. Snow Load: none
 - 4. Lowest One-day Mean Temperature: 32°F
 - 5. Corrosion Allowance: none
 - 6. Roof Type: Self-supporting stainless steel
 - 7. Concrete Compressive Strength: 4,000 psi
 - 8. Steel Reinforcing Tensile Strength: 60,000 psi
- D. Seismic Design Criteria:
 - 1. Site Coordinates: 39.312544°N, -123.781737°W
 - 2. Site Class: C
 - 3. Response Modification Coefficient, R: 3 (anchored tank)
 - 4. Overstrength Factor, Ω_0 : 2
 - 5. Seismic Design Category: D
 - 6. Seismic Use Group: III
 - 7. Maximum Considered Earthquake Spectral Acceleration (MCE_R):
 - a. $S_S = 1.74$

- b. $S_1 = 0.709$
 - 8. Spectral Response Acceleration, S_{DS} : 1.392g
 - 9. Spectral Response Acceleration, S_{D1} : 0.662g
 - 10. MCE Spectral Response Acceleration for short Period, S_{MS} : 2.008g
 - 11. MCE Spectral Response Acceleration Parameter for 1 sec Period, S_{M1} : 0.993g
 - 12. Simultaneous combination of horizontal and vertical loads: Yes
 - 13. Minimum Freeboard: Per AWWA D103-19
 - 14. Roof Live Load: 20 psf
 - 15. Seismic Design: Per AWWA D103-19
 - 16. Hoop Stress Combination: Combine impulsive and convective induced stresses by the root mean square method.
 - 17. Pressure Stability: To be considered for seismic loading.
- E. Tank Foundation Design Criteria:
- 1. Minimum Embedment: 18 inches
 - 2. Minimum Width: 24 inches
 - 3. Allowable Bearing Pressure: 3,500 psf
 - 4. Base Fraction Coefficient: 0.45 (concrete on crushed aggregate fill)
 - 5. Base Fraction Coefficient: 0.20 (steel tank bottom)
 - 6. Lateral Passive Resistance: 300 pcf
- F. Accessories: All accessories shall be in accordance with AWWA D103-19, Cal OSHA, and the Division of Industrial Safety, and as shown on the Drawings or described below:
- 1. Ladders:
 - a. For the interior and exterior, Contractor shall furnish and install Type 304 stainless steel ladder.
 - b. The ladders shall begin at the ground or tank bottom and extend along the height of the tank to top of the tank or the hatch opening. Ladder rungs shall be one-inch diameter SLIPNOT skid resistant stainless steel, or approved equal.
 - c. Security enclosure: provide stainless steel security enclosure and access gate per details and location shown on the Plans.
 - 2. Roof Hatch:
 - a. Contractor shall furnish and install weather-tight roof hatches as shown on the Concept Drawings.
 - b. The cover shall have automatic hold-open arm, with compression spring operator for easy opening and closing, with inside and outside handles and locking hasp on the top side.
 - c. The hatch shall be Type 304 stainless steel.
 - d. Rubber gasket sealant shall be installed on roof hatches.
 - e. Roof hatches shall be completely sealed against any water intrusion.
 - 3. Vents:
 - a. Mushroom type vents shall be constructed and installed as shown on the Drawings and fitted with replaceable 2 x 2 (2 openings per linear inch) stainless steel backer mesh and #3 stainless steel insect mesh. The vent assembly shall be Type 304 stainless steel.
 - b. Type 304 stainless steel nuts and bolts shall be used to install roof vents and screens.
 - 4. Tank Inlet, Outlet, Drain, and Overflow Piping:
 - a. Tank piping connections shall be located as shown on the Drawings.
 - b. Stainless steel pipe for connections shall be at least 1/4-inch thick.
 - c. All exposed metallic piping that is not stainless steel shall be coated with fusion bonded epoxy coating with urethane topcoat.
 - 5. Tank Outlet Anti-Vortex Plate:
 - a. Material: Type 304 stainless steel.
 - b. Size: Per outlet pipe diameter.
 - c. Include threaded rods, nuts and washers.

- d. Manufacturer:
 - 1) Neptune-Benson.
 - 2) Franklin Hodge.
 - 3) Approved Equivalent.
 - 6. Level Indicator:
 - a. Contractor shall furnish and install new water level indicator assembly as shown in the project plans with depths measured in 2-inch increments from empty to full. Water level indicator shall be at half scale.
 - b. The water level indicator assembly shall include a Type 304 stainless steel jacketed foam glass float, bottom anchor, top anchors, stainless steel guide wires and float cable, support brackets and gauge-board assembly, aluminum housing, 304 stainless steel trim, Teflon bearing sheave elbows, cable clamp, stainless steel indicator, cable fastener and gauge board connector.
 - c. Provide spring tensioners for tensioning guide wire for smooth operation.
 - d. Manufacturer:
 - 1) LiquiLevel Industrial Series
 - 2) Approved Equivalent.
 - 7. Tie-off points:
 - a. Contractor shall provide four (4) OSHA compliant tie-off points on the tank roof. Coordinate locations with Engineer.
 - 8. Manways
 - a. Manways shall be 30-inch diameter clear opening and shall be located as shown on the Concept Drawings.
 - b. Manway shall be inward opening with swing arm and include a cover plate and easy lock system.
 - c. Manway shall be installed and furnished per OSHA standards for drinking water storage tanks.
 - d. Nuts and bolts shall be Type 304 stainless steel.
 - e. Provide and install gasket suitable for potable water service.
 - 9. Sampling Ports
 - a. Install sampling ports and fittings on the tank per Concept Drawings.
 - 10. Handrail
 - a. Handrail shall be installed on tank roof as shown on Concept Drawings. Handrail assembly shall meet all OSHA, Federal and State regulations and consist of Type 304 stainless steel.
 - 11. Elastomeric Sealant/Adhesive
 - a. Gasketed joints not permitted.
 - b. Manufacturer:
 - 1) Sikaflex-1a.
 - 2) Sikaflex-201 US.
 - 3) Manus-Bond 75-AM.
 - c. Approved Equivalent.
- G. Glass-Fused-to-Steel Tank (Schedule H Alternate Bid Item)
- 1. Design requirements for High Strength Hot Rolled Carbon Steel shall be ASTM A1011 Grade 50, 55, 60, 65, 70; ASTM A572 Grade 42, 50, 60, 65; or special Enamenable Titanium Rich Hot Rolled Carbon Steel SRT480 that is specifically manufactured for Enameling application.
 - 2. Titanium Rich Steel Mechanical properties:
 - a. SRT480: Titanium (Ti) Rich Hot Rolled Carbon Steel with Min. Ultimate Tensile Strength of 60KSI before firing and Min. Yield Strength of 42KSI after steel firing utilizing min. 30% reduction of steel's published yield strength as outlined by AWWA D103-19 Sections 5.3.2; 5.3.2.1 & 5.3.2.2.
 - 3. Steel plates shall be mechanically rolled in factory to the required tank radius utilizing rolling machines.

4. When Rolled Structural Shapes are used, the design and engineering shall conform to minimum standards of the latest AWWA D-103-19.
 - a. Material shall conform to minimum standards of ASTM A36 or ASTM A992.
5. Horizontal Wind Girders/Stiffeners: A36 or equal.
 - a. Design requirements for intermediate horizontal wind stiffeners shall be of the Web-truss design type with an extended tail creating multiple layers of stiffener, permitting wind loads to be distributed around the tank.
 - b. Web truss stiffeners shall be of steel with hot dipped galvanized coating.
 - c. Rolled steel angle stiffeners are not permitted for use as intermediate horizontal wind stiffeners.
 - d. The number and size of wind girders shall be determined by the design calculations. Multiple wind girders shall be utilized as determined by the calculations permitting wind loads to distribute uniformly around the tank.
 - e. Wind girder shall be fabricated of steel with hot dipped galvanized coating.
6. Bolt Fasteners:
 - a. Bolts used in tank lap joints shall be ½" - 13 UNC- 2A rolled thread, with 4-splines, and shall meet the minimum requirements of AWWA D103-19.
 - b. Bolt Material SAE J429 Grade 8/ASTM A490/ASTM A354 SAE J429 Grade 8
 - 1) Tensile Strength - 150,000 psi Min.
 - 2) Proof Load - 120,000 psi Min.
 - 3) Allowable shear stress with threads excluded from the shear plane: 36,818psi Min.
7. Bolt Finish:
 - a. JS1000 or NFZ3000 Coating/Plating System by Leland Industries or equal.
 - b. Zinc, mechanically deposited. 2.0 mils minimum - under bolt head, on shank and threads.
8. Bolt Head Encapsulation:
 - a. High impact polypropylene copolymer encapsulation of entire bolt head up to the shank.
 - b. Resin shall be stabilized with an ultraviolet light resistant material such that the color shall appear black.
9. Tank sidewall bolts shall be installed such that the head portion is located inside of the tank and washer and nut are located on the exterior.
10. All lap joint bolts shall be properly selected such that threaded portions will not be exposed in the "shear plane" between the sheets.
11. Also, bolt lengths shall be sized as to achieve a neat and uniform appearance.
12. Excessive threads extending beyond the nut will not be permitted.
13. Surface Preparation and Cleaning:
 - a. After plate fabrication and prior to application of the glass coating system, all sheets/plates shall be steel grit-blasted to SSPC SP-10/NACE2 (Near White Metal) on both sides.
 - b. The surface anchor pattern shall be not less than 1.0 mil (0.001 inches).
 - c. All sheets shall be air blasted to remove any latent grit and then coated immediately with a rust preventative material.
14. Sheet Edge Preparation
 - a. Prior to glass slurry application all four (4) exposed rectangular continuous sheet edges for each specific sheet radii shall be mechanically rounded in profile resulting in an optimized radius and adhere to The Porcelain Enameling Institute's Technical Manual PEI-101.
 - b. All edges shall receive glass coating system approx. 5mils DFT.
15. Glass Coatings, Application and Firing
 - a. The tank coating system shall conform solely to Section 12.4 of the latest ANSI/AWWA D-103-19.
 - b. The manufacturer shall be currently listed on NSF website (www.nsf.org) as approved and in full compliance with NSF61 and NSF372 standards.

- c. Glass coatings to be applied by Wet Spraying and must be fused-to-steel by firing in high temperature oven at min. 1450°F - 1650°F in strict accordance with the ISO 9001 quality control procedures, including firing time, furnace humidity, and temperature control requirements.
 - d. The tank manufacturers coating process shall employ equipment that evenly coats the sheet surfaces and all (4) exposed sheet edges.
 - e. Manufacturer shall maintain and use supplementary directional spray nozzles using an automated machine process to consistently coat the sheet edge profiles per PEI 101 standard.
 - 1) The sheet edges shall be coated with the same Vitreous enamel glass coating system as the sheet surface.
 - 2) A base coat of Nickel Oxide (NiO) primer, or a ground coat of glass frit shall contain Nickel Oxide (NiO) primer and it is to be applied to all 6 sides of the sheet.
 - 3) A second coat of milled Cobalt Blue or Olive-Green glass shall be applied to both sides of the sheets.
 - 4) For NSF-61 potable water application a third coat of Titanium Dioxide (TiO₂) reinforced glass mixture shall be applied to all interior sidewall and floor, roof sheet surfaces.
 - 5) Interior coating color shall be White.
 - f. Glass-Fused-to-Steel Coating Systems shall be min. 7-18 MILS DFT. As per AWWA D103-19 Section regarding Glass Coatings - Dry Film Thickness (DFT) of the interior and exterior coating should be minimum 6.0 mils and should not exceed 19.0 mils DFT. In no case DFT shall exceed 20mils. All plates with DFT over 20mils shall be rejected.
16. Glass Coating Characteristics:
- a. Acid and alkali resistant pH: 2-13
 - b. Hardness: 6.0 (Mohs)
 - c. Adhesion: 3,450 N/cm
17. Nozzle and Manway Openings:
- a. To be shop located and cut in factory, mechanically rounded prior to glass application and shall receive glass coating system on the edges approx. 5mils DFT.
18. Tank Colors:
- a. Interior:
 - 1) Titanium Dioxide White.
 - b. Exterior:
 - 1) Provide color samples to District for selection during shop drawing and submittal review.
19. Cathodic Protection System Type:
- a. Galvanic Magnesium or Zinc Sacrificial Bolt-On Anode type composed of 5-lb or 10-lb anodes.
20. Design for water with a Specific Conductance of approximately 170 µohm/cm.
- H. Tank Manufacturer:
- 1. United Industries Group, Inc.
11 Rancho Circle
Lake Forest, CA 92630
USA
Art Yanovskiy, Sr. Project Manager
ay@unitedind.com
(949) 759-3200
 - 2. American Structures, Inc.
PO Box 409
Menomonie, WI 54751
USA
Alex Peterson, Estimator

- alex@ameristruct.com
(715) 235-425
3. Tarsco Bolted Tank
5897 Highway 59
Goodman, MO 64843
USA
Pat Wilson
pat.wilson@tfwarren.com
(417) 658-4265
4. Approved Equivalent

PART 3 - EXECUTION

3.1 ERECTION, INSTALLATION, APPLICATION

- A. Field erection of bolted steel tanks shall be in strict accordance with the tank manufacturer's recommendations and instructions.
- B. Particular care shall be exercised in handling and bolting of the tank plates, supports, and members to avoid abrasion or scratching in strict accordance with the manufacturer's recommendations.

3.2 CATHODIC PROTECTION SYSTEM INSTALLATION INSTRUCTIONS (BID ALTERNATE):

- A. Cathodic protection shall be applied to the submerged inner surfaces.
- B. Anodes shall be 5lb or 10lb tear drop shaped Magnesium or Zinc anodes.
- C. Bolt in place anodes by the tank erectors. Install anodes on 1/2" diameter bolts.
- D. Anode quantity and placement will be given on the anode installation drawing.
- E. The CP system is to be comprised of anodes evenly spaced over the tank interior and exterior surfaces in an arrangement to be determined by the design.
- F. Mount anodes using bolts and nuts. Counter rotate nuts to improve anode to tank shell continuity.

3.3 FIELD QUALITY CONTROL

- A. Testing
1. Hydrostatic Test:
- a. Following completion of erection and cleaning of the tank, the tank shall be tested for liquid-tightness.
- 1) Perform leak test of tank floor by vacuum method as described in AWWA D103-19.
- 2) Perform leak test on roof by spraying the outside with potable water from a hose with a minimum 50 psig static head pressure at the nozzle. Monitor the inside of the roof for evidence of leakage.
- 3) Perform leak test on tank by filling the tank with potable water to its overflow elevation and monitoring the level and water loss for a period of not less than five (5) calendar days.
- b. Any leaks disclosed by these tank tests shall be corrected by the Contractor in accordance with the tank manufacturer's recommendations and AWWA D103-19.

- B. Inspection: The District's designated inspector shall be present for all testing

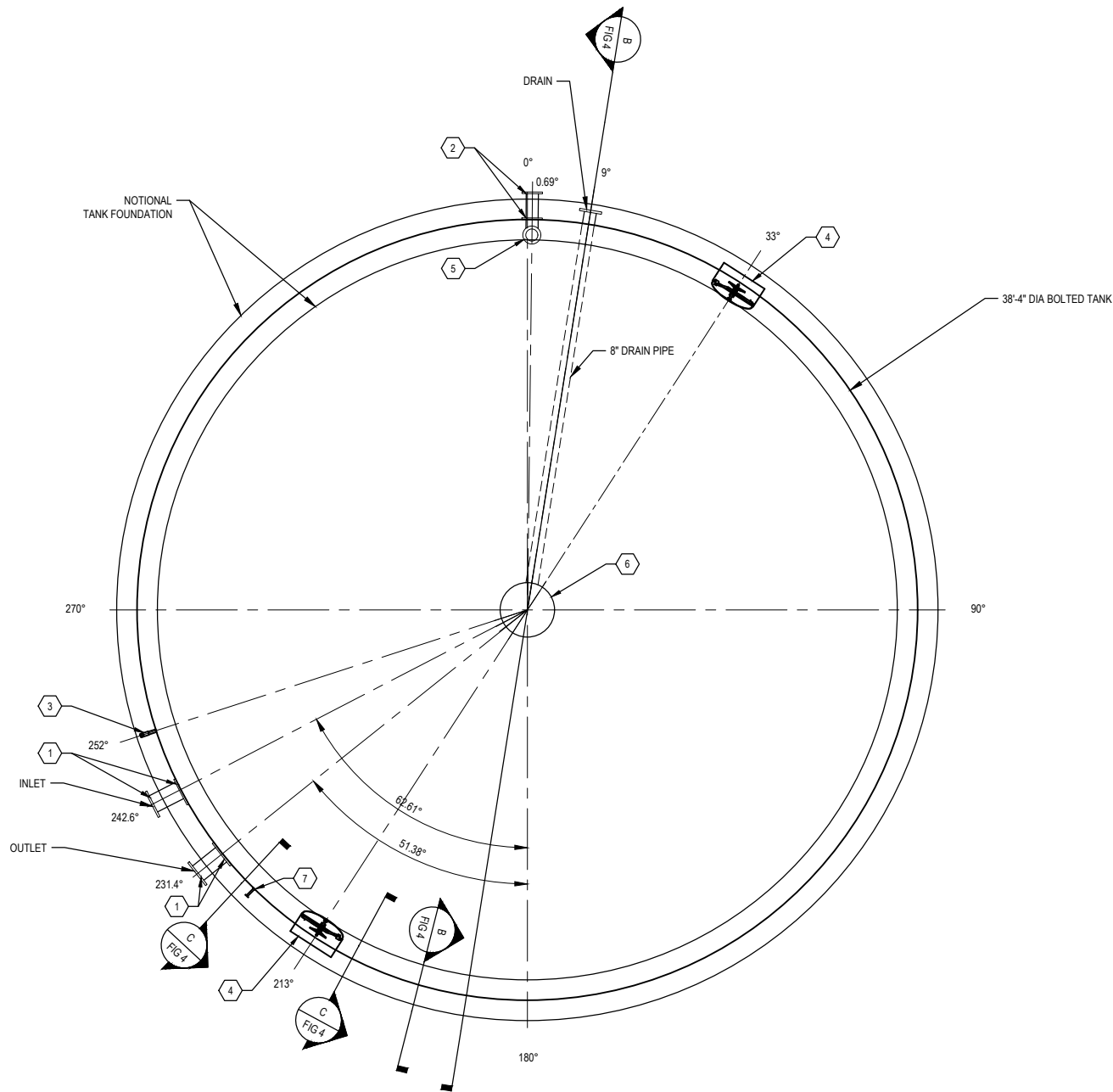
END OF SECTION

GENERAL NOTES

1. THESE DRAWINGS AND DETAILS ARE CONCEPTUAL ONLY AND ARE INTENDED TO CONVEY THE GENERAL SIZE, LAYOUT AND REQUIRED FEATURES OF THE RECYCLED WATER TANK.
2. ALTERNATIVE DETAILS MEETING THE DESIGN REQUIREMENTS AND INTENT CONVEYED IN THESE DRAWINGS AND IN SPECIFICATION SECTION 33 16 13 MAY BE PROPOSED.

KEYNOTES

1. PROVIDE 12" SST 150# TANK FLANGE
2. PROVIDE 8" SST 150# TANK FLANGE
3. LIQUID LEVEL INDICATOR
4. 32" Ø MANWAY
5. 8" OVERFLOW PIPE
6. SUMP
7. PROVIDE SAMPLE TAP



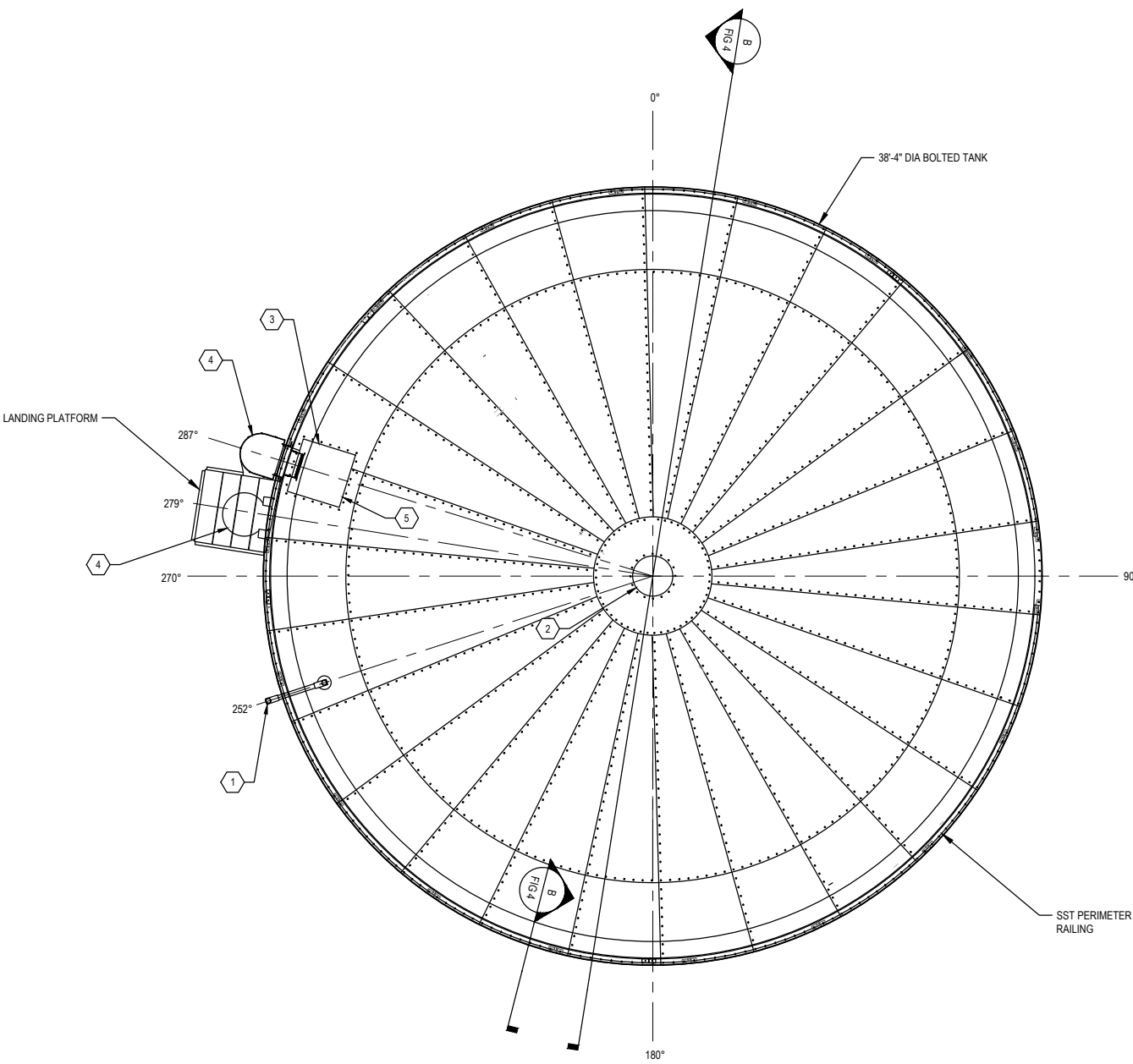
RECYCLED WATER TANK FLOOR PLAN

SCALE 1/4" = 1'-0"



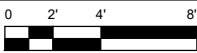
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KEYNOTES	
1. LIQUID LEVEL INDICATOR	3 FIG 5
2. Ø17 1/2" SST ROOF VENT	4 FIG 9
3. 36" X 36" STAINLESS STEEL ROOF HATCH	8 FIG 5
4. EXTERIOR SST CAGED LADDER	1 FIG 8
5. INTERIOR SST LADDER	1 FIG 5

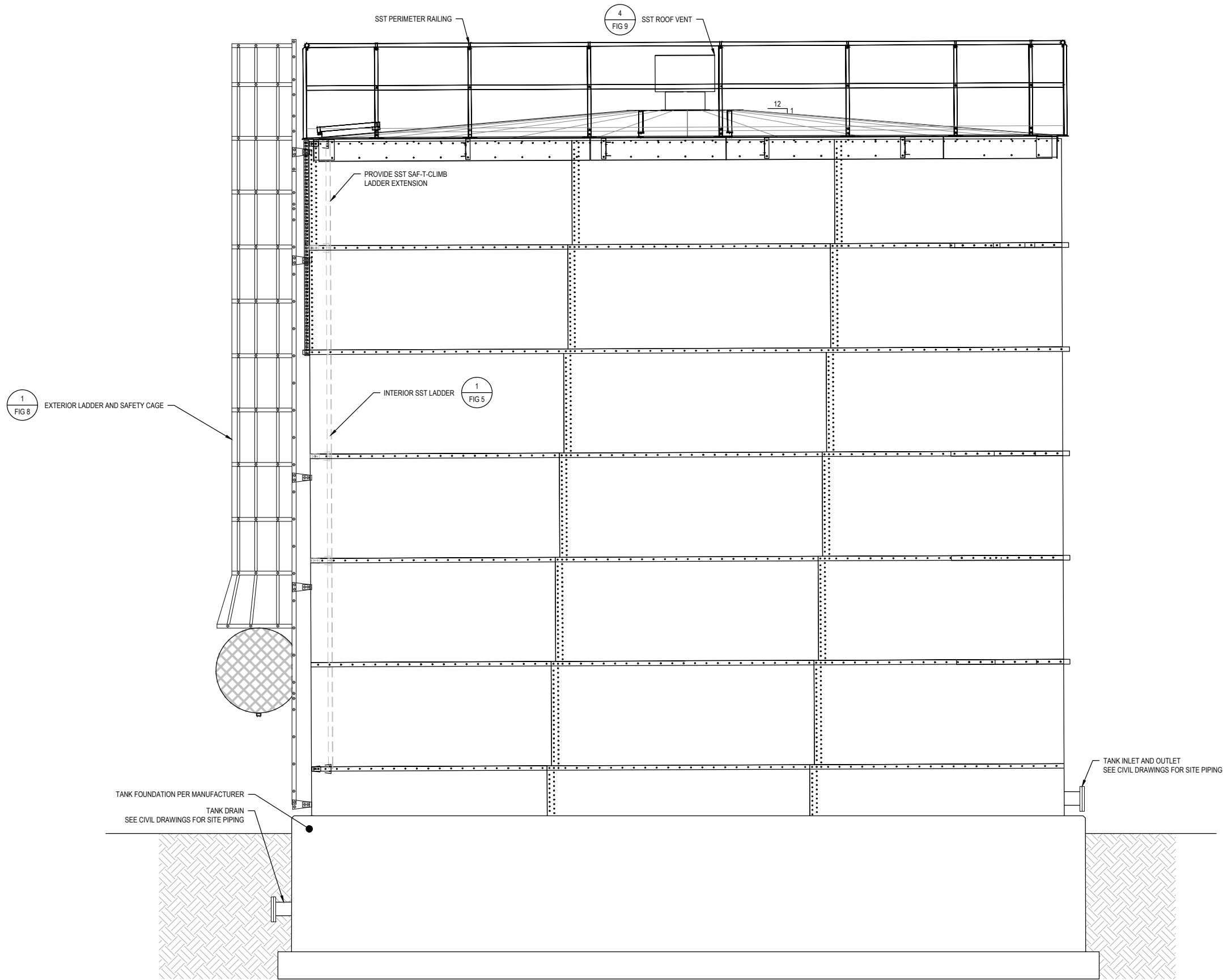


RECYCLED WATER TANK ROOF PLAN

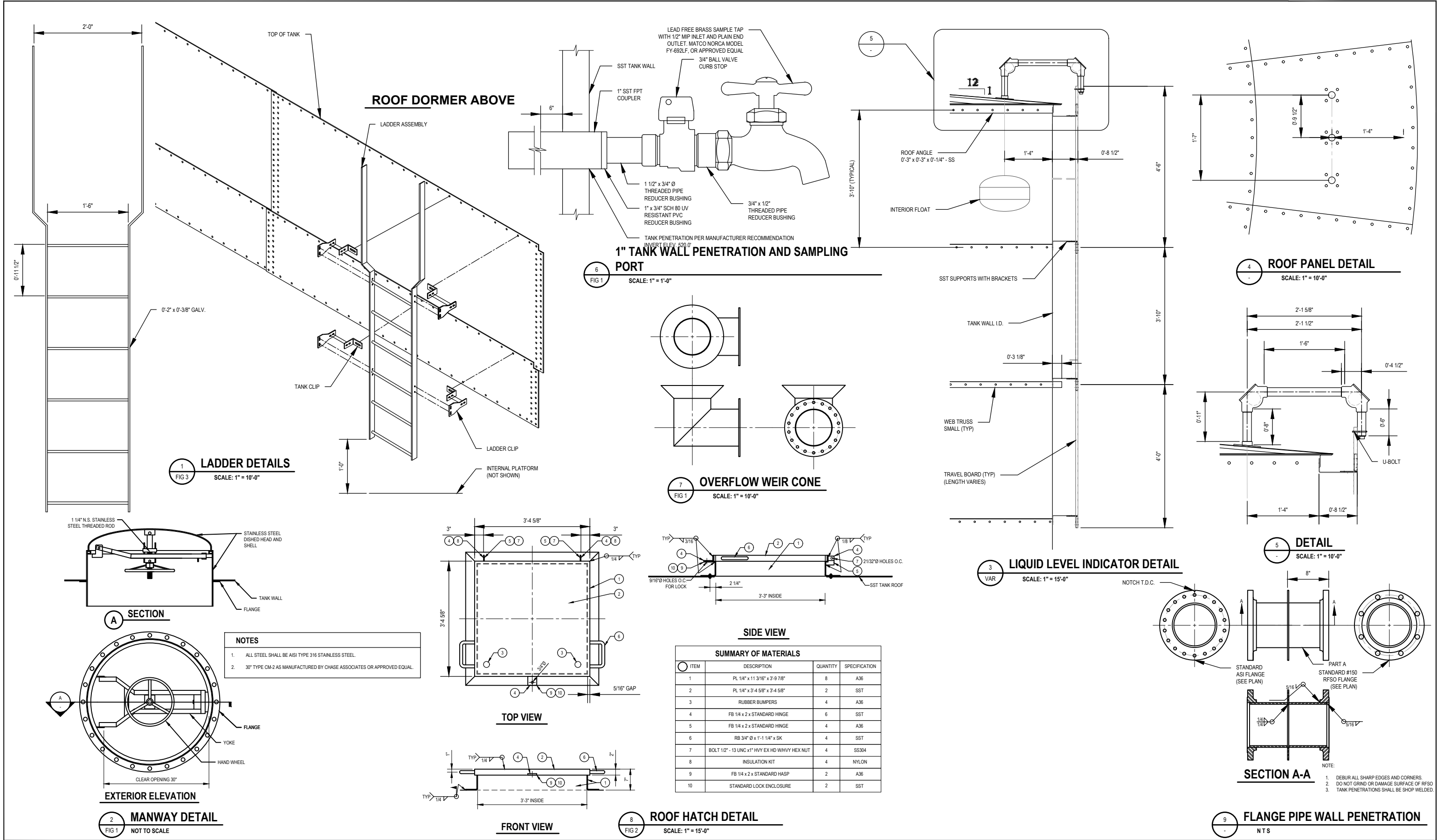
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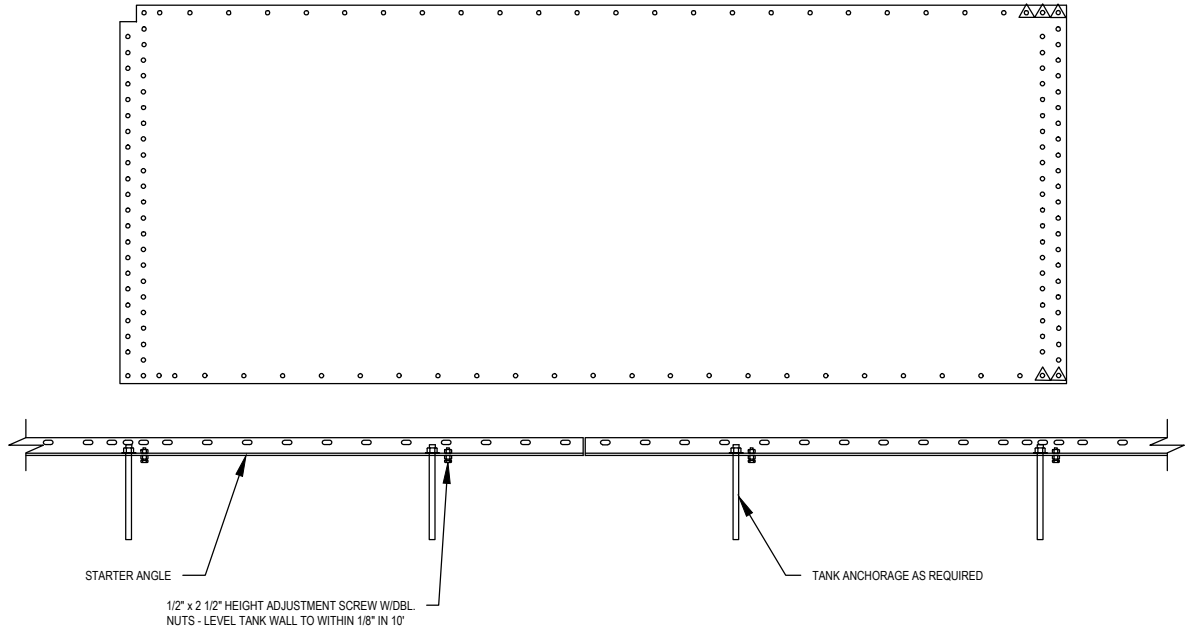


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							Drafting Check M. KENNEDY	Design Check M. KENNEDY				
							Project Manager M. KENNEDY	Date JANUARY 2026				
No.	Issue	Drawn	Approved	Date			This document shall not be used for construction unless signed and sealed for construction.		Scale SHOWN			



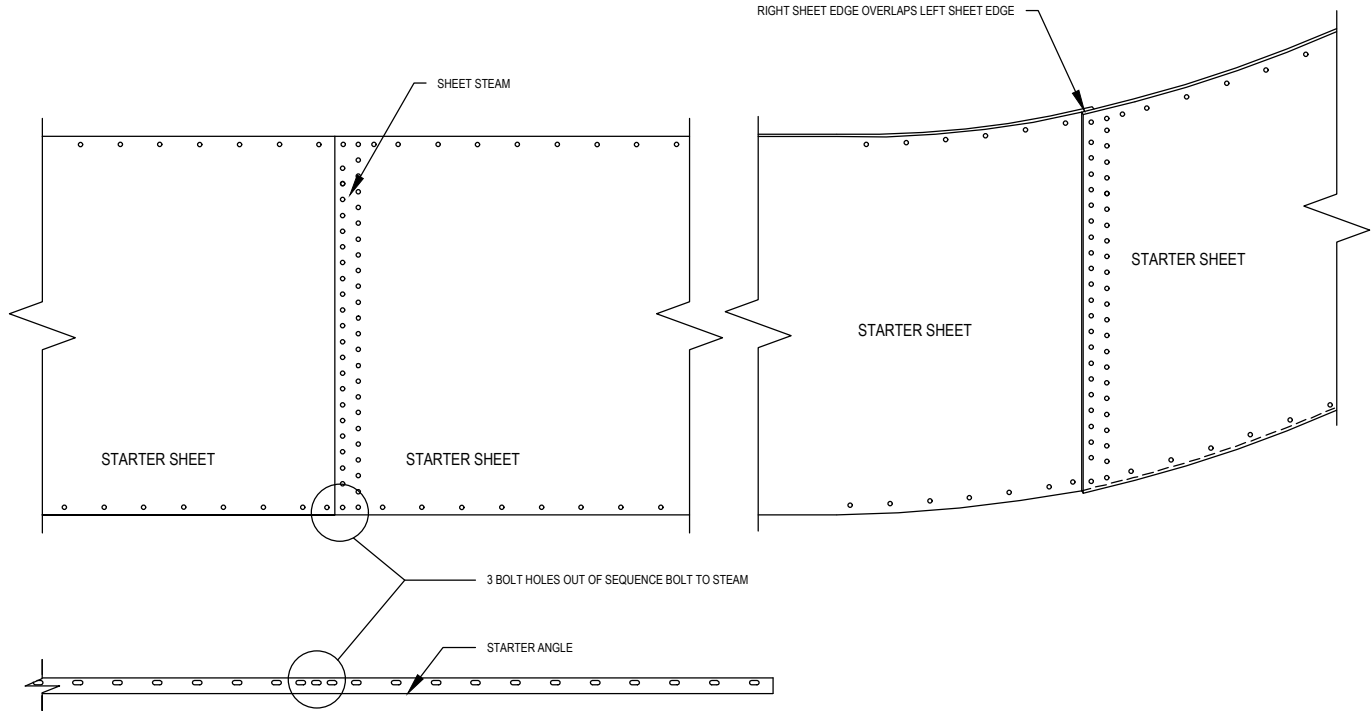
					Bar is one inch on original size sheet 01" Reuse of Documents This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD and shall not be reused in whole or in part for any other project without GHD's written authorization. © 2025 GHD	GHD Inc. 2235 Mercury Way Suite 150 Santa Rosa California 95407 USA T 1 707 523 1010 F 1 707 527 8679 W www.ghd.com	DrawnC. BACH	DesignerM. KENNEDY	ClientMENDOCINO CITY COMMUNITY SERVICES DISTRICT	ProjectRECYCLED WATER DISTRIBUTION AND STORAGE IMPROVEMENTS	TitleRECYCLED WATER TANK ELEVATION VIEW	Project No.12619547	Original SizeANSI D	Figure No.FIGURE 3	Figure3 of 9	
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							Project ManagerM. KENNEDY	DateJANUARY 2026								
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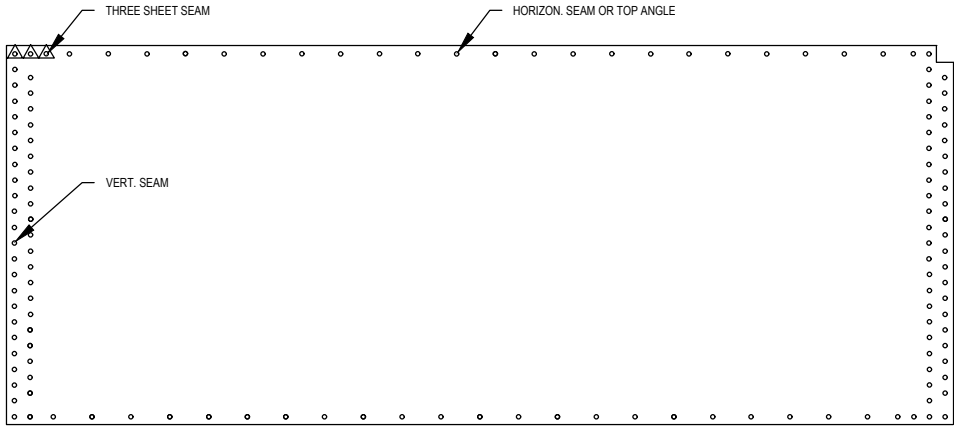
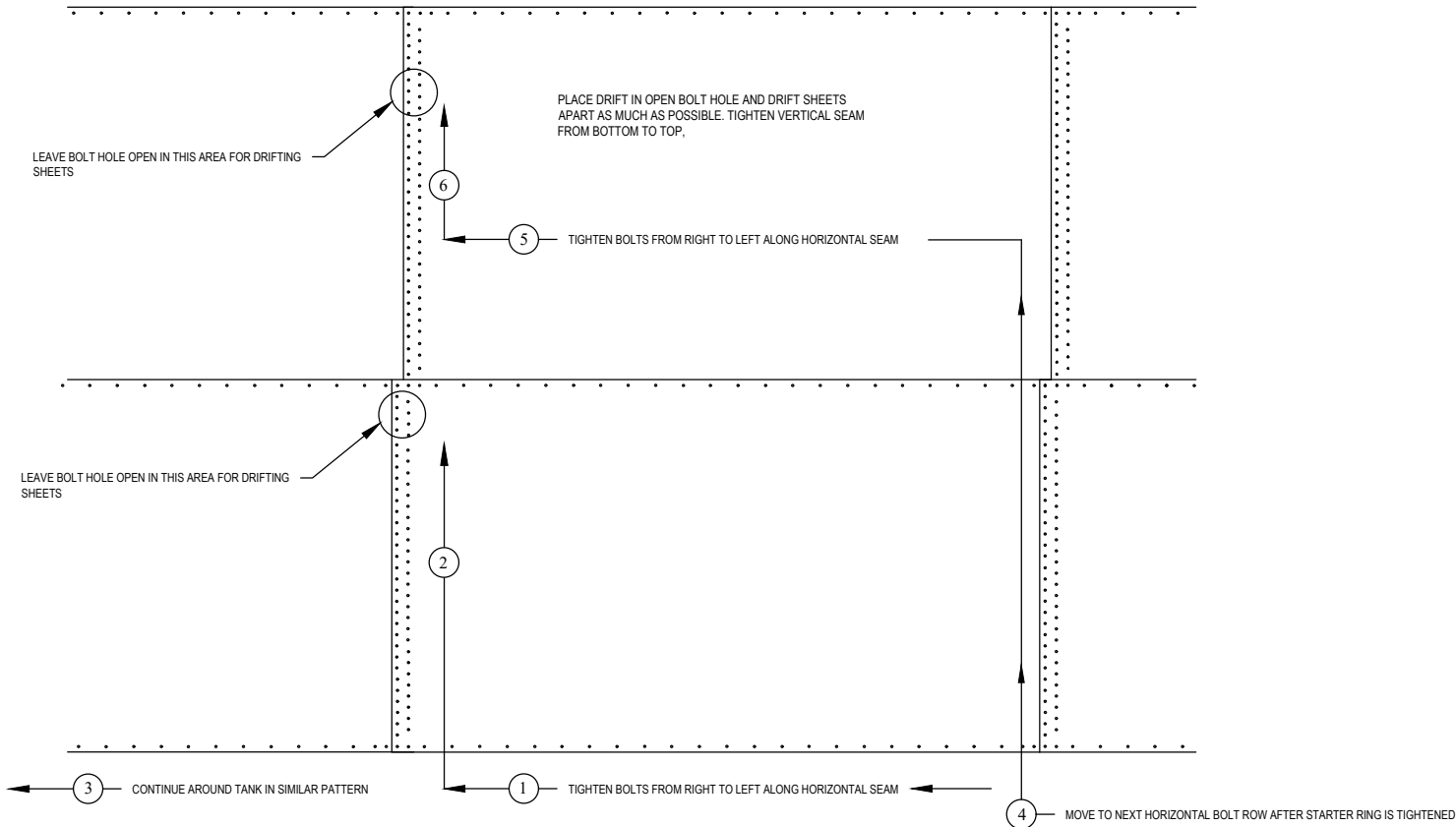
STARTER SHEET AS VIEWED FROM FROM THE INSIDE OF THE TANK FACING CENTER

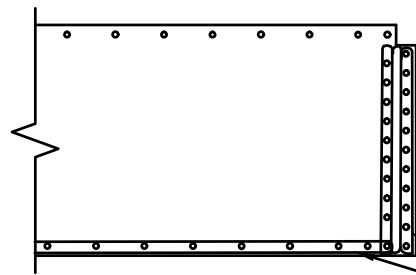
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STARTER SHEET AS VIEWED FROM THE OUTSIDE OF THE TANK

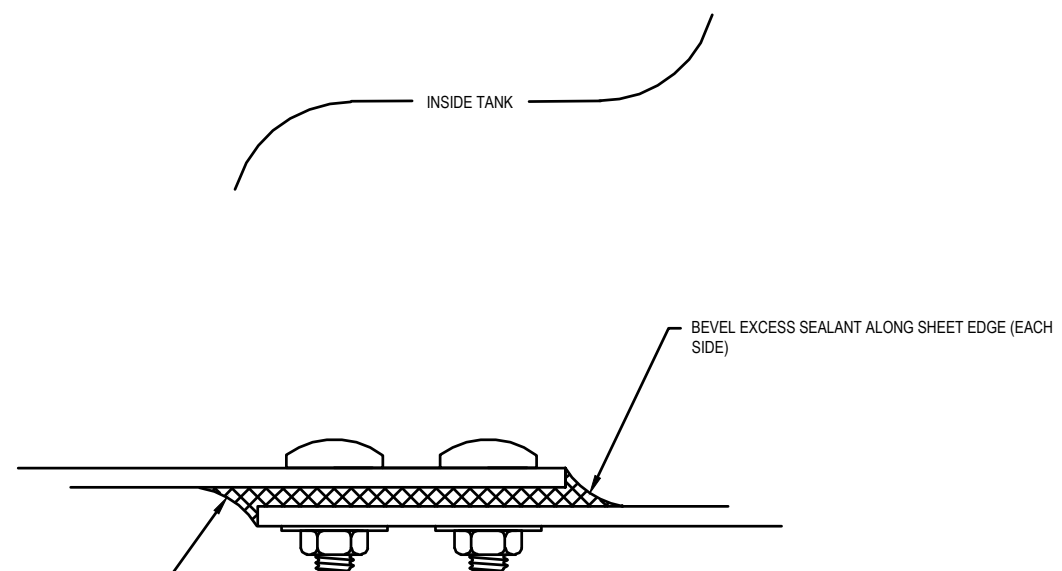
LAP RIGHT OVER LEFT
NOT TO SCALE





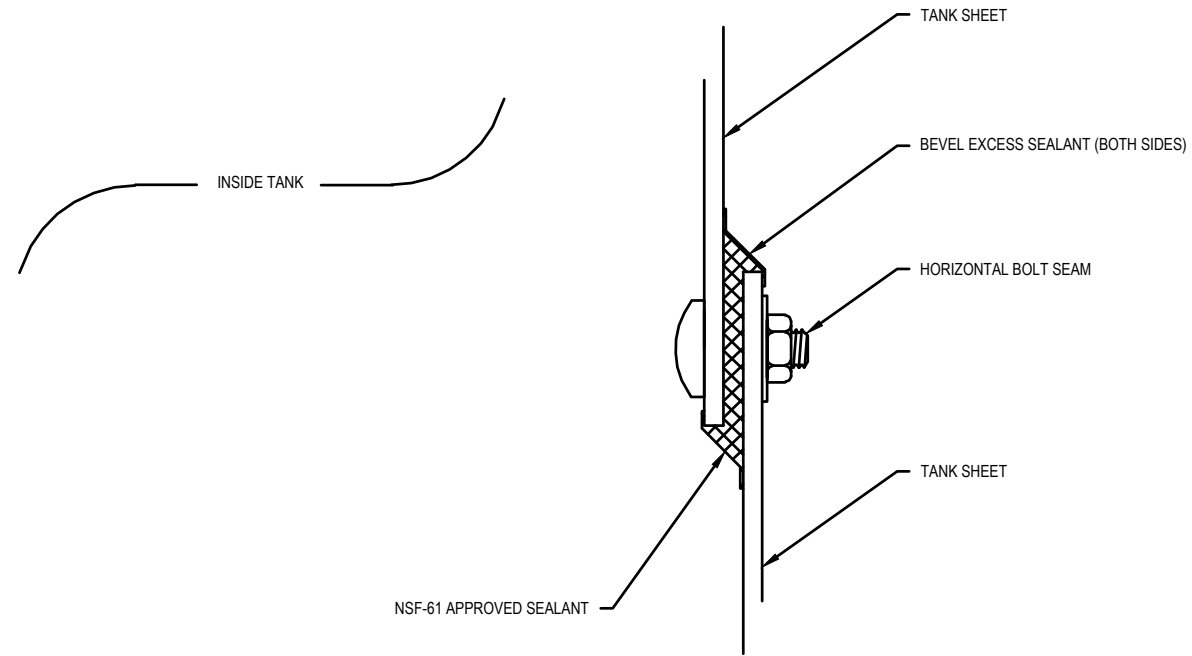
SIDEWALL SHEET
NOT TO SCALE

GENEROUS BEAD OF NSF-61 APPROVED SEALANT ON EACH SIDE OF HOLE (TYP) HOLES SHOULD BE COVERES BY SEALANT. MAKE SURE CORNERS AND EDGES ARE COMPLETELY COVERED WITH SEALANT.



NSF-61 APPROVED SEALANT

VERTICAL SEAM
NOT TO SCALE

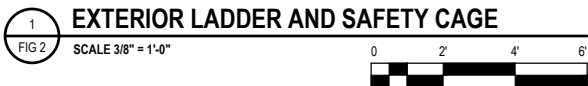


NSF-61 APPROVED SEALANT

HORIZONTAL SEAM
NOT TO SCALE

SEALANT APPLICATION LOCATIONS
NOT TO SCALE

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KEYNOTE	PART DESCRIPTION
1	LADDER ASSEMBLY (SST)
2	4' WALK-THRU LADDER (SST)
3	WALK-THRU ANGLE (SST)
4	WALK-THRU CONNECTOR PLATE - GALV.
5	LADDER BRACKET (SST)
6	TANK BRACKET (SST)
7	SAFETY CAGE (SST)
8	SAFETY CAGE BOTTOM RING (SST)
9	LADDER LOCKOUT (SST)
10	LADDER LOCKOUT HINGE PLATE (SST)
11	LADDER LOCKOUT LATCH PLATE (SST)

NOTE

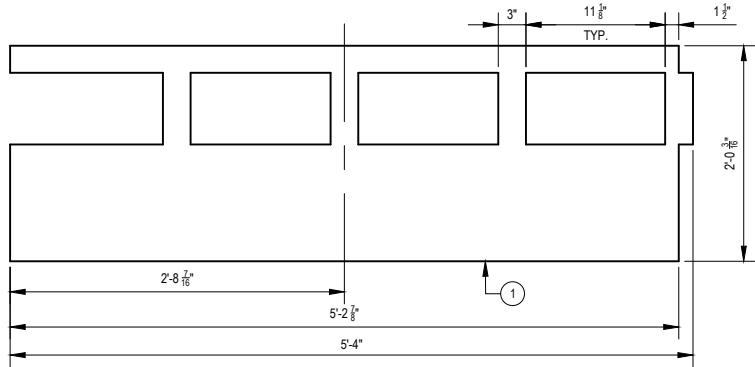
- ASSEMBLY SAFETY CAGE WITH SST NUTS, BOLTS AND WASHERS.

GENERAL NOTES

1. ALL EXTERIOR ABOVE GRADE PIPE SHALL BE TYPE 316 SST.

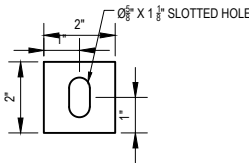
BILL OF MATERIALS		
ITEM#	QTY.	DESCRIPTION
1	1	11GA x 1'-0" $\frac{3}{8}$ " x 5'-2" $\frac{1}{2}$ " LG x PATTERN (NOTE 1)
2	2	WORM DRIVE BAND, $\frac{1}{2}$ " WIDE x 5'-5" LG
3	1	WOVEN WIRE MESH, 16 x 16 x 0.018" WIRE x 10" $\frac{1}{2}$ " WIDE x 5'-5" LG (NOTE 2)
4	1	WELDED WIRE MESH, 2 x 2 x 0.120" WIRE x 10" $\frac{1}{2}$ " WIDE x 5'-5" LG (NOTE 2)
5	1	DISHED HEAD, Ø 2'-8" AS SHOWN
6	8	BOLT, Ø $\frac{1}{2}$ " x 1'-12" HEX W/ NUT
7	4	11GA x 2" SQ. xPATTERN
8	1	11GA x Ø 2'-2" O.D. x 1'-8" I.D.

- NOTES:
1. ROLL NECK TO 1'-6" INSIDE DIAMETER.
2. ITEM #4 TO BE INSTALLED OVER ITEM #3.
3. VERIFY ALL DIMENSIONS PRIOR TO FABRICATION.



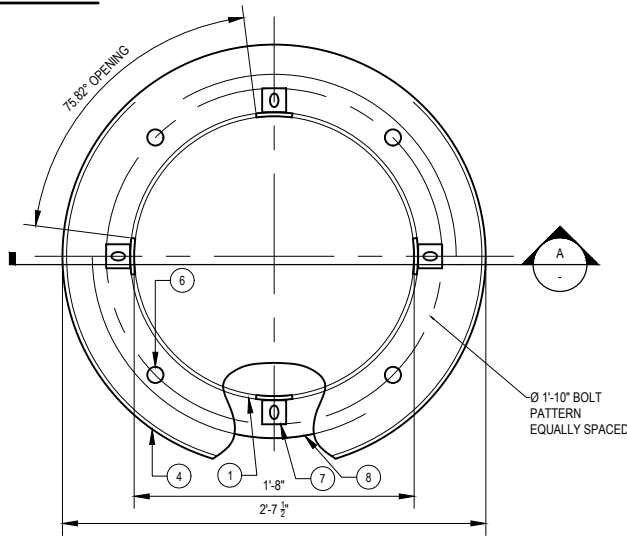
NECK LAYOUT

SCALE: NTS



ITEM #7 - DETAIL

SCALE: NTS

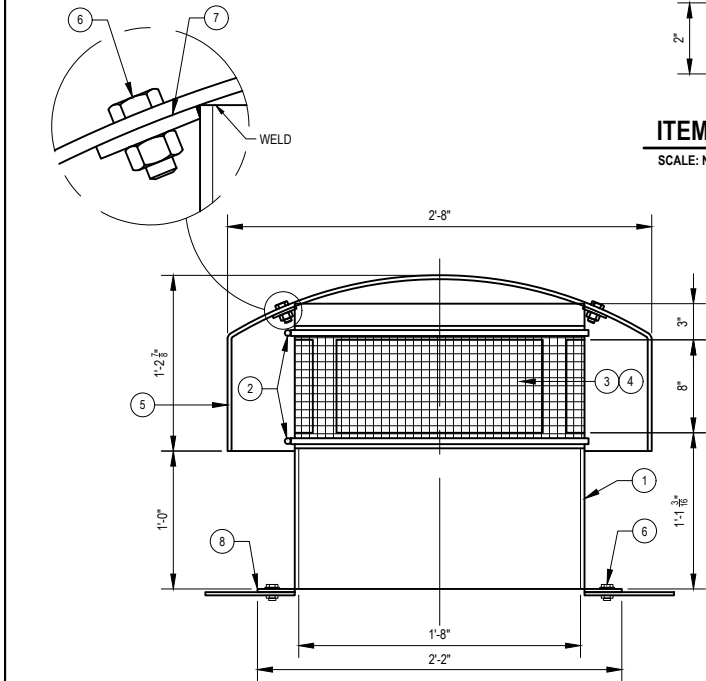


ROOF VENT DETAILS

SCALE: NTS

SECTION

SCALE: NTS



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SECTION 33 31 00

SANITARY UTILITY SEWERAGE SYSTEMS

PART 1 GENERAL

1.1. SUMMARY

- A. Section Includes:
 - 1. PVC sanitary sewage pipe.
 - 2. Sanitary sewer manholes.
 - 3. Sanitary sewer system materials and appurtenances.
- B. Related Sections:
 - 1. Section 31 00 00 – Earthwork.
 - 2. Section 31 01 40 – Shoring and Trench Safety.
 - 3. Section 31 23 00 – Trench Excavation and Backfill.
 - 4. Section 31 23 19 – Dewatering.

1.2. REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and a 18-in. Drop.
- B. ASTM International:
 - 1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
 - 2. ASTM C1244-20 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
 - 3. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - 4. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
 - 5. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
 - 6. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Laterals.
 - 7. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³).
 - 8. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³).
 - 9. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 10. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - 11. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
 - 12. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 13. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

14. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
15. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. Others specified

1.3. DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.4. DESIGN REQUIREMENTS

- A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.
- B. Design of Lifting Devices for Precast Components: In accordance with ASTM C913.
- C. Design of Joints for Precast Components: In accordance with ASTM C913; maximum leakage of 0.025 gallons per hour per foot of joint at 3 feet of head.

1.5. SUBMITTALS

- A. Section 01 33 00 - Submittals: Requirements for submittals.
- B. Submit all product data, shop drawings, laboratory test results, leakage testing details including testing equipment, material source information, and certificates of compliance listed in this Section under a single submittal cover for review. Incomplete submittals will not be reviewed.
- C. Product Data: Submit cover and frame construction, features, configuration, and dimensions.
- D. Materials List
1. In accordance with the provisions of Section 01 33 00 "Submittals" of the Specifications, submit with the shop drawings a complete list of all materials and equipment proposed to be furnished and installed under this portion of the work, giving manufacturer's name, catalog number, and catalog cuts for each item where applicable.
 2. The Contractor shall use a single manufacturer for each of the following types of items unless otherwise approved by the Engineer.
 - Pipe
 - Fittings
 - Laterals
- E. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- F. Testing Certifications:
1. Leakage Testing

- G. Bypass pumping and/or diversion system plan. This shall include temporary documentation of pump and discharge line capacities, manufacturer, and age. Bypass pumping plan shall also include shop drawings that identify pumping locations and methods with sufficient detail to assure that the work can be accomplished without sewage spills. The plans shall include an emergency discharge response plan to be followed in the event of a failure of the bypass pumping system.

1.6. DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast manholes and structures.
- C. Store precast concrete manholes and structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.
- D. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.

1.7. CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Project Closeout: Requirements for submittals.
- B. Project Record Documents: Record location of pipe alignments, profiles, lateral connections, manholes, invert elevations and existing utilities.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8. QUALITY ASSURANCE

- A. Perform Work in accordance with specified standards.

1.9. FIELD MEASUREMENTS

- A. Verify field measurements and elevations are as indicated.

1.10. COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

PART 2 PRODUCTS

2.1. SANITARY SEWAGE PIPE

- A. Color: Green
- B. Gravity PVC Laterals and Mains (size 4-inch and larger): ASTM D3034 and ASTM F-679, Poly (Vinyl Chloride) (PVC) material; inside nominal diameter as specified on the Drawings, bell and spigot style rubber ring sealed gasket joint.

1. Fittings: SDR 26 gasketed type. Flexible transition couplers shall have stainless steel shear bands. Lateral bends from cleanout to main shall be gasket x spigot long radius bends
2. Joints: ASTM F477 & ASTM D-3139, elastomeric gaskets.
3. Diameter ratio: SDR 26
4. Size: Per plans. All laterals shall be either 4" or 6" as indicated on Plans or identified during trenching.

C. Risers

1. (Size 4" and 6") shall be SDR 35 or 26

2.2. RESTRAINED AND MECHANICAL JOINTS

A. Manufacturer:

1. For PVC Pipe:
 - a. Mechanical Joint Fittings: EBAA Iron, Inc., Series 2000PV or equivalent.
2. Substitutions: Section 01 60 00 - Product Requirements.

B. Materials: ASTM D-2241.

C. Joints: Gasketed, meeting ASTM D-3139 and ASTM F-477

2.3. COUPLINGS

A. Manufacturers

1. APAC - 300 Series
2. Dresser - Style 253
3. Ford - Ultra-Flex
4. Romac - 501 Series
5. Smith-Blair -Quantum Series
6. Substitutions: Section 01 60 00 - Product Requirements.

B. System compatible with connecting pipe; verify connecting pipe O.D.

2.4. FLEXIBLE PIPE TO MANHOLE CONNECTOR

A. Rubber Conforms to ASTM C923 or D5926.

B. Install in accordance with manufacturer's instructions.

C. Manufacturers

1. Kor-N-Seal® I.
2. Fernco Concrete Manhole Adapters.
3. Substitutions: Section 01 60 00 - Product Requirements.

2.5. LATERAL FITTINGS

- A. Assembly Components:
 - 1. PVC Hub: Heavy-duty PVC per ASTM D3034 specifications.
 - 2. Rubber Sleeve: Meets ASTM F477.
 - 3. Stainless Steel Band: Minimum 301 SST with 305 SST screws.
- B. Size: Match existing lateral size.
- C. Performance: Watertight joint per ASTM D3212.
- D. Manufacturer:
 - 1. Inserta Fittings Co., Inserta Tee® or approved equivalent.

2.6. MANHOLES

- A. Manholes: Reinforced precast concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923.
- B. Joint Seal:
 - 1. RAM-NEK or approved equal will be allowed for joint sealing.
- C. Pipe to Manhole Connectors:
 - 1. Flexible couplings shall be as manufactured by Mission Rubber Company or equal.

2.7. FRAMES AND COVERS

- A. Manufacturers:
 - 1. D&L Supply A-1024
 - 2. South Bay Foundry SBF 1900 CPH
 - 3. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description:
 - 1. Casting shall be first-class grey iron, tough, and of even grain, and shall be dipped after they have been thoroughly cleaned in asphalt that has been heated to not less than 200 degrees F.
 - 2. Ring and cover shall be Phoenix Iron Works P-1090 or approved equal with closed pick hole.
 - a. All material used in manufacturing shall conform to A.S.T.M A-48 Class 35 B or of United States Government Specifications QQ1-652b.

2.8. CONFIGURATION

- A. Shaft Construction: Concentric cone top section; lipped male/female joints; sleeved to receive pipe sections.
- B. Shape: Cylindrical.
- C. Clear Inside Dimensions: 48 inch diameter.
- D. Design Depth: As indicated on Drawings.
- E. Clear Cover Opening: As indicated on Drawings.
- F. Pipe Entry: Furnish openings as indicated on Drawings.

2.9. BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Section 31 00 00.

PART 3 EXECUTION

3.1. EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify items provided by other sections of Work are properly sized and located.
- C. Verify built-in items are in proper location, and ready for roughing into Work.
- D. Verify correct size of manhole and structure excavation.
- E. Verify trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

3.2. PREPARATION

- A. Correct over excavation with fine aggregate.
- B. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.
- C. Prior to the installation of each new individual sewer wye on the main, the Contractor shall determine the exact location of the existing sewer lateral at the back of sidewalk or PUE. Two acceptable methods of locating a sewer lateral at the back of sidewalk are.
 - 1. Removing sidewalk and/or potholing by hand digging at the back of sidewalk to locate the existing lateral pipe a minimum of 24 hours prior to sewer main installation in that area.
 - 2. Inserting a metallic electricians "fish tape" into the existing lateral pipe after the pipe is exposed during sewer main excavation and tracing the "fish tape" to the back of sidewalk using a pipe and cable metal locator. If this method does not locate the existing sewer lateral, method "1" shall be used.

- D. All existing pipe impeding the construction of new laterals shall be removed within the trench limits and prepared for reconnection.
- E. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.
- F. Do not install structures where site conditions induce loads exceeding structural capacity of structures.
- G. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

3.3. BEDDING

- A. Excavate pipe trench in accordance with Section 31 23 00.
- B. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches.
- C. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4. INSTALLATION - PIPE

- A. Install pipe, fittings, and accessories in accordance with City of Sebastopol Standard Details and City of Santa Rosa Sewer Construction Specifications (Section 130). Seal joints watertight.
- B. Lay pipe to slope gradients noted on drawings to meet join existing property side laterals; with maximum variation from indicated slope of 1/8 inch in 10 feet. Pipe shall be installed at continuous slope as shown on drawings.
- C. Excavate bell holes to permit proper joint installation.
- D. Install pipe to have bearing along entire length of pipe.
- E. Install bedding at sides and over top of pipe to minimum compacted thickness of 6 inches.
- F. Cover is the distance from the top of the pipe to the final finished grade measured directly over the pipe.
- G. Minimum cover for all sewer mains and laterals shall be 36". The Engineer may approve shallower installations but in no case shall cover be less than 24".
- H. Where cover is less than 36", special construction techniques must be approved such as the use of ductile iron pipe, a concrete cap over the trench, or the use of control density backfill.
- I. Refer to Section 31 23 00 for backfilling and compacting requirements. Do not displace or damage pipe when compacting.
- J. Install all sewer laterals perpendicular to the curb unless otherwise shown per plan.
 - 1. Any lateral not installed perpendicular to the curb shall installer tracer wire (material & type per Section 33 11 00) in the following manner, unless otherwise shown on drawings and details:
 - a. Wrap wire two times around wye connection at main and secure.

- b. Lay both ends on top of and along the lateral to the cleanout and up the cleanout riser. Both ends of the wire shall extend approximately 6 inches beyond riser.
 - c. Secure wire to top of lateral pipe at approximately 5 foot intervals. Ends of wire must be easily accessible inside the cleanout box.
- K. Install plastic ribbon tape continuous over top of pipe buried 12 inches below finish grade, above pipe line; coordinate with Section 31 23 00.

3.5. INSTALLATION - LATERAL FITTINGS

- A. Core mainline pipe using manufacturer-approved hole saw.
- B. Compression-fit Inserta Tee® into cored wall; no glues, grout, or epoxies.
- C. Backfill around fitting with same material and compaction as mainline pipe.
- D. Field verification per ASTM F2487 or local standards.
- E. Use only manufacturer-approved tools and methods to maintain warranty.

3.6. MANHOLE INSTALLATION

- A. Excavation and Backfill:
 - 1. Excavate for manholes and structures in accordance with Section 31 23 00 in location and to depth shown. Provide clearance around sidewalls of structure for construction operations.
 - 2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes and structures in dry trench.
 - 3. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation.
- B. Place manhole base.
- C. Place manhole and structure sections plumb and level, trim to correct elevations, anchor to base.
- D. Backfill excavations for manholes and structures in accordance with Section 31 23 00.
- E. Form and place manhole and structures cylinder plumb and level, to correct dimensions and elevations.
- F. Cut and fit for pipe.
- G. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour to form continuous drainage channel.
 - 1. The invert shall be shaped to provide an adequate channel between the inlet and outlet pipes. The channel and shelf shall be steel troweled to a smooth dense surface. Adequate care must be taken to prevent displacement of the sewer pipe from line or grade during construction of the base.

2. The Contractor shall have the option of laying pipe through the manhole, shaping the upper half of the channel and the shelf, and later breaking out the pipe above the spring line, in which case they will be required to patch and smooth up with mortar the broken edges of pipe, or they may stop the pipe at the inside face of the manhole and construct the channel to the shape and size of the pipe. The invert shall follow a straight line between the inlet and outlet pipe, or a smooth curve on an even grade, if changing direction.

- H. Set cover frames and covers level without tipping, to correct elevations.

3.7. PRECAST CONCRETE MANHOLE INSTALLATION

- A. Lift precast components at lifting points designated by manufacturer.
- B. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.
- C. Set precast structures bearing firmly and fully on crushed stone bedding, compacted in accordance with provisions of Section 31 23 00 or on other support system shown on Drawings.
- D. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.
- E. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.
- F. Joint sealing materials may be installed on site or at manufacturer's plant. Joints shall be filled with mortar consisting of one (1) part cement to three (3) parts sand by volume before placing each section, and after the shaft is in place the joints inside and outside shall be neatly stuck and outside joints shall be banded to insure waterproofing the completed structure.
- G. Verify manholes and structures installed satisfy required alignment and grade.
- H. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Fill annular space with mortar.
- I. Cut pipe to finish flush with interior of structure.
- J. Shape inverts through manhole and structures as shown on Drawings.

3.8. FRAME AND COVER INSTALLATION

- A. Set frames using mortar and masonry.
- B. Set frame and cover 2 inches above finished grade for manholes with covers located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.
- C. Casting shall be first-class grey iron, tough, and of even grain, and shall be dipped after they have been thoroughly cleaned in asphalt that has been heated to not less than 200 degrees F. After castings have seasoned sufficiently so that there will be no further distortion due to temperature changes, the cover and ring seat shall be machined so that the tops are flush

and the entire area of the seat is in contact with the cover in any position of the cover on the seat.

3.9. TESTING OF SEWERS

- A. Test for leakage shall be performed for all portions of the sewer, including manholes, is required.
 1. All testing required shall conform with the City of Santa Rosa Sewer Construction Specification 130-1.08
- B. All new or rehabilitated sanitary sewer manholes shall be tested unless otherwise directed by the Engineer. If the manhole fails the test, the manhole shall be repaired and retested at the contractor's expense. If manhole joint sealants are compromised during the vacuum test, the manhole must be disassembled and the joint sealants replaced. If there is reason to believe that the manhole has been disturbed after the initial vacuum test, additional tests may be requested by the Engineer and performed at the Contractor's expense.
 1. Leakage Testing:
 - a. Water Test: Manholes, after inlets and outlets have been plugged, shall be filled with water to the rim of the frame casting and shall lose no more than 2 inches over a period of 30 minutes.
 - b. Vacuum Testing shall be performed in accordance with ASTM C 1244-20. Vacuum testing shall not take place until all permanent paving is complete.
 - 1) All lift holes and joints shall be grouted and the entire manhole, including grade rings, sealed prior to testing.
 - 2) All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole.
 - 3) The test head shall be placed in accordance with the manufacturer's recommendations. The test unit shall be braced against the manhole frame and not the grade ring(s) or taper.
 - 4) Vacuum test gauge and test equipment used for this test shall be supplied by the Contractor and shall be operated per manufacturer's specifications by qualified personnel. Accuracy and calibration of the gauge shall be certified by a reliable testing firm at 6 month intervals, or when requested by the Engineer.
 - 5) A vacuum of 10 inches HG (4.91 PSI) of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time it takes the indicator gauge to drop from 10 inches HG (4.91) to 9 inches Hg (4.4 PSI) shall be measured. The manhole will pass the vacuum test if the time is greater than shown in the following table:

Minimum Test Time Based On Manhole Diameter (sec.)

Manhole Depth in Feet	Manhole Diameter in Inches			Time in Seconds
	48	60	72	
0-4	10	13	16	
4-8	20	26	33	
8-12	30	39	49	
12-16	40	52	67	
16-20	50	65	81	
20-24	59	78	97	
24-30	74	98	121	

- 6) After the vacuum test, manholes shall be visually inspected for leaks and defects and repaired as required by the engineer

c. Exfiltration or Infiltration testing

2. Installation of vacuum equipment and indicating devices must be in accordance with the manufacturer's recommendations and performance specifications, which must be provided by the manufacturer and approved by the Engineer. The equipment must be capable of testing the entire manhole, including cast iron frame and grade adjustment rings.

3.10. BYPASS PUMPING AND/OR DIVERSION SYSTEM

- A. Bypass pumping shall be performed per the City of Santa Rosa Sewer Specification 130-1.10
- B. Contractor shall allow up to 10 working days for response from the City and Engineer for any request regarding sewer flows.

3.11. FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Compaction Requirements: In accordance with Section 31 23 00.
- C. Test concrete manhole and structure sections in accordance with ASTM C-1244-20.
- D. Each manhole shall be tested for leakage by plugging the sewer line between the manhole and the first joint. The manhole shall be filled with water to the rim of the frame casting and shall lose no more than 2 inches over a period of 30 minutes. In lieu of water testing, testing of sewer manholes may be done by vacuum testing per the City of Santa Rosa Sanitary Sewer Standard Specifications (Section 130) and ASTM C 1244-20.
- E. When tests indicate Work does not meet specified requirements, remove work, replace and retest.

3.12. PROTECTION OF FINISHED WORK

- A. Section 01 70 00 -Project Closeout: Requirements for protecting finished Work.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

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SECTION 33 47 13

POND AND RESERVOIR LINERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Impermeable geomembrane liners for ponds and reservoirs
 - a. Nonwoven geotextile fabric
 - b. High-density polyethylene (HDPE) liners
- B. Related Sections:
- C. Section 01 33 00: Submittal Procedures
Section 01 40 00: Quality Requirements
Section 01 70 00: Project Closeout
Section 31 00 00: Earthwork
Section 31 23 00: Trench Excavation and Backfill

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Liners:
 - 1. Basis of Measurement: Lump sum.
 - 2. Basis of Payment: Includes sub-grade preparation, liner accessories, tests, and trench backfill.

1.3 REFERENCES

- A. ASTM International:
 - ASTM D4437: Standard Practice for Nondestructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes
 - ASTM D5641: Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber
 - ASTM D5820: Standard Practice for Pressurized Air Channel Evaluation of Dual-Seamed Geomembranes
 - ASTM D6365: Standard Practice for Nondestructive Testing of Geomembrane Seams Using the Spark Test
 - ASTM D6497: Standard Guide for Mechanical Attachment of Geomembrane to Penetrations or Structures
 - ASTM D7002: Standard Practice for Electrical Leak Location on Exposed Geomembranes Using the Water Puddle System
- B. Geosynthetic Research Institute (GRI):
 - GRI GM6: Pressurized Air Channel Test for Dual Seamed Geomembranes
 - GRI GM13: Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
 - GRI GM14: Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes
 - GRI GM19a: Seam Strength and Related Properties of Thermally Bonded Homogeneous Polyolefin Geomembranes/Barriers
 - GRI GT12(a): Test Methods and Properties for Nonwoven Geotextiles Used as Protection (or Cushioning) Materials

1.4 SUBMITTALS

- A. Section 01 33 00–Submittals and Substitution Procedures
- B. Submit the following to the Engineer, for review and approval, prior to shipment or installation of the liner:
 - 1. Documentation of manufacturer's qualifications
 - 2. Manufacturer's quality control program manual or descriptive documentation
 - 3. Manufacturer's installation instructions: Submit special procedures for geotextile and liner installation, including methods for liner seaming and attachment of geomembrane liner to pipe boots at pipe penetrations.
 - 4. A material properties sheet, including at a minimum all properties specified in GRI GM13 or GRI GT12(a), including test methods used.
 - 5. Manufacturer's Certificates: certifying that products meet or exceed specified requirements
 - 6. Two (2) samples of liner material, 12-inch x 12-inch in size
 - 7. Two (2) samples of geotextile material, 12-inch x 12-inch in size
 - 8. Documentation of installer's qualifications, as specified herein
 - a. A list of at least 10 completed facilities, including 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 for each installation
 - b. Resumes or qualifications of the Installation Supervisor, Master Seamer Technicians to be assigned to this project.
 - c. Quality control program
 - 9. Example material warranty and liner installation warranty
 - 10. Resin supplier's name, resin production plant identification, resin brand name and number, production date of the resin, resin manufacturer's quality control certificates, and certification that the properties of the resin meet the requirements for the project.
- C. Shop Drawings: Show joining details and special details.
 - 1. Submit copies of shop drawings for Engineer's approval. Shop drawings shall show the proposed panel layout identifying locations of all seams and details, including pipe penetrations. 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 Engineer. Butt seams on a slope, if allowed, should be staggered.
 - 2. Anchor trench details and calculations.
 - 3. Placement of geomembrane will not be allowed to proceed until Engineer 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. Prequalification test seam samples
 - 5. Field seam nondestructive test results
 - 6. Field seam destructive test results
 - 7. Daily field installation reports
- E. Contractor shall submit a leak location survey work plan to the Engineer for approval prior to commencement of the leak location survey. The leak location survey work plan shall include:
 - 1. Qualifications of the proposed Leak Location Contractor, including the number of years the Leak Location Contractor has performed the proposed survey method
 - 2. Resumes of proposed onsite supervisors
 - 3. Description of the proposed survey method, and procedures
 - 4. Required site preparations

5. Estimated duration of survey
6. Quality control and field calibration procedures
7. A list of projects demonstrating the qualifications and experience where the proposed Leak Location Contractor and leak location supervisor
8. Sample of a final report (per ASTM D7002) provided by the Leak Location Contractor following the completion of the survey

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00—Closeout Procedures and Submittals
- B. Project Record Documents:
 1. Accurately record actual pipe penetration locations.
 2. Submit installation record drawings.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten (10) years' documented experience.
- B. Installer Qualifications:
 1. The Geomembrane Installer shall be an approved Manufacturer's Installer.
 2. The Liner Installer shall have at least five (5) years' experience in the installation of HDPE liners. The Liner Installer shall have installed at least 10 projects involving a total of 5,000,000 square feet of HDPE geomembrane or similar during the last three (3) years.
 3. Installation shall be performed under the direction of a field Installation Supervisor who shall be responsible throughout the liner installation, for liner 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 square feet 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 square feet 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. All seaming, patching, other welding operations, and testing shall be performed by qualified technicians employed by the Liner Installer.
- C. The Leak Location Contractor shall have qualifications and experience in conducting the proposed survey method, including having tested a minimum of 15,000,000 square feet of geomembrane liner within the previous three (3) years. In addition, the leak location surveys must be supervised by a professional or technician with a minimum of three (3) years and 1,000,000 square feet of liner testing experience using the proposed leak location survey method. The Leak Location Supervisor must be onsite full-time during the performance of the leak location survey.

1.7 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. Liner shall be protected from mud, dirt, dust, puncture, cutting, or any 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.
- D. Rolls shall not be stacked more than three (3) high.
- E. Transport and handle liner with equipment designed to protect liner from damage.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.
- B. 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 following limits temperature limits:
 - 1. No geomembrane material may be seamed at material temperatures below 32°F or above 170°F.

1.9 GEOMEMBRANE PRE-CONSTRUCTION MEETING

- A. Geomembrane Pre-Construction Meeting shall be held at the site prior to installation of the geomembrane. At a minimum, the meeting shall be attended by the Liner Installer, Engineer or Engineer's representative, and the Earthwork Contractor.
- B. Topics for this meeting shall include:
 - 1. Responsibilities of each party
 - 2. Lines of authority and communication
 - 3. Resolution of any project document ambiguity
 - 4. Methods for documenting, reporting and distributing documents and reports
 - 5. Procedures for packaging and storing archive samples
 - 6. Review of time schedule for all installation and testingReview of panel layout and numbering systems for panels and seams including details for marking on geomembrane
 - 7. Procedures and responsibilities for preparation and submission of as-built panel and seam drawings
 - 8. Temperature and weather limitations—installation procedures for adverse weather conditions; defining acceptable subgrade, geomembrane, or ambient moisture and temperature conditions for working during liner installation
 - 9. Subgrade conditions, dewatering responsibilities and subgrade maintenance plan
 - 10. Deployment techniques, including allowable subgrade for the geomembrane
 - 11. Plan for controlling expansion/contraction and wrinkling of the geomembrane
 - 12. Covering of the geomembrane and cover soil placement
 - 13. Measurement and payment schedules
 - 14. Health and safety
- C. The meeting shall be documented by a person designated at the beginning of the meeting and minutes shall be transmitted to all parties.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 WARRANTY

- A. Section 01 70 00—Closeout Procedures and Submittals.

- B. Furnish 20-year manufacturer's material warranty for repair or replacement of liners that fail due to defects in materials or that deteriorate under conditions of normal weather. Warranty does not include deterioration or failure of liner due to exposure to harmful chemicals, gases or vapors, abnormal and severe weather phenomena, fire, earthquakes, floods, vandalism, or abuse by persons, animals, or equipment.
- C. The Geomembrane Installer shall guarantee the geomembrane installation against defects in the installation and workmanship for one (1) year, commencing with the date of final acceptance.

PART 2 PRODUCTS

2.1 SOURCE QUALITY CONTROL

- A. Manufacturing Quality Control:
 - 1. The test methods and frequencies used by the manufacturer for quality control/quality assurance of the above geomembrane prior to delivery, shall be in accordance with GRI GM13, or approved equivalent.
 - 2. The manufacturer's geomembrane quality control certifications, including results of quality control testing of the products must be supplied to the Engineer to verify that the materials supplied for the project are in compliance with all product specifications in this section.
 - a. The certification shall be signed by a responsible party employed by the manufacturer, such as the QA/QC Manager, Production Manager, or Technical Services Manager.
 - b. Certifications shall include lot and roll numbers and corresponding shipping information.
 - 3. The manufacturer will provide certification that the geomembrane and welding rod supplied for the project have the same base resin and material properties.

2.2 NONWOVEN GEOTEXTILE UNDERLAYMENT

- A. Manufacturers:
 - 1. Agru America, Layfield, or approved equal complying with requirements specified herein.
 - 2. Substitutions: Section 01 60 00–Product Requirements.
- B. A nonwoven geotextile shall be installed as a cushioning underlayment to the equalization pond liner to protect it against puncture or tear due to rock, stones, concrete or other hard surfaces and/or objects. The nonwoven geotextile shall consist of needle-punched polypropylene fibers which form continuous or short lengths and achieve their strength by interlocking. The geotextile shall be supplied as a continuous sheet with no factory seams in rolls.
- C. The geotextile shall comply, at minimum, with the material properties in Table 1(a) of GRI GT12a Specification and have a minimum nominal weight of 12 oz/square yard.

Property ⁽¹⁾	Test Method ASTM	Unit	Mass/Unit Area (oz/yd ²)
Mass per unit area	D5261	oz/yd ²	12
Grab tensile strength	D4632	lb	300
Grab tensile elongation	D4632	%	50
Trap. Tear strength	D4533	lb	115
Puncture (CBR) strength	D6241	lb	800
UV Resistance ⁽²⁾	D7238	%	70

Notes:

- (1) Also for hot air and ultrasonic seaming methods.
- (2) Elongation measurements should be omitted for field testing.

2.3 HIGH DENSITY POLYETHYLENE (HDPE) LINER

- A. Manufacturers:
 1. Agru America, Layfield, or Poly-flex installed
 2. Approved equal complying with requirements specified herein.
 3. Substitutions: Section 01 60 00–Product Requirements.
- B. Installers:
 1. Northwest Linings & Geotextile Products, Inc.
 2. Approved equal complying with requirements specified herein.
- C. 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 Density >0.94 g/cm) 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. The geomembrane will comply with requirements as shown in Table 1(a) of GRI GM13.
- D. The geomembrane seams shall comply, at minimum, with the strength requirements shown in Table 1(a), GRI GM19a Specification. UV resistance strength after 1,600 hours shall be 90% in accordance with ASTM D 4329.

Geomembrane Nominal Thickness	60 mils
Hot Wedge Seams ⁽¹⁾	
Shear strength, lb/in.	120
Shear elongation at break ⁽²⁾ , %	50
Peel strength, lb/in.	91
Peel separation, %	25
Extrusion Fillet Seams	
Shear strength, lb/in.	120
Shear elongation at break ⁽²⁾ , %	50
Peel strength, lb/in.	78
Peel separation, %	25

Notes:

- (1) Also for hot air and ultrasonic seaming methods.
- (2) Elongation measurements should be omitted for field testing.

- E. Material: high-density polyethylene (HDPE) with material properties as specified, 60 mil nominal thickness.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work. Verify anchor trench excavation, where liner is to be secured, is in correct location and configuration.
- B. Verify subgrade and anchor trench excavation is free from angular rocks, rubble, roots, vegetation, debris, voids, protrusions, and groundwater; and other conditions affecting

performance of liner.

3.2 PREPARATION

- A. Shape slopes to even surface and to required depth and section as indicated on Drawings and according to liner manufacturer's instructions. Grading shall be checked for any high spots and lining shall not be installed until even grading profile corresponding to grading elevations on plans is achieved.
- B. Remove sharp sticks, stones, and trash from bottom and sides of excavation subgrade that may puncture liner.
- C. Prepare perimeter anchor trench, as indicated on Drawings.
- D. Surfaces to be lined shall be smooth and free of debris, roots, and angular or sharp rocks to a depth of four (4) inches. All fill shall consist of well-graded material free of organics, trash, clay balls or other harmful matter. No sharp edged stones, stones larger than one (1) inch diameter or hard objects shall be allowed within the top four (4) inches of the subgrade. The surface shall be compacted in accordance with Project Specifications, but in no event below the minimum required to provide a firm unyielding foundation sufficient to permit the movement of vehicles and welding equipment over the surface without causing rutting or other harmful effects. The subgrade shall have no sudden sharp or abrupt changes in grade.
- E. The earthwork contractor shall protect the subgrade from becoming too dry. Flooding and freezing Protection, if required, may consist of a thin plastic protective cover or other material as approved by the Engineer installed over the subgrade until the placement of the liner begins. Subgrade found to have cracks greater than ½ inch in width or depth or that exhibit swelling, heaving, or other similar conditions shall be reworked to remove these defects.
- F. The Geomembrane Installer and Engineer or Engineer'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 during geomembrane installation in a manner that ensures subgrade suitability.
- G. All subgrade damaged by construction equipment and deemed unsuitable for membrane deployment shall be repaired prior to placement of the geomembrane.

3.3 SUBGRADE READINESS CHECKLIST

- A. The following checklist items shall be completed, and verification provided to the lining installer, a minimum of three (3) days prior to mobilization by the installer.
 - 1. Sub-grade rolled and compacted to 90% minimum and smooth, no sticks, sharp or angular stones, any stones over ½-inch diameter
 - 2. No standing water in pond; pumps on hand in case of rain
 - 3. No mud in sub-grade
 - 4. Perimeter anchor trenches dug
 - 5. All pipes installed that will protrude through liner
 - 6. All pipes that will be booted have a minimum 18-inch clearance all the way around with no bell on the end or excess dirt at pipe base
 - 7. All concrete poured and cured at least three (3) days. Concrete is flat and smooth at point of liner attachment
 - 8. Liner materials on site and staged not more than 100 yards from the area to be lined
 - 9. Scoop loader or equivalent on site to move and string materials
 - 10. Ramp into pond removed or if a large pond, left in place to allow access for material placement

11. Deviations from any of the above to be coordinated in writing with liner manufacturer and installer

3.4 GEOTEXTILE INSTALLATION

- A. Place the roll of needle-punched nonwoven geotextile at the top of the slope/grade and roll down grade. Overlap successive and adjacent rolls by 450 mm (18 inches) minimum.
- B. Do not allow vehicles to drive directly on the geotextile.
- C. Geotextile should be stored such that it is protected from rain and direct sunlight.

3.5 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. The quantity of geomembrane that will be anchored and seamed together in one (1) day should be deployed.
- C. No vehicular traffic shall travel on the geomembrane other than an approved low ground pressure all-terrain 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.
- F. Damaged panels or portions of the damaged panels that 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. In these areas, the geomembrane shall allow the geomembrane to rest in intimate contact with the subgrade.
- H. Wrinkles caused by panel placement or thermal expansion should be minimized.
- I. Considerations on Site Geometry: 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 fieldseams 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 Engineer or Engineer'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 75 mm (3 in.).
- K. Crest Anchorage System:
 1. The anchor trench shall be excavated by the earthwork contractor to lines and widths shown on the design drawings prior to geomembrane placement.
 2. Anchor trenches excavated in clay soils susceptible to desiccation cracks should be excavated only the distance required for that day's liner placement to minimize the potential for cracking of the clay soils.

3. Corners in the anchor trench shall be slightly rounded where the geomembrane enters the trench to minimize sharp bends in the liner.

3.6 FIELD SEAMING PROCEDURES

A. General Requirements:

1. Layout: In general, seams shall be oriented parallel to the slope, (down hill) not across the slope. Whenever possible, horizontal seams should be located not less than five (5) feet from the toe of the slope. Each seam shall be numbered in a manner compatible with the panel layout drawing for documentation of seam testing results.
2. Personnel: All personnel performing seaming operations shall be trained in the operation of the equipment being used and will qualify by successfully welding a test seam as described herein. The project foreman will provide direct supervision of all personnel seaming to verify proper welding procedures are followed.

B. Equipment:

1. Fusion Welding: Fusion Welding consists of placing a heated wedge, mounted on a self propelled vehicular unit, between two (2) overlapped sheets such that both sheets are heated to temperatures ranging from 600°F. to 950°F. After being heated by the wedge, the overlapped edges pass through a set of preset pressure rollers that compress the panels together forming a continuous homogenous fusion weld. The fusion welder is equipped with a temperature readout device that continuously monitors the temperature of the wedge.
2. Extrusion Fillet Welding: Extrusion welding consists of introducing a ribbon of molten resin along the edge of the seam overlap to the two (2) sheets to be welded. The molten polymer causes some of the material of each sheet to be liquefied resulting in a homogeneous bond between the molten weld bead and the surfaces of the sheets. The extrusion welder is equipped with gauges giving the temperature in the apparatus and the preheat temperature at the nozzle.

C. Seam Preparation:

1. Fusion Welding:
 - a. Overlap the panels approximately four (4) inches.
 - b. Clean the seam area prior to seaming to ensure the area is clean and free of moisture, dust, dirt, and debris. No grinding is required for fusion welding.
 - c. Adjust the panels so that seams are aligned with the fewest possible number of wrinkles and "fishmouths."
2. Extrusion Welding:
 - a. Overlap the panels a minimum of three (3) inches.
 - b. Temporarily bond the panels to be welded taking care not to damage the geomembrane.
 - c. Grind seam overlap prior to welding within 15 minutes of welding operation in manner that does not damage the geomembrane.
 - d. Clean the seam area prior to seaming to ensure the area is clean and free of moisture, dust, dirt, and debris of any kind.
 - e. Purge the extruder prior to beginning the seam to remove all heat-degraded extrudate from the barrel.
 - f. Keep welding rod clean and off the ground.

D. Test Seams:

Test seams shall be performed at the beginning of each seaming period and at least once each five (5) hours for each seaming apparatus used that day. Test seams shall be made on fragment pieces of the liner and under the same conditions as actual seams.

1. Test Seam Length:
 - a. The test seam shall be at least three (3) feet long, made by joining two (2) pieces at

- least nine (9) inches in width.
2. Sample Procedures:
 - a. Visually inspect the seam for squeeze out, footprint, pressure, and general appearance.
 - b. Two (2) samples one (1)-inch wide shall be cut from the test seam. The samples shall then be tested in peel and shall not fail in the seam. Failure shall be a film tear bond (FTB). If a sample fails, the entire procedure shall be repeated.
 - c. If any of the second set of samples fails, the machine shall not be accepted and used for seaming until the problem is corrected and two (2) passing tests are achieved.
 - d. After completion of the test the remaining portion of the test seam shall be discarded. Documentation of the test seams will be maintained by listing machine I.D. number, operator's name, temperature control setting, and test results.
 - e. If test samples are to act as destructive samples, then the sample shall be marked, logged and saved. If samples are to be cut from the actual finished seam for lab testing, the test seams shall be discarded as specified above.
 - E. General Seaming Procedures:
 1. Seaming shall extend to the outside edge of panels to be placed in the anchor trench.
 2. While welding a seam, monitor and maintain the proper overlap.
 3. Inspect seam area to ensure area is clean and free of moisture, dust, dirt, and debris of any kind.
 4. While welding a seam, monitor temperature gauges to ensure proper settings are maintained and that the machine is operating properly.
 5. Align wrinkles at the seam overlap to allow welding through a wrinkle.
 6. Fishmouths or wrinkles at seam overlaps that cannot be welded through shall be cut along the ridge in order to achieve a flat overlap. The cut area shall be seamed. Any portion where the overlap is inadequate shall be patched with an oval or round patch extending six (6) inches beyond the cut in all directions.
 7. All cross/butt seams between two (2) rows of seamed panels shall be welded during the coolest time of the day to allow for contraction of the geomembrane.
 8. All "T" joints shall have the overlap from the wedge welder seam trimmed back to allow an extrusion fillet weld. Then grind two (2) inches on either side of the seam and extrusion weld all of the area prepared by grinding.
 - F. Weather Conditions: The Installation Supervisor will determine when seaming shall be restricted by weather. Many factors, such as, ambient temperature, humidity, wind, sunshine, etc., can affect the integrity of field seams and must be taken into account when deciding whether or not seaming should proceed. Test seams are required prior to daily production seaming to determine if the weather conditions will affect the installer's ability to produce quality seams. Additional nondestructive and destructive testing of production seams substantiate the decision made by the Installation Supervisor to seam on any given day.
 - G. 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.
 - H. 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 affect a flat overlap. The cut shall be terminated with a keyhole cut (nominal ½ inch diameter hole) so as to minimize crack/tear propagation. The overlay shall subsequently be seamed. The keyhole cut shall be patched with an oval or round patch of the same base geomembrane material extending a minimum of 6 inches beyond the cut in all directions.

3.7 PIPE AND PENETRATION SEALING SYSTEM

- A. Provide penetration sealing system as shown in the Project Drawings. Installation of pipe penetrations shall be in accordance with ASTM D6497.
- B. Penetrations shall be constructed from the base geomembrane material, flat stock, prefabricated boots and accessories as shown on the Project Drawings. The pre-fabricated or 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 paragraph 3.7.B. Alternatively, where field nondestructive testing cannot be performed, attachments will be field spark tested by standard holiday leak detectors in accordance with ASTM D6365. 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 Liner 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
 - 3. tester and hold approximately 1 inch above the weld, moving slowly over the entire length of the weld in accordance with ASTM D6365. If there is no spark the weld is considered to be leak free.
 - 4. A spark indicates a hole in the seam. The faulty area shall be located, repaired, and retested by the Liner Installer.
 - 5. Care should be taken if flammable gases are present in the area to be tested.

3.8 FIELD QUALITY CONTROL AND TESTING

- A. The Engineer or Engineer'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 be prepared and tested by the Liner 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 D4437 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, test seams should be made by each technician one (1) time every 4–6 hours; additional tests may be required with changes in environmental conditions.
 - 3. Two, 1 inch wide specimens shall be die-cut by the Liner Installer from each end of the test seam. These specimens shall be tested by the Liner Installer using a field tensiometer testing both tracks for peel strength and also for shear strength. Each specimen shall fail in the parent material and not in the weld. Seam separation equal to or greater than 10% 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 Paragraph 3.7.C.4 of this section. All four (4) 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 Engineer or Engineer's Representative for archiving.

C. Field Seam Nondestructive Testing

1. All field seams shall be nondestructively tested by the Liner 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 nondestructive testing shall be recorded and submitted to the Engineer or Engineer'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 Engineer or Engineer'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. Nondestructive testing shall be performed using vacuum box, air pressure or spark testing equipment.
4. Nondestructive tests shall be performed by experienced technicians familiar with the specified test methods. The Liner Installer shall demonstrate to the Engineer or Engineer's Representative all test methods to verify the test procedures are valid.
5. Extrusion seams shall be vacuum box tested by the Liner Installer in accordance with ASTM D4437 and ASTM D5641 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 vacuum adjusted to approximately 5 psig.
 - c. The Liner Installer shall create a leak-tight seal between the gasket and geomembrane interface by wetting a strip of geomembrane approximately 12 inch by 48 inch (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 Liner Installer shall then close the bleed valve, open the vacuum valve, maintain initial vacuum of approximately 5 psig for approximately five (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 five (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 nondestructively tested, such as, pipe penetrations, alternate nondestructive spark testing (as outlined in paragraph 3.6.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 Liner Installer in accordance with ASTM D5820 and ASTM D4437 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 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 Liner 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 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 4 psig after this 5-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 4 psig during the testing period or pressure does not stabilize, the faulty area shall be located, repaired and retested by the Liner 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 feet seam length or another predetermined length in accordance with GRI GM 14 shall be taken by the Liner Installer from a location specified by the Engineer or Engineer'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 Liner Installer as directed by the Engineer or Engineer'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 Liner 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 inch wide by 36 inch long with the seam centered lengthwise. The sample shall be cut into three (3) equal sections and distributed as follows: one (1) section given to the Engineer or Engineer's Representative as an archive sample; one (1) section given to the Engineer or
- 4. Engineer's Representative for laboratory testing as specified in paragraph 3.7.D.5 below; and one (1) section retained by the Liner Installer for field testing as specified in paragraph 3.7.D.4 below.
- 5. For field testing, the Liner Installer shall cut 10 identical 1 inch wide replicate specimens from his/her sample. The Liner Installer shall test five (5) specimens for seam shear strength and five (5) for peel strength. Peel tests will be performed on both inside and outside weld seam tracks. To be acceptable, 4 of 5 test specimens must comply with strength criteria in GRI Test Method GM19a with less than 10% separation. If four (4) of five (5) specimens pass, the sample qualifies for testing by the testing laboratory.
- 6. Destructive seam testing in the laboratory shall be in conducted in in accordance with ASTM 5820 or ASTM D4437, or GRI GM6.
- 7. Reports of the results of examinations and testing shall be prepared and submitted to the Engineer or Engineer's Representative.
- 8. 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 Liner Installer at locations indicated by the Engineer, typically 10 feet 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 inadequate 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 nondestructively vacuum box tested until adequacy of the seams is achieved.
- 9. Cap strip seams exceeding 150 feet in length shall be destructively tested.

E. Identification of Defects

- 1. Panels and seams shall be inspected by the Installer and Engineer or Engineer'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 nondestructively tested using one (1) of the methods described in paragraph 3.7.B. Each location that fails nondestructive 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 Liner Installer shall repair the seam between the two (2) 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 an 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 inch 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 nondestructively tested using either vacuum box or spark testing methods. Tests that pass the nondestructive test shall be taken as an indication of a successful repair. Failed tests shall be reseamed and retested until a passing test result. 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 nondestructive and destructive testing
 - 4. Results of pre-qualification test seams
 - 5. Results of nondestructive testing
 - 6. Results of vacuum testing of repairs
- I. Destructive test results shall be reported prior to covering of liner or within 48 hours.

3.9 INSPECTION AND LEAK TEST

- A. Section 01 40 00–Quality Requirements
- B. Before initial filling of pond or placement of earth or other cover, inspect seams and repaired areas to ensure tight, continuously bonded installation. Repair damaged liner and seams and reinspect repaired work.
- C. The inspection will include a performance of a leak location survey using the water puddle electrical method for post-geomembrane installation performance, for a bare geomembrane underlain by an electrically conducting material.
 - 1. The leak location test complies with ASTM 7002 and be capable of detecting leaks 1.3 mm in size
 - 2. Contractor shall prepare the site for the leak location survey based on requirements of Leak Location Contractor and ensure that the materials below the geomembrane contain

sufficient moisture to conduct a leak location survey. Typically, a moisture content of one (1) to two (2) percent by weight is sufficient to conduct the survey. If the geomembrane is installed on a desiccated (dusty) subgrade, it may be necessary to spray the geomembrane with water prior to the leak location survey to allow time for the subgrade at the leaks to be wetted.

3. Any leaks detected will be repaired before the ponds are filled

3.10 FINAL ACCEPTANCE

- A. Section 01 70 00—Closeout Procedures and Submittals
- B. Protect installed liner according to liner manufacturer's instructions. Repair or replace areas of liner damaged by scuffing, punctures, traffic, rough subgrade, or other unacceptable conditions.
- C. Liner Acceptance
 1. Geomembrane liner installation will be accepted by the Engineer when:
 - a. The entire installation is finished
 - b. All installer's QC documentation is completed and submitted to the Owner
 - c. Verification of the adequacy of all field seams and repairs and associated geomembrane testing is complete.

END OF SECTION

SECTION 40 05 23

GENERAL-DUTY VALVES FOR PROCESS PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Gate Valves
 - 2. Plug Valves
 - 3. Globe Valves
 - 4. Plastic Ball Valves
 - 5. Ball Check Valves
 - 6. Swing Check Valves
 - 7. Air Release Valves
 - 8. Pressure Relief Valves
 - 9. Well Service Valves
- B. Related Requirements:
 - 1. Section 01 30 00: Administrative Requirements
 - 2. Section 01 33 00: Submittal Procedures
 - 3. Section 01 40 00: Quality Requirements
 - 4. Section 01 60 00: Product Requirements
 - 5. Section 01 70 00: Execution and Closeout Requirements
 - 6. Section 40 05 29: Pipe Hangers and Supports
 - 7. Section 40 05 53: Identification for Process Piping, Water and Wastewater Equipment
 - 8. Section 40 27 00: Process Piping
 - 9. Section 40 92 13: Mechanical Appurtenances

1.2 REFERENCE STANDARDS

- A. Manufacturers Standardization Society (MSS):
 - MSS SP-80: Bronze Gate, Globe, Angle and Check Valves
 - MSS SP-110: Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
 - MSS SP-122: Plastic Industrial Ball Valves
- B. American water Works Association (AWWA):
 - AWWA C512: Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
- C. ASTM-International (ASTM):
 - ASTM A126: Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - ASTM D2464: Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
 - ASTM D2466: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
 - ASTM D2467: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- D. American Society of Mechanical Engineers (ASME):

ASME A13.1: Scheme for the Identification of Piping Systems

1.3 PREINSTALLATION MEETINGS

- A. Section 01 30 00—Administrative Requirements: Requirements for preinstallation meeting

1.4 SUBMITTALS

- A. Section 01 33 00—Submittal Procedures: Requirements for submittals
- B. Product Data: Submit manufacturer's catalog information with valve dimensional data, pressure and temperature ratings for each service, and materials of construction.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

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 valves.
- C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

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 QUALITY ASSURANCE

- A. Perform Work according to Mendocino Community Service District standards.
- B. Section 01 40 00 – Quality Requirements

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years' documented experience
- B. Installer: Company specializing in performing work of this section with minimum three (3) years' documented experience

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00—Product Requirements: Requirements for transporting, handling, storing, and protecting products

- B. Inspection: Accept valves on site in shipping containers with labeling in place and inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not install valves underground when bedding is wet or frozen.

1.11 WARRANTY

- 1. Section 01 70 00–Execution and Closeout Requirements: Requirements for warranties.
- 2. Furnish 5-year manufacturer's warrant for valves excluding packing.

PART 2 PRODUCTS

2.1 GATE VALVES

- A. Design Criteria:
 - 1. MSS SP 80, Class 150 or greater.
- B. Materials and Construction:
 - 1. Body: Bronze.
 - 2. Bonnet: Bronze.
 - 3. Union Bonnet Nut: Bronze.
 - 4. Packing Nut: Bronze.
 - 5. Stem: Bronze.
 - 6. Disc Ring: Bronze.
 - 7. Seat Ring: 420 Stainless Steel.
 - 8. Disc: 420 Stainless Steel.
 - 9. Handwheel Nut: Bronze or Brass
 - 10. Handwheel: Bronze or Brass
- C. Manufacturers:
 - 1. Crane Valve
 - 2. Mueller Co., LLC
 - 3. Milwaukee Valve Company
 - 4. Engineer-approved equal

2.2 PLUG VALVES

- A. General: Eccentric Plug valves of rectangular port construction with resilient faced cylindrical plugs eccentrically offset from the seat, for the purpose of providing isolation or throttling control as indicated.
- B. Design Criteria:
 - 1. ASTM B16.1.
 - 2. AWWA C517.
- C. Materials and Construction:
 - 1. Body: Stainless Steel, Type 304 or 316.
 - 2. Bearings: Sleeve type and made of sintered, oil impregnated permanently lubricated type 316L sintered stainless steel.
 - 3. Packing: Acrylonitrile-Butadiene (NBR) multiple V-ring type, with a packing gland follower.

4. Seat: 1/8" thick welded overlay of not less than 95% pure nickel.
5. Actuator: Lever

D. Manufacturers:

1. DeZurik
2. Henry Pratt
3. Mueller Co., LLC
4. Engineer-approved equal

2.3 GLOBE VALVES

- A. General: Globe valves two (2) inches and smaller, not provided by packaged equipment supplier.

B. Design Criteria:

1. MSS SP 80, Class 300, Type 3.

C. Materials:

1. Body: Bronze.
2. Bonnet: Bronze.
3. Union Bonnet Ring: Bronze.
4. Disc: 420 Stainless Steel.
5. Body Seat Ring: 420 Stainless Steel.
6. Stem: Bronze.
7. Disc Ring: Bronze or Brass.
8. Packing: Graphite.
9. Packing Nut: Bronze or Brass.
10. Handwheel: Ductile Iron.
11. Handwheel Nut: Steel Cadmium.

D. Connections:

1. As indicated on drawings.

E. Manufacturers:

1. Milwaukee Valve Company: Model 593A.
2. Stockham: Model B-74.
3. Engineer-approved equal.

2.4 PLASTIC BALL VALVE

A. General:

1. Plastic ball valves to be used within buildings and not exposed to UV radiation unless manufactured with titanium dioxide.

B. Manufacturers:

1. Spears Manufacturing Company
2. Hayward Flow Control
3. American Valve, Inc.
4. Ashi/America
5. Engineer approved equal

- C. Schedule 80 PVC Material Conforming to ASTM D2466 and ASTM D2467 for socket weld type and Schedule 80 ASTM D2464 for threaded type.

- D. Three (3) inches and smaller, not provided by packaged equipment supplier: MSS SP 122,

Class 150

2.5 BALL CHECK VALVES

- A. Manufacturers:
 - 1. Spears Manufacturing Company
 - 2. Hayward Flow Control: TC Series
 - 3. Engineer approved equal
- B. Three (3) inches and smaller, not provided by packaged equipment supplier: MSS SP 110, Class 150

2.6 SWING CHECK VALVE

- A. Manufacturers:
 - 1. Cla-val, model 81-02
 - 2. Engineer approved equal
- B. No slam check valve.

2.7 AIR RELEASE VALVES

- A. Manufactures:
 - 1. Val-Matic: Model: 15A, Size 3/4"
 - 2. Or Engineer approved equal
- B. Materials and Features (3 inches and smaller, not provided by packaged equipment supplier):
 - 1. Body and Cover: ASTM A126 Class B Cast Iron
 - 2. Float: Type 316 Stainless Steel
 - 3. Float Arm: Type 316 Stainless Steel
 - 4. Lever Frame: Type 316 Stainless Steel
 - 5. Seat: Type 316 Stainless Steel
 - 6. Orifice: Type 316 Stainless Steel
 - 7. Orifice Button: Viton
 - 8. Working pressure 175 psi.
- C. Accessories:
 - 1. Provide Screened hood on outlet
 - 2. Provide ball valve of same size as air valve in accordance with this Section and with materials compatible with the installed location.

2.8 PRESSURE RELIEF VALVES

- A. General:
 - 1. Pressure relief valves shall release fluid pressure from a pipe network upon exceedance of a specified pressure threshold to prevent rupture or failure of mechanical components within the system.
- B. Three (3) inches and smaller, not provided by packaged equipment supplier: Pressure relief valves shall include an adjustable compression spring (0 psi to 150 psi) and diaphragm capable of withstanding maximum operating pressures within the system prior to pressure relief activation.
- C. Materials (3 inches and smaller, not provided by packaged equipment supplier):
 - 1. Valve body: PVC

2. Diaphragm: PTFE
3. Spring: 316 Stainless Steel
4. Hardware: 316 Stainless Steel

2.9 WELL SERVICE AIR VALVES

- A. General
 1. Well service air valves shall be automatic float operated valves designed to exhaust air from the pump column on pump startup and allow air to enter on pump shutdown or should negative pressure occur within the pipeline.
- B. Design and Construction:
 1. Valves shall be manufactured and tested in accordance with AWWA C512.
 2. Valve shall have full size NPT inlets, outlets and through flow area equal to the nominal valve size.
 3. Floats shall be protected against direct water impact by an internal baffle and unconditionally guaranteed against failure including pressure surges.
 4. Valve shall be Dual Port Throttling type designed for vertical turbine pumps to regulate the air exhaust rate.
- C. Manufacturers:
 1. Val-Matic
 2. Or Engineer approved equal
- D. Well service valves for vertical pumps shall be sized according to no head flow capacity as following:
 1. 0-350 gpm
 - a. Val-Matic or approved equal Model 100ST ½" NPT size
 2. 351-1,350 gpm
 - a. Val-Matic or approved equal Model 101ST 1" NPT size
- E. Accessories:
 1. Provide ball valve of same size as air valve in accordance with this Section and with materials compatible with the installed location.

2.10 ACCESSORIES

- A. Pipe Tapping Saddles:
 1. General:
 - a. Where shown on plans, the pressure devices and air release valves shall be installed with service saddles with stainless steel straps.
 2. Construction and Materials:
 - a. Body: Ductile Iron
 - b. Style: Strap
 - c. Strap and Hardware Material: Type 304 Stainless Steel
 3. Manufacturers:
 - a. Romac: Model 101S
 - b. Muller Co.
 - c. Or approved Equal

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install valves in accordance with manufacturer's requirements.
- B. Install valves with stems upright or horizontal, not inverted.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- D. Install $\frac{3}{4}$ -inch gate or ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment, according to Drawings.
- E. Install valves with clearance allowing access.
- F. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Section 33 05 17—Precast Valve Vaults and Utility Boxes.
- G. Refer to Section 40 05 29—Pipe Hangers and Supports.
- H. Refer to Section 40 27 00—Process Piping for piping materials applying to various system types.
- I. Pipe Saddle Installation:
 - 1. Prior to installation, thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean seat for the gasket. Care shall be taken that the gaskets are wiped clean before they are installed.
 - a. Install in accordance with the manufacturer's recommendations. Bolts shall be tightened progressively, drawing bolts on opposite sides a little at a time until bolts have a uniform tightness.
 - b. Workers tightening bolts shall use torque-limiting wrenches.

3.2 FIELD QUALITY CONTROL

- A. Section 01 40 00—Quality Requirements: Requirements for inspecting and testing

END OF SECTION

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SECTION 40 05 29

PIPE HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Pipe hangers and supports.
 - 2. Hanger rods.
 - 3. Structural attachments.
 - 4. Pipe guides.
 - 5. Formed steel channel.
- B. The Contractor shall provide all labor, equipment, materials, tools, incidentals, and supervision required to construct all pipe hangers and supports including, but not limited to, hardware, fasteners, hangers, cradles, pipe, floor stanchions, base plates, and anchor bolts complete and operable.
- C. Related Requirements:
 - 1. Section 01 30 00: Administrative Requirements
 - 2. Section 01 33 00: Submittal Procedures
 - 3. Section 01 60 00: Product Requirements
 - 4. Section 03 30 00: Cast-in-Place Concrete
 - 5. Section 09 90 00: Painting and Coating
 - 6. Section 40 05 23: General Duty Valves for Process Piping
 - 7. Section 40 27 00: Process Piping

1.2 REFERENCE

- A. This section contains references to the following documents. They are a part of this section as specified and modified. In case of a conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
 - 1. AISC: Manual of Steel Construction—14th Edition
 - 2. MSS SP 58: Pipe Hangers and Supports—Materials, Design, Manufacture, Selection, Application and Installation— Latest Edition
 - 3. MSS SP 69: Pipe Hangers and Supports—Selection and Application
 - 4. AWS D1.1: Structural Welding Code Steel—Reference Manual
 - 5. ASTM A36: Standard Specification for Carbon Structural Steel
 - 6. ASTM A47: Standard Specification for Ferritic Malleable Iron Castings
 - 7. ASTM A181: Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
 - 8. ASTM A576: Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
 - 9. ASTM A653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

1.3 COORDINATION

- A. Section 01 30 00—Administrative Requirements: Requirements for coordination
- B. Coordinate Work of this section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 SUBMITTALS:

- A. Submit the following in accordance with Section 01 33 00—Submittal Procedures:
- B. Shop Drawings
 - 1. Support System
 - a. Drawings of each piping system shall be to the scale as shown, locating each support, hanger, guide, and anchor, including seismic bracing.
 - b. Include critical dimensions, sizes and pipe hanger and support locations - and detail of trapeze hangers, anchors, and guides.
 - c. Identify support, hanger, guide and anchor type by catalog number and Shop Drawing detail number.
- C. Manufacturer's Certificate:
 - 1. Certify that products meet or exceed specified requirements.
 - 2. Certify that all iron and steel products and materials incorporated into the construction are in full compliance with the American Iron and Steel (AIS) requirements.
- D. Welders' Certificate: Submit welders' certification of compliance with ASME Section IX, verifying qualification within previous 12 months.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00—Product Requirements: Requirements for transporting, handling, storing, and protecting products
- B. Inspection: Accept materials on-site in original factory packaging, labeled with manufacturer's identification.
- C. Protect products from weather and construction traffic, dirt, water, chemical, and damage by storing in original packaging.

1.6 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Standard pipe supports and components shall be manufactured by
 - 1. B-Line
 - 2. Grinnell
 - 3. Superstrut
 - 4. Unistrut
 - 5. Standon
 - 6. Or approved equal
- B. Description
 - 1. Install Contractor-designed and selected support system, as approved, in accordance with Manufacturers Standardization Society of the Valve and Fitting Industry, Inc. (MSS) SP 69, "Pipe Hangers and Support—Selection and Application" and as specified herein.
 - a. Pipe support materials shall conform to MSS SP 58.

- b. Provide means of vertical adjustment after erection.
- c. Hangers for pipe sizes ½ to 1½ inches shall be adjustable swivel, split ring.
- d. Hangers for pipe sizes 2 inches and larger shall be adjustable, clevis.
- e. Hangers for Double Containment Pipe shall be adjustable, clevis, Grade 304 stainless steel, 4 foot maximum spacing.
- f. Multiple or trapeze hangers shall be channels with welded spacers and hanger rods.
- g. Wall support for parallel sets of pipes 3 inches and smaller shall be channel with two-hole pipe strap.
 - 1) Sleeves shall be included to isolate plastic pipe, copper pipe, or tubing from clamp.
- h. Wall support for individual pipes 3 inches and smaller shall be two (2)-hole pipe strap.
 - 2) Sleeves shall be included to isolate plastic pipe, copper pipe, or tubing from clamp.
- i. Wall support for pipe sizes 4 in and larger shall be welded bracket with pipe clamps.
- j. Vertical support shall be riser clamp.
- k. Floor supports shall be stainless steel adjustable pipe saddle, lock nut, nipple, floor flange, and stainless steel support.
- l. Floor supports at pipe flanges shall be stainless steel flange plate, lock nut, nipple, floor flange, and support.

C. Performance and Design Criteria:

- 1. Select and design within the specified spans and component requirements where pipe supports and details are not provided on the Drawings.
- 2. The absence of pipe supports and details on the Drawings shall not relieve Contractor of responsibility for sizing and providing supports throughout the project.
- 3. Criteria for Structural Design and Selection of Pipe Support System Components:
 - a. Dead loads imposed by the weight of the pipes filled with water, except air and gas pipes within specified spans and component requirements, plus insulation
 - b. Design in accordance with the "Design Load Criteria" listed in the Structural Notes of Drawing S-002.
- 4. Safety Factors: Minimum of 5. Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor the support, to withstand the shear and pullout loads imposed by loading and spacing on each particular support.
- 5. Piping smaller than 30 inches: supports are shown only where specific types and locations are required; additional pipe support may be required.

- a. Acceptable Support Spacing and Rod Diameter limits are shown below:

Pipe Size	Maximum Support/ Hanger Spacing	Minimum Rod Size Single Rod Hangers
1-inch and smaller	6 feet	¼-inch
1¼-inch through 2½-inch	8 feet	¼-inch
3-inch and 4-inch	10 feet	⅜-inch
6-inch	12 feet	⅜-inch
8-inch	12 feet	½-inch
10-inch and 12-inch	14 feet	⅝-inch
14-inch	16 feet	¾-inch
16-inch and 18-inch	16 feet	⅞-inch
20-inch	18 feet	1-inch
24-inch	18 feet	1¼-inch
30-inch and larger	As shown on plans	-

- 6. Pipe Hangers:
 - a. Allow for expansion and contraction of piping while eliminating undue stress on piping appurtenances and equipment.

- b. Provide linkage to permit lateral or axial movement where anticipated.
- c. Where horizontal pipe movement is greater than ½ inch, or where hanger rod deflection from the vertical is greater than 4 degrees from cold to hot position of pipe, hanger rod and structural attachment shall be offset to maintain rod vertical in hot position.
- d. Plastic Piping Hanger Spacing: as recommended by manufacturer for flow temperature in pipe, unless specifically shown or noted otherwise on the Drawings.
- e. Sway Bracing: Provide where shown, or on 10-foot maximum centers.
- 7. Heat Transmission: Design supports, hangers, anchors, and guides to prevent excessive heat from being transmitted to building structure, equipment, or piping appurtenances
- 8. Riser Supports: Support risers on each floor with riser clamps and lugs, independent of connected horizontal piping.
- 9. Point Loads:
 - a. Support plastic piping containing meters, valves, appurtenances, and other point loads on both sides.
 - b. Avoid point loads on plastic piping by providing extra wide pipe saddles or stainless steel shields.
- 10. Noise Reduction: Wrap copper tubes located within buildings with a 2-inch-wide strip of rubber at each pipe support, bracket, clip, or hanger.
- 11. Support piping connections to equipment by pipe support and not by the equipment.
- 12. Support large or heavy valves, fittings, and/or appurtenances independently of connected piping. Support no pipe from pipe above it.
- 13. Provide supports at piping changes in direction or in elevation, adjacent to flexible joints and couplings, and where otherwise shown.
- 14. All submerged pipe hangers and supports shall be Grade 304 stainless steel or fiberglass. Submerged piping includes piping inside and below any tank (or vault) walls or walkways.
- 15. Do not install pipe supports and hangers in equipment access areas.
- 16. Vibration Isolation Pad: Provide for pedestal type pipe support under base flange adjacent to equipment and where required to isolate vibration.
- 17. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing.
- 18. Install lateral supports for seismic loads at all changes in direction.
- 19. At each channel type support, provide every pipe with intermediate pipe guide, except where pipe anchors and alignment guide are required.
- 20. All pipe hangers and supports for submerged or outdoor service exposure shall be 304 stainless steel or fiberglass.
- 21. Nuts, bolts, and washers for use with stainless steel hangers and supports shall be of same type stainless steel as specified for support.
- 22. Dielectric Barrier:
 - a. Provide between supports and copper or stainless steel pipe.
 - b. Provide between stainless steel supports and non-stainless steel ferrous piping.

2.2 HANGER RODS

- A. Hanger Rods:
 - a. Stainless Steel Type 304
 - b. Threaded both ends
 - c. Diameter: according to table schedule in paragraph 2.1.C.5, above

2.3 STRUCTURAL ATTACHMENTS

- A. Anchor bolts and concrete inserts:
 - 1. Anchor bolts and concrete anchors shall be stainless steel unless otherwise specified.
 - 2. The use of anchors relying on the deformation of a lead alloy will not be permitted.
 - 3. Concrete inserts shall consist of a hot-dip galvanized steel shell and expander plug for

threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.

4. Size inserts to suit threaded hanger rods.
5. Minimum capacity shall be 1,140 pounds.
6. The location of the insert shall be carefully determined, and the insert shall be anchored to the form prior to placing the concrete.
 - a. A No. 4 reinforcing bar, 3 feet long, shall be looped through the insert and tied to the surrounding reinforcement.

B. Inserts Standards and Manufacturers: Inserts shall meet the requirements of ANSI/MSS SP 69, Type 18 and shall be manufactured by Grinnell, Figure 282; Elcen, Figure 65; or equal.

C. Mounting Brackets:

1. Material: Type 304 Stainless Steel
2. Construction: Welded

D. Riser Clamps:

1. Material: Type 304 Stainless Steel
2. Support of Copper Tubing: Provide copper-plated clamps

E. Offset Clamps:

1. Material: Type 304 Stainless Steel
2. Double leg, two (2)-piece, field adjustable

2.4 FORMED STEEL CHANNEL

A. Description:

1. Galvanized 12-gage-thick steel, 1 $\frac{5}{8}$ -inch wide series, Type 304 stainless steel
2. Include holes 1 $\frac{1}{2}$ in O.C.
3. Members and Connections: Design for all loads with a safety factor of 5.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00—Administrative Requirements: Requirements for installation examination
- B. Verify field dimensions as indicated on Drawings.

3.2 INSTALLATION

- A. Welded and bolted attachments to the building structural steel shall be in accordance with the requirements of AISC Manual of Steel Construction. Unless otherwise specified, there shall be no drilling or burning of holes in the building structural steel.
- B. Inserts:
 1. The Contractor shall install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.
 2. Install inserts for placement in concrete forms.
 3. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 4. Embedded anchor bolts shall be used instead of concrete inserts for support installations in areas below water surface or normally subject to submerging.
 5. Coordinate inserts with Section 03 30 00—Cast-In-Place Concrete

C. Pipe Hangers and Supports:

1. Hanger rods, supports, clamps, anchors, channels, and guides shall conform and be sized in accordance with MSS SP 58 and SP 69.
2. Hanger components shall not be used for purposes other than, for which they were designed. They shall not be used for rigging and erection purposes.
3. Hanger and support components in contact with plastic pipe shall be free of burrs and sharp edges.
4. The Contractor shall adjust hangers and supports to obtain required pipe slope and elevation. Shims may be made of material that is compatible with the piping material may be used.
5. Support horizontal piping as indicated on shop drawings.
6. Install hangers with minimum ½-inch space between finished covering and adjacent Work.
7. Use hangers with 1½ inches minimum vertical adjustment.
8. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
9. Provide copper-plated hangers and supports for copper piping.
10. Insulated Piping: Provide two (2) bolted clamps designed to accommodate insulated piping.
11. Use offset clamps where pipes are indicated as offset from wall surfaces.

D. Support Locations

1. The Contractor shall locate supports as near as possible to concentrated loads (such as, valves, flanges, etc.). Locate hangers, supports, and accessories within the maximum span lengths in this Specification to support continuous pipeline runs unaffected by concentrated loads.
2. At least one (1) hanger or support shall be located within 2 feet from a pipe change in direction.
3. The Contractor shall locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping.
4. Where piping is connected to equipment, a valve, piping assembly, etc. that will require removal for maintenance, the piping shall be supported in such a manner that temporary supports shall not be necessary for this procedure.
5. Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves, and fittings.
6. Design hangers for pipe movement without disengagement of supported pipe.
7. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
8. Support riser piping independently of connected horizontal piping.
9. Support horizontal cast iron pipe adjacent to each hub, with 5-foot maximum spacing between hangers.
10. Place hangers within 12 inches of each horizontal elbow.

E. Welding shall conform to the following:

1. AWS D1.1 Structural Welding Code—Steel welding shall be with electrodes (AWS 5.1)
2. Stainless Steel AWS D1.1 Structural Welding Code welding shall be with electrodes (AWS D10.4).
3. Welding of structural members shall be done by welders who have a current American Welding Society (AWS) certificate for the type of welding to be done.
4. Welds shall be full penetration type unless otherwise indicated in the Drawings.

F. Equipment Bases and Supports:

1. Provide housekeeping pads as detailed on Drawings.
2. Using templates furnished with equipment, install anchor bolts and accessories for mounting and anchoring equipment.

3. Construct supports of stainless steel pipe and fittings. Brace and fasten with flanges bolted to structure.
 4. Base plates shall be cut and drilled to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.
 5. Finished floor beneath structural attachments and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of voids and foreign material.
 6. Provide rigid anchors for pipes after vibration isolation components are installed. Comply with Section 40 27 00, "Process Piping."
- G. Provide coating system specified in Section 09 90 00, "Painting and Coating" for all non-stainless steel pipe supports in outdoor exposed and vault piping areas.

END OF SECTION

SECTION 40 05 53

IDENTIFICATION FOR PROCESS PIPING, WATER, AND WASTEWATER EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Tags
 - 2. Pipe markers
 - 3. Lockout devices
 - 4. Signs
- B. Related Requirements:
 - 1. Section 01 30 00: Administrative Requirements
 - 2. Section 01 33 00: Submittal Procedures
 - 3. Section 01 70 00: Closeout Requirements
 - 4. Section 09 90 00: Painting and Coating
 - 5. Section 40 05 23: General Duty Valves for Process Piping

1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME A13.1: Scheme for the Identification of Piping Systems
- B. United States Department of Defense:
 - 1. MIL-STD-810C: Environmental Test Methods

1.3 PREINSTALLATION MEETINGS

- A. Section 01 30 00—Administrative Requirements: Requirements for pre-installation meeting

1.4 SUBMITTALS

- A. Section 01 33 00—Submittal Procedures: Requirements for submittals
- B. Product Data: Submit manufacturer's catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color-coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

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 tagged valves; include valve tag

numbers.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Perform Work according to State of California Plumbing Code, Mendocino City Community Services District standards, and California Code of Regulations §60310.

1.8 QUALIFICATIONS

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

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Brady Corporation.
- B. Seton Identification Products.
- C. Marking Services Inc.
- D. Engineer approved equal.

2.2 PIPE AND EQUIPMENT TAGS

- A. General: Tags shall be the mechanically attached types that are not easily removable; they shall not be the adhesive applied type. Markers shall consist of pressure sensitive legends applied to plastic backing that is strapped or otherwise mechanically attached to the pipe. Legend and backing shall be resistant to petroleum based oils and grease and shall meet criteria for humidity, solar radiation, rain, salt, fog, and leakage fungus, as specified by MIL-STD-810C. Markers shall withstand a continuous operating temperature range of -40 °F to 180 °F. Plastic coding markers shall not be the individual letter type but shall be manufactured and applied in one continuous length of plastic. In addition, pipe markers shall include uni- and bi-directional arrows in the same sizes as the legend. Legends and arrows shall be white on blue or red backgrounds and black on other specified backgrounds.

Outside Pipe Diameter ^a (inches)	Letter Height (inches)
Less than 1-1/2	1/2
1-1/2 through 3	1-1/8
Greater than 3	2-1/4
a) Outside pipe diameter shall include insulation and jacketing.	

2.3 PIPE MARKERS

- A. Color Coding:

1. Process Pipe and valve color coding shall conform to ASME A13.1—Scheme for the Identification of Piping Systems, in accordance with the State of California Plumbing Code, California Code of Regulations Title 22 Recycled Water Regulations, and Mendocino City Community Services District standards.

B. Plastic Tracer Tape:

1. Description:
 - a. Tracer tape shall be 6 inches wide, colored the same as the background colors, as specified in the Pipe Schedule, and made of inert plastic material suitable for direct burial. Tape shall be capable of stretching to twice its original length and shall be as manufactured by Allen Systems, W. H. Brady Co., Seton Name Plate Corporation, Marking Services Inc., or equal.
 - b. A single line of tape as specified in the Pipe Schedule shall be provided 2.5 feet above the centerline of buried pipe. For pipelines buried 8 feet or greater below finished grade, contractor shall provide a second line of tape 12 inches below finished grade, above and parallel to each buried pipe. Tape shall be spread flat with message side up before backfilling.

C. Magnetic Tracer Tape:

1. Polyethylene magnetic tracer tape shall be as manufactured by Allen Systems, W.
2. H. Brady Co., Seton Name Plate Corporation, Marking Services Inc., or equal. Tape shall be acid and alkali-resistant, 3 inches wide, 0.005 inch thick, and have 1500 psi strength and 140 percent elongation value. The tape shall be colored the same as the background colors as specified in the Pipe Schedule and shall be inscribed with the word "CAUTION--PIPE" BURIED BELOW" and the name of the piping system.
3. Polyethylene magnetic tracer tape shall be buried 12 to 18 inches below ground and shall be above and parallel to buried nonferrous, plastic and reinforced thermosetting resin pipe lines. For pipelines buried 8 feet or greater below final grade, the Contractor shall provide a second line of tape 2.5 feet above and parallel to the buried pipe.

2.4 SIGNS

A. Description:

1. All use areas where recycled water is used that are accessible to the public shall be posted with signs that are visible to the public, in a size no less than 4 inches high by 8 inches wide, that include the following wording: "RECYCLED WATER - DO NOT DRINK." Each sign shall display an international symbol similar to that shown in Attachment A.

PART 3 EXECUTION

3.1 PREPARATION

- A. Section 01 70 00—Execution and Closeout Requirements: Requirements for installation preparation
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Prepare surfaces as specified in Section 09 90 00—Painting and Coating for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting as specified in Section 09 90 00—Painting and Coating.

- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.
- D. Tags
 - 1. Install tags using corrosion-resistant chain.
 - 2. Number tags as indicated in tag schedule.
- E. Install underground plastic pipe markers 12 inches below finished grade, directly above buried pipe.
- F. Identify valves in main and branch piping with tags.
- G. Piping:
 - 1. Identify piping, concealed or exposed, with plastic pipe markers.
 - 2. Identify service, flow direction, and pressure.
 - 3. Install in clear view and align with axis of piping.
 - 4. Locate identification not to exceed 20 feet on straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- H. Ceiling Tacks:
 - 1. Provide ceiling tacks to locate valves above T-bar-type panel ceilings.
 - 2. Locate in corner of ceiling panel closest to equipment.

3.3 ATTACHMENTS

- A. "DO NOT DRINK" Symbol

END OF SECTION



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SECTION 40 27 00
PROCESS PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes
 - 1. Ductile Iron Pipe.
 - 2. Carbon Steel Pipe.
 - 3. Stainless Steel Pipe.
 - 4. PVC Pipe and Tube.
 - 5. CPVC Pipe.
 - 6. Polyethylene (PE) Tube.

1.2 REFERENCES

- A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B120.1 – Pipe Threads, General Purpose (Inch).
 - b. B16.3 – Malleable Iron Threaded Fittings: Classes 150 and 300.
 - c. B16.5 – Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
 - d. B16.11 – Forged Fittings, Socket-Welding and Threaded.
 - e. B16.21 – Nonmetallic Flat Gaskets for Pipe Flanges
 - f. B16.42 – Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300
 - g. B31.3 – Process Piping
 - 2. American Water Works Association (AWWA):
 - a. C104/A214 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - b. C105/A215 – Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - c. C110/A2110 – Ductile-Iron and Gray-Iron Fittings.
 - d. C111/ A2111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - e. C115/A2115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - f. C151/A2151 – Ductile-Iron Pipe, Centrifugally Cast.
 - g. C153/A2153 – Ductile-Iron Compact Fittings.
 - h. C207 – Steel Pipe flanges for Waterworks Service, Sizes 4 In Through 144 In (100 mm Through 3,600 mm).
 - i. C651 – Disinfecting Water Mains.
 - 3. ASTM International (ASTM):
 - a. A47/A47M – Standard Specification for Ferritic Malleable Iron Castings.
 - b. A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A105/A105M – Standard Specification for Carbon Steel Forgings for Piping Applications.
 - d. A181/A181M – Standard Specification for Carbon Steel Forgings, and General-Purpose Piping.
 - e. A197/A197M – Standard Specification for Cupola Malleable Iron.
 - f. A276 – Standard Specification for Stainless Steel Bars and Shapes.
 - g. A312/A312M – Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
 - h. A536 – Standard Specification for Ductile Iron Castings.

- i. B98/B98M – Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes.
- j. D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
- k. D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- l. D2239 – Standard Specification for Polyethylene (PE) Plastic Pipe Based on Controlled Inside Diameter.
- m. D2464 – Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- n. D2467 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- o. D2564 – Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
- p. D2737 – Standard Specification for Polyethylene (PE) Plastic Tubing.
- q. D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products Materials.
- r. D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- s. D4101 – Standard Specification for Polypropylene Injection and Extrusion Materials.
- t. F436 – Standard Specification for Hardened Steel Washers.
- u. F437, Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- v. F439 – Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- w. F441 /F441M – Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
- x. F714 – Standard Specification for Polyethylene (PE) Plastic Pipe Based on Outside Diameter.
- y. F493 – Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- z. F656 – Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- 4. FM Global (FM)
- 5. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc (MSS): SP-43, Wrought and Fabricated Butt-Welding Fittings for Low-Pressure, Corrosion Resistant Applications
- 6. NSF International (NSF): 61 Drinking Water System Components Health Effects
 - a. National Fire Protection Association (NFPA): 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances

1.3 DEFINITIONS

- A. Submerged or Wetted: Zone below elevation of top of tank wall or under tank cover.

1.4 DESIGN REQUIREMENTS

- A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:
 - 1. Buried Piping: H20-S16 traffic load with 1.5 impact factor, AASHTO HB-17, as applicable.
 - 2. Thrust Restraints: Design for test pressure shown in Piping Schedule. All pressure piping shall be restrained.

1.5 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Fabricated Piping:

- a. Detailed pipe fabrication or spool drawings showing special fittings and bends, dimensions, coatings, and other pertinent information.
 - b. Layout drawings showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.
 2. Pipe Wall Thickness: Identify wall thickness and rational method or standard applied to determine wall thickness for each size of each different service including exposed, submerged, buried, and concrete encased installations for Contractor-designed piping.
 3. Hydraulic Thrust Restraint for Restrained Joints: Details including materials, sizes, assembly ratings, and pipe attachment methods.
 4. Dissimilar Buried Pipe Joints: joint types and assembly drawings.
 5. Pipe Corrosion Protection: Product data.
 6. Anchorage and bracing drawings and cut sheets.
- B. Informational Submittals:
 1. Manufacturer's Certification of Compliance, in accordance with Section 01 60 00, Product Requirements for:
 - a. Pipe and fittings.
 - b. Factory applied resins and coatings.
 2. Anchorage and bracing calculations.
 3. Test logs.
 4. Pipe coating applicator certification.
- C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.
 1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.
 2. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with the following:
 1. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
 2. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.
 3. Linings and Coatings: Prevent excessive drying.
 4. Cold Weather Storage: Locate products to prevent coating from freezing to ground.
 5. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.

PART 2 PRODUCTS

2.1 PIPING

- A. As specified on Piping Data Sheet(s) located at the end of this section as Supplements and on Piping Schedule located on Drawings.
- B. Diameters Shown:
 1. Standardized Products: Nominal size
 2. Fabricated Steel Piping (Except Cement-Lined): Outside diameter, ASME B36.10M.

3. Cement-Lined Steel Pipe: Lining inside diameter.

2.2 JOINTS

- A. Flanged Joints:
 1. Flat-faced, carbon steel, stainless steel, or alloy flanges when mating with flat-faced cast or ductile iron flanges.
 2. Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.
- B. Threaded Joints: NPT taper pipe threads in accordance with ASME B 1.20.1.
- C. Socket Joints:
 1. For use in PVC and CPVC pipe in connection to threaded valves and where future disassembly of attached equipment is not required.
- D. Restrained Flanged Coupling Adaptors:
 1. General: To be used on plain end of flanged spool where shown on Plans.
 2. Manufacturers:
 - a. Ebba Iron: Model 2100 Megaflange.
 - b. Romac: Model RFCA.
 - c. Approved Equivalent.
 3. Construction and Materials:
 - a. Flange Body: Ductile iron conforming to ASTM A536
 - b. Hardware: Type 304 stainless steel
 - c. Flange circles: compatible with AWWA C110.
 - d. Coating: Factory applied fusion bonded epoxy.
 - e. Gaskets: Specifically designed for use with restrained flanged coupling adaptor.
- E. Expansion Joints:
 1. General: Bellows type pump connector/expansion joint with tie-rods.
 2. Application: For connection of distribution piping to pumps.
 3. Manufacturer
 - a. Metraflex: Model MPTR, Multi-ply Bellows Pump Connector/Expansion Joint.
 - b. Approved Equivalent.
 4. Materials: 316 stainless steel body, flanges, and fasteners.
 5. Pressures: Pressure rated to withstand maximum pressures of adjoining pipe system
 6. Accessories:
 - a. Internal liner: Manufacturer recommended internal liner; liner material shall be compatible with process water chemical composition.
 7. Installation shall occur without equipment and piping being anchored and supported on either end of joint.

2.3 GASKET LUBRICANT

- A. Lubricant shall be supplied by pipe manufacturer and no substitute or "or equal" will be allowed.

2.4 PIPE CORROSION PROTECTION

- A. Coatings: See Section 09 90 00–Painting and Coating, for details of coating requirements and the Piping Schedule for specific lining and coating requirements.
- B. Heat Shrink Wrap:
 1. Type: Cross-linked polyolefin wrap or sleeve with mastic sealant.

2. Manufacturer: Raychem or Approved Equivalent.

C. Polyethylene Encasement (Bagging):

1. Encasement Tube: Black polyethylene encasement tube. 8 mils minimum thickness, conforming to AWWA C105/A21.5, free of gels, streaks, pinholes, foreign matter, undispersed raw materials, and visible defects such as tears, blisters, and thinning at folds.
2. Securing Tape: Thermoplastic tape, 8 mils minimum thickness, 1 inch wide, pressure sensitive adhesive face capable of bonding to metal, bituminous coating, and polyethylene encasement tube.

2.5 THRUST TIES

- A. Buried Ductile Iron Pipe and Fittings: Unless restraint is otherwise specified or shown, conform to NFPA 24. Tie-rod attachments relying on clamp friction with pipe barrel to restrain thrust are unacceptable. Restraint joints are required.

2.6 VENT AND DRAIN VALVES

- A. Pipeline 2-inch Diameter and Smaller: ½-inch vent, 1-inch drain, unless shown otherwise
- B. Pipelines 2½-inch Diameter and Larger: ¾-inch vent, 1-inch drain, unless shown otherwise

2.7 FABRICATION

- A. Mark each pipe length on outside with the following:
 1. Size or diameter and class
 2. Manufacturer's identification and pipe serial number
 3. Location number on laying drawing
 4. Date of manufacture
- B. Code markings according to approved Shop Drawings
- C. Shop fabricate flanged pipe in shop, not in field, and delivered to Site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by manufacturer.

2.8 FINISHES

- A. Factory prepare, prime, and finish coat in accordance with Plans, Specifications and Section 09 90 00—Painting and Coating.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.
- B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

3.2 PREPARATION

- A. See Section 09 90 00 – Painting and Coating for additional requirements.
- B. Notify Engineer at least 2 weeks prior to field fabrication of pipe or fittings.
- C. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.
- D. Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

3.3 INSTALLATION–GENERAL

- A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.
- B. Remove foreign objects prior to assembly and installation.
- C. Flanged Joints:
 - 1. Install perpendicular to pipe centerline.
 - 2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
 - 3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
 - 4. Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.
 - 5. Raised-Face Flanges: Use raised-face flanged when joining with raised-face flanges. Use flat-face flange when joining with flat-faced ductile or cast iron flange.
 - 6. Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.
 - 7. Flange fillers are to be avoided, but if necessary, may be used to make up for small angles up to 6 degrees and for filling gaps up to 2 inches between flanges. Stacked flange fillers shall not be used.
 - 8. Threaded flanged joints shall be shop fabricated and delivered to Site with flanges in-place and properly faced.
 - 9. Manufacturer: Same as pipe manufacturer.
- D. Threaded and Coupled Joints
 - 1. Conform to ASME B1.20.1.
 - 2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
 - 3. Countersink pipe ends, ream and clean chips and burrs after threading.
 - 4. Make connections with not more than three threads exposed.
 - 5. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.
- E. PVC and CPVC Piping:
 - 1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
 - 2. Use strap wrench for tightening threaded plastic joints. Do not over tighten fittings.
- F. Ductile Iron Piping:
 - 1. Cutting Pipe: Cut pipe with milling type cutter, rolling pipe cutter, or abrasive blade cutter. Do not flame cut.
 - 2. Dressing Cut Ends:
 - a. General: As required for the type of joint to be made.
 - b. Rubber Gasketed Joints: Remove sharp edges or projections.
 - c. Push-On Joints: Bevel, as recommended by pipe manufacturer.
 - d. Flexible Couplings and Restrained Flanged Coupling Adapters: As recommended by

the coupling or adapter manufacturer.

3.4 INSTALLATION–EXPOSED PIPING

- A. Piping Runs:
 - 1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
 - 2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement. Consult manufacturer of flow measuring device for proper installation.
- B. Supports: As shown on Plans and specified in Section 40 05 29 – Pipe Hangers and Supports.
- C. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.
- D. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.
- E. Install piping so that no load or movement more than that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.
- F. Piping clearance, unless otherwise shown:
 - 1. Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
 - 2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
 - 3. From Adjacent Work: Minimum 1 inch(es) from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
 - 4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
 - 5. Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
 - 6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.
 - 7. Do not route piping over, around, in front of, behind, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

3.5 INSTALLATION–BURIED PIPE

- A. Joints:
 - 1. Dissimilar Buried Pipes: Provide flexible mechanical compression joint for pressure pipe.
 - 2. Concrete Encased or Embedded Pipe: Do not encase joints in concrete, unless specifically shown.
- B. Placement:
 - 1. Keep trench dry until pipe laying and joining are completed.
 - 2. Pipe Base and Pipe Zone: As specified in Division 31.
 - 3. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
 - 4. Measure for grade at pipe invert, not at top of pipe.
 - 5. Excavate trench bottom and sides of ample dimensions to permit visual inspection and testing of entire flange, valve, or connection.

6. Prevent foreign material from entering pipe during placement.
 7. Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.
 8. Lay pipe upgrade with bell ends pointing in direction of laying.
 9. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
 - a. Shorter pipe lengths.
 - b. Special mitered joints.
 - c. Standard or special fabricated bends.
 10. After joint has been made, check pipe alignment and grade.
 11. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
 12. Prevent uplift and floating of pipe prior to backfilling.
- C. PVC, or CPVC Pipe Placement:
1. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and during operation.
 2. Do not lay pipe when temperature is below 40 °F, or above 90 °F when exposed to direct sunlight.
 3. Shield ends to be joined from direct sunlight prior to and during the laying operation.
- D. Tolerances:
1. Deflection from Horizontal Line Except PVC or CPVC: Maximum 2 inches.
 2. Deflection from Vertical Grade: Maximum 1/4 inch(es).
 3. Joint Deflection: Maximum of 75 percent of manufacturer's recommendation.
 4. Horizontal position of pipe centerline on alignment around curves maximum variation of 1.75 feet from position shown.
 5. Pipe Cover: Minimum 3 feet, unless otherwise shown.

3.6 INSTALLATION—CONCRETE ENCASED

- A. Provide reinforced concrete pipe encasement where shown on Drawings and where otherwise required. Some piping may be required to be concrete encased for pipe strength requirements that are included in the Specifications. Piping under and within the influence of buildings, utility trenches, vaults, slabs, and other structures shall be concrete encased. See details on Drawings for encasement requirements.
1. Where concrete encased piping crosses structure construction and expansion joints, provide flexible piping joints to coincide with structure joints to prevent excessive pipe stress and breakage.

3.7 PIPE CORROSION PROTECTION

- A. Ductile Iron Pipe:
1. Exposed: As specified in Section 09 90 00, Painting and Coating, and as shown in Piping Schedule.
 2. Buried: Wrap with polyethylene bagging.
 3. Submerged or Embedded: Coat with coal-tar epoxy as specified in Section 09 90 00 – Painting and Coating. If in potable water service, use NSF 61 approved epoxy.
 4. Dissimilar Materials: As specified in Section 33 11 00 – Recycled Water Utilities.
- B. PVC and CPVC Pipe, Exposed: As specified in Section 09 90 00 – Painting and Coating.
- C. Piping Accessories:
1. Exposed:
 - a. Field paint black and galvanized steel, brass, copper, and bronze piping components

as specified in Section 09 90 00 – Painting and Coating, as applicable to base metal material.

- b. Accessories include, but are not limited to, pipe hangers, supports, expansion joints, pipe guides, flexible couplings, vent and drain valves, and fasteners.
- 2. Buried:
 - a. Ferrous Metal and Stainless Steel Components: Coat as specified in Section 09 90 00 – Painting and Coating.
 - b. Bolts, Nuts, and Similar Items: Coat with bituminous paint.
 - c. Flexible Couplings and Similar Items: Wrap with heat shrink wrap or coat with cement.
 - d. Buried Valves and Similar Elements on Wrapped Pipelines: Coat with bituminous paint and wrap entire valve in polyethylene encasement.
 - e. Cement-Coated Pipe lines: Cement coat appurtenances same as pipe.
 - f. Polyethylene Encasement: Install in accordance with AWWA C105/A21.5 and manufacturer's instructions.
 - g. Tape Coating System: As specified in Section 09 90 00 – Painting and Coating.
 - h. Heat Shrink Wrap: Apply in accordance with manufacturer's instructions to surfaces that are cleaned, prepared, and primed.

3.8 THRUST RESTRAINT

- A. Location:
 - 1. Buried Piping: Where shown and where required to restrain force developed at pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist because of hydrostatic testing and normal operating pressure.
 - 2. Exposed Piping: At all joints in piping.
- B. Thrust Ties:
 - 1. Ductile Iron Pipe: Attach with socket clamps anchored against grooved joint coupling or flange.
 - 2. Flanged Coupling Adapters: For exposed installations, install manufacturer's anchor studs through coupling sleeve or use dismantling joints.
- C. Mechanical Joint Valve Restraint in Proprietary Restrained Joint Piping: Install pipe joint manufacturer's adapter gland follower and pipe end retainer, or mechanical joint anchor gland follower.

3.9 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

- A. Application and Installation: As specified in accordance with Section 03 30 00 – Cast-in-Place Concrete.

3.10 BRANCH CONNECTIONS

- A. Do not install branch connections smaller than 1/2-inch nominal pipe size, including instrument connections, unless shown otherwise.
- B. When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including first block valve in the line carrying the lower pressure, unless otherwise shown.
- C. Threaded Pipe Tap Connections:
 - 1. Ductile Iron Piping: Connect only with service saddle or at tapping boss of a fitting, valve body, or equipment casting.
 - 2. Welded Steel or Alloy Piping: Connect only with welded threadolet or half-coupling as

specified on Piping Data Sheet.

3. Limitations: Threaded taps in pipe barrel are unacceptable.

3.11 VENTS AND DRAINS

- A. Vents and drains at high and low points in piping required for completed system may or may not be shown. Install vents on high points and drains on low points of pipelines at all low and high point locations.

3.12 DISINFECTION

- A. All potable water piping shall be disinfected using one of the procedures described in AWWA C651. Recycled water lines need not be disinfected, but must be flushed and clean of debris and any materials introduced in the tapping, construction, or laying of pipelines.

3.13 FIELD FINISHING

- A. Notify Engineer at least 3 days prior to start of surface preparation or coating application work.
- B. As specified in Section 09 90 00 – Painting and Coating.

3.14 PIPE IDENTIFICATION

- A. As specified in Section 40 05 53 – Identification for Process Piping, Water and Wastewater Equipment.

3.15 FIELD QUALITY CONTROL

- A. Pressure Leakage Testing: As specified in Section 40 80 01 – Process Piping Leakage Testing.

3.16 CLEANING

- A. Following assembly and testing, and prior to final acceptance, flush pipelines, except as stated below, with water at 2.5 fps minimum flushing velocity until foreign matter is removed.
- B. Blow clean of loose debris low pressure air lines with compressed air at 4,000 fpm; do not flush with water.
- C. Immediately after cleaning low pressure air service piping, dry to minus 40 °F dew point with dry compressed instrument air or compressed commercial grade nitrogen.
- D. If it is impractical to flush large diameter pipe at 2.5 fps or blow at 4,000 fpm velocity, clean in-place from inside by brushing and sweeping, then flush or blow line at lower velocity.
- E. Insert cone strainers in flushing connections to attached equipment and leave in-place until cleaning is complete.
- F. Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.

3.17 SUPPLEMENTS

- A. The supplements listed below, following "End of Section ," are a part of this Specification:
 1. Data Sheets.

Number	Title
40 27 00.01	Cement-Mortar Lined Ductile Iron Pipe and Fittings
40 27 00.02	Stainless Steel Pipe and Fittings – General Service
40 27 00.03	Carbon Steel Pipe and Fittings – General Service
40 27 00.10	Polyvinyl Chloride (PVC) Pipe and Fittings
40 27 00.11	Process Tubing
40 27 00.12	Chlorinated Polyvinyl Chloride (CPVC) Pipe and Fittings

END OF SECTION

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Section 40 27 00.01

CEMENT-MORTAR DUCTILE IRON PIPE AND FITTINGS

ITEM	DESCRIPTION
General	Materials in contact with potable water shall conform to NSF 61 acceptance. Pipe manufacturer shall submit certification that source manufacturing facility has been producing ductile iron pipe of the specified diameters, dimensions, and standards for a period of not less than 10 years. Testing a pipe required by AWWA A21.51 shall be conducted in testing and laboratory facilities located in the USA and operating under USA laws and regulations. Pipe shall be handled during manufacture and shipped without nesting (without insertion of one pipe inside another).
Pipe	Buried Liquid Service Using Mechanical or Proprietary Restrained Joints: AWWA C111/A21.1 1, and AWWA C151 /A21.5 1, pressure class conforming to Table 5 and Table 7 for Type 4 trench, 250 psi minimum working pressure. Follower glands shall be ductile iron. Exposed Pipe Using Grooved End and Flange Joints: AWWA C115/A21.15, thickness Class 53 minimum, 250 psi minimum working pressure.
Lining	Cement-mortar: AWWA C104/A21.4
Fittings	Lined and coated same as pipe. Mechanical: AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C153/A21.53 ductile iron, 250 psi minimum working pressure—follower glands shall be ductile iron. Proprietary Restrained: AWWA C 110/A21.0, AWWA C111/A21.11, and AWWA C153/A2 1.53, ductile iron, 250 psi minimum working pressure. Restraint shall be achieved with removable metal elements fitted between a welded bar on the pipe barrel and the inside of the joint bell or fitting sizes smaller than 16 inches may be mechanical joint, restrained by anchor gland followers, ductile iron anchor type, wedge action, with break-off tightening bolts. Assembled joints shall be rated for deflection in operation at rated pressure. Rated deflection shall be not less than 1½ degrees for 36-inch and smaller pipe. Rated deflection shall be not less than ½ degree for 42-inch and larger pipe. Clow Corp., American Cast Iron Pipe Co., U.S. Pipe. Restrained joints relying on metal teeth molded into the gasket to prevent joint separation under pressure will not be accepted. Grooved End: AWWA C606 and AWWA C110/A21.10, ductile iron, 250 minimum working pressure; Victaulic or approved equal Flange: AWWA C110/A21.10 ductile iron, faced and drilled, Class 125 flat face. Gray cast iron will not be allowed.

Joints	Mechanical: 250 psi minimum working pressure. Proprietary Restrained: 225 psi minimum working pressure. Clow Corp., Super-Lock; American Cast Iron Pipe Co., Flex-Ring or Lok-Ring; U.S. Pipe, TR Flex. Grooved End: Rigid type radius cut conforming to AWWA C606, 250 psi minimum working pressure; Victaulic or approved equal. Flange: Class 125 flat face, ductile iron, threaded conforming to AWWA C115/ A21.15. Gray cast iron will not be allowed.
Bolting	Grooved End: 250 psi minimum working pressure, malleable iron according to ASTM A47/A47M or ductile iron according to ASTM A536; Victaulic or approved equal Grooved End Adapter Flanges: 250 psi minimum working pressure, malleable iron per ASTM A47/A47M or ductile iron per ASTM A536; Victaulic or approved equal
Bolting	Mechanical, Proprietary Restrained, and Grooved End Joints: Manufacturer's standard with stainless steel hardware in exposed locations. Class 125 Flat-Faced Flange: Type 304 stainless steel, ASTM A320/A320M, Grade B8M hex head bolts; ASTM A194/A194M, Grade 8M hex nuts and ASTM F436/F436M Type 3 alloy washers at nuts and bolt heads—achieve 40 percent to 60 percent of bolt minimum yield stress. Flanged Joints in Sumps, Wet Wells, and Submerged and Wetted Installations: Type 316 stainless steel, ASTM A320/A320M, Grade B8M hex head bolts; ASTM A194/A194M, Grade 8M hex nuts and ASTM F436/F436M Type 3 alloy washers at nuts and bolt heads—achieve 40 percent to 60 percent of bolt minimum yield stress.
Gaskets	General: Gaskets in contact with potable water shall be NSF 61 certified. Mechanical and Proprietary Restrained Joints; Water and Sewage Service: Rubber conforming to AWWA C111/ A21.11. Grooved End Joints: Halogenated butyl conforming to ASTM D2000 and AWWA C606. Flanged, Water, Sewage and Hot Air Services: 1/8-inch-thick, homogeneous black rubber (EPDM), hardness 60 (Shore A), rated to 275°F, conforming to ASME B 16.21 and ASTM D2000 4CA 415 A25 B35 C32 EA14 F19. Full face for Class 125 flat- faced flanges, flat-ring type for Class 250 raised-face flanges. Blind flanges shall be gasketed covering entire inside face with gasket cemented to blind flange. Gasket pressure rating to equal or exceed the system hydrostatic test pressure
Joint Lubricant	Manufacturer's standard

END OF SECTION

SECTION 40 27 00.02

STAINLESS STEEL PIPE AND FITTINGS

Item	Description
Pipe	Stainless Steel, ASTM A 312 ASME SA 312 / ASTM A 358 ASME SA 358, Type 304. Schedule 40
Joints	Welded or Flanged
Fittings	Flanged: 150- or 300-pound malleable iron, ASTM A197/A197M or A47/A47M, dimensions in accordance with ASME B16.3.
Branch Connections	Welded, flanged, straight, or reducing tees in conformance with Fittings specified above.
Unions	Threaded stainless steel, ASTM A 312 ASME SA 312 / ASTM A 358 ASME SA 358, Type 304.

END OF SECTION

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SECTION 40 27 00.03

CARBON STEEL PIPE AND FITTINGS

Item	Description
Pipe	Black Carbon Steel, ASTM A53/A53M, Grade B seamless or ERW. Schedule 40
Joints	Threaded
Fittings	Threaded: 150- or 300-pound malleable iron, ASTM A197/A197M or A47/A47M, dimensions in accordance with ASME B16.3
Branch Connections	Threaded, straight, or reducing tees in conformance with Fittings specified above.
Unions	Threaded malleable iron, ASTM A197/A197M or ASTM A47/A47M, 150-or 300-pound WOG, meeting the requirements of ASME B16.3.
Thread Lubricant	100 percent virgin PTFE Teflon tape

END OF SECTION

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SECTION 40 27 00.10

POLYVYNL CHLORIDE (PVC) PIPE AND FITTINGS

Item	Description
General	Materials in contact with potable water shall conform to NSF 61 acceptance.
Pipe	Schedule 80 for all PVC: Type I. Grade I or Class 12454 conforming to ASTM D1784 and ASTM D1785. Pipe shall be manufactured with titanium dioxide for ultraviolet protection. Threaded Nipples: Schedule 80 PVC
Fittings	Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket weld type and Schedule 80 ASTM D2464 for threaded type. Fittings shall be manufactured with titanium dioxide for ultraviolet protection.
Joints	Solvent socket weld except where connection to threaded valves and equipment may require future disassembly.
Flanges	One-piece, molded hub type PVC flat face flange in accordance with fittings above, ASME B16.1, Class 125 drilling.
Bolting	Flat Face Mating Flange and In Corrosive Areas: ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts. ASTM A194/A194M Grade 8M hex head nuts and ASTM F436 Type 3 washers at nuts and bolt heads. Achieve 40 percent to 60 percent of bolt minimum yield stress. With Raised Face Mating Flange: ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts. ASTM A194/A194M Grade 8M hex head nuts and ASTM F436 Type 3 washers at nuts and bolt heads. Achieve 40 percent to 60 percent of bolt minimum yield stress.
Gaskets	Flat Face Mating Flange: Full faced 1/8-inch-thick ethylene propylene (EPR) rubber. Raised Face Mating Flange: Flat ring 1/8-inch EPR rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.
Solvent Cement	Socket type joints shall be made employing solvent cement that meets or exceeds the requirements of ASTM D2564 and primer that meets or exceeds requirements of ASTM F656, chemically resistant to the fluid service, and as recommended by pipe and fitting manufacturer except solvent weld cement for PVC pipe joints in on site generated oxidant service shall be free of silica filler and shall be certified by the manufacturer to be suitable for that service, IPS Weld-On 724 or approved equal. Certification shall be submitted. Solvent cement and primer shall be listed by NSF 61 for contact with potable water.
Coating	Coat all exterior piping and fittings in accordance with Section 09 90 00.
Thread Lubricant	Teflon tape

END OF SECTION

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SECTION 40 27 00.11

PROCESS TUBING

Item	Location	Description
General	Materials in contact with potable water shall conform to NSF 61 acceptance.	
	Tubing OD and ID shall be compatible with connected equipment fittings	
Tubing	Peristaltic Pump Suction	Polyethylene (PE) or clear polyvinyl chloride (PVC) as recommended by equipment manufacturer for service conditions including: suction lift, flow temperature, and flow rate.
	Peristaltic Pump Discharge	PE or braided PVC of same interior diameter of equipment tubing. Material as recommended by equipment manufacturer for service conditions including: discharge pressure, flow temperature, and flow rate. Pressure rating according to pipe schedule.
	Sampler Discharge	Material as recommended by equipment manufacturer for service conditions or PE conforming to ASTM D2737 and ASTM D3350, and either ASTM D2239 or ASTM F714 depending on fittings.
	Pump Vent Line	
	Equipment Drain and Brine Lines	
Fittings	All	Material in contact with fluid shall be chemically compatible. Fitting style depending on equipment connections: threaded, barb with stainless steel hose clamp or push on with grip rings, speed fittings.
Joints	Not allowed	
Gaskets and O-Rings		Material: fluoroelastomer (FKM) rubber or manufacturer recommended as chemically compatible with fluid in contact.
Thread Lubricant		Teflon® tape

END OF SECTION

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SECTION 40 27 00.12

CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND FITTINGS

Item	Description
General	Materials in contact with potable water shall conform to NSF 61 acceptance.
Pipe	Schedule 80 for all CPVC: Type I, Grade I or Class 12454 conforming to ASTM D1784 and ASTM F441/F441M. Threaded Nipples: Schedule 80 CPVC
Fittings	Schedule to Match Pipe Above: ASTM F439 for socket weld type and Schedule 80 ASTM D437 for threaded type.
Joints	Solvent socket weld except where connection to threaded valves and equipment may require future disassembly.
Flanges	One-piece, molded hub type CPVC flat face flange in accordance with fittings above, ASME B16.1, Class 125 drilling.
Bolting	Flat Face Mating Flange and In Corrosive Areas: ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts. ASTM A194/A194M Grade 8M hex head nuts and ASTM F436 Type 3 washers at nuts and bolt heads. Achieve 40 percent to 60 percent of bolt minimum yield stress. With Raised Face Mating Flange: ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts. ASTM A194/A194M Grade 8M hex head nuts and ASTM F436 Type 3 washers at nuts and bolt heads. Achieve 40 percent to 60 percent of bolt minimum yield stress.
Gaskets	Flat Face Mating Flange: Full faced 1/8-inch-thick fluoroelastomer (FKM) rubber. Raised Face Mating Flange: Flat ring 1/8-inch FKM rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.
Solvent Cement	Solvent weld cement for CPVC pipe joints in on site generated oxidant service shall be free of silica filler and shall be certified by the manufacturer to be suitable for that service, IPS Weld-On 724 or approved equal. Certification shall be submitted. Solvent cement and primer shall be listed by NSF 61 for contact with potable water.
Coating	Coat all exterior piping and fittings in accordance with Section 09 90 00.
Thread Lubricant	Teflon tape

END OF SECTION

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SECTION 40 80 01
PROCESS PIPING LEAKAGE TESTING

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section specifies the hydrostatic and leakage testing of process piping.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Related Sections include the following:
1. Section 40 27 00: Process Piping
 2. Section 40 92 13: Mechanical Appurtenances

1.3 SUBMITTALS

- A. Testing Plan: Submit prior to testing and include at least the following information:
1. Testing dates
 2. Piping systems and section(s) to be tested
 3. Identification of pipeline material
 4. Test type
 5. Test Pressure
 6. Method of isolation
 7. Calculation of maximum allowable leakage for piping section(s) to be tested
- B. Certification of Calibration: Testing Equipment.
- C. Certified Test Report including:
1. Identification of pipeline material
 2. Test fluid
 3. Test pressure
 4. Remarks: Leaks identified (type and location), types of repairs, or corrections made.
 5. Certification by Contractor that the leakage rate measured conformed to the specifications

1.4 TEST PRESSURES

- A. Test pressures for the various services and types of piping are shown on the pipe schedule.

PART 2 MATERIALS (NOT USED)

PART 3 PART 3 EXECUTION

3.1 TESTING PREPARATION

- A. Notify Engineer in writing 5 business days in advance of testing. Perform testing in presence of Engineer.
- B. Pressure Piping:
1. Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.
 2. Wait 10 days minimum after concrete thrust blocking is installed to perform pressure tests. If high-early strength cement is used for thrust blocking and pipe joints and fittings

- are restrained, wait may be reduced to 2 days.
3. When testing mortar-lined or PVC piping, fill the pipe to be tested with water and allow it to soak for at least 48 hours to absorb water before conducting the pressure test.
 4. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
 5. New Piping Connected to Existing Piping: Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Engineer.
- C. Test section may be filled with water and allowed to stand under low pressure prior to testing.
- D. Gravity Piping:
1. Perform testing after service connections, cleanouts, and backfilling have been completed between stations to be tested.

3.2 HYDROSTATIC TEST FOR PRESSURE PIPING

- A. Fluid: Clean water of such quality to prevent corrosion of materials in piping system.
- B. Exposed Piping:
1. Perform testing on installed piping prior to application of insulation.
 2. Maximum Filling Velocity: 0.25 foot per second, applied over full area of pipe.
 3. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four (4) bolts, or use equipment vents to purge air pockets.
 4. Maintain hydrostatic test pressure continuously for 30 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.
 5. Examine joints and connections for leakage.
 6. Correct visible leakage and retest as specified.
 7. Leave pipe full of water after repair of leaks.
- C. Buried Piping:
1. Hydrostatically test each portion of pressure piping, including valved section, at 1.5 times working pressure of piping, based on elevation of lowest point in piping corrected to elevation of test gage.
 2. Conduct hydrostatic testing for at least two (2) hours.
 3. Slowly fill with water portion of piping to be tested, expelling air from piping at high points.
 4. Install corporation cocks at high points.
 5. Close air vents and corporation cocks after air is expelled.
 6. Raise pressure to specified test pressure.
 7. Observe joints, fittings, and valves undergoing testing.
 8. Remove and renew cracked pipes, joints, fittings, and valves that show visible leakage.
 9. Retest.
 10. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
 11. Maintain pressure within plus or minus 5.0 psi of test pressure.
 12. Determine actual leakage by measuring quantity of water necessary to maintain specified test pressure for duration of test.
 13. Maximum Allowable Leakage:

$$L = \frac{S \times D \times P^{1/2}}{133,200}$$

where:

L = Allowable leakage, in gallons per hour

S = Length of pipe tested, in feet

D = Nominal diameter of pipe, in inches

P = Test pressure during leakage test, in pounds per square inch

14. If testing of piping indicates leakage greater than that allowed, locate source of leakage, make corrections, and retest until leakage is within acceptable limits.
15. Correct visible leaks regardless of quantity of leakage.

3.3 HYDROSTATIC TEST FOR GRAVITY PIPING

- A. Testing Equipment Accuracy: $\pm \frac{1}{2}$ -gallon water leakage under specified conditions
- B. Maximum Allowable Leakage: 0.16 gallons per hour per inch diameter per 100 feet. Include service connection footage in test section, subjected to minimum head specified.
- C. Gravity Sanitary and Roof Drain Piping: Test with 15 feet of water to include highest horizontal vent in filled piping. Where vertical drain and vent systems exceed 15 feet in height, test systems in 15-foot vertical sections as piping is installed.
- D. Exfiltration Test
 1. Hydrostatic Head:
 - a. At least 6 feet above maximum estimated groundwater level in section being tested.
 - b. No less than 6 feet above inside top of highest section of pipe in test section, including service connections.
 2. Length of Pipe Tested: Limit length such that pressure on invert of lower end of section does not exceed 30 feet of water column.
- E. Infiltration Test:
 1. Groundwater Level: At least 6 feet above inside top of highest section of pipe in test section, including service connections.
- F. Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.
- G. Defective Piping Sections: Replace or test and seal individual joints, and retest as specified.

3.4 FIELD QUALITY CONTROL

- A. Test Report Documentation:
 1. Test date
 2. Description and identification of piping tested
 3. Test fluid
 4. Test pressure
 5. Remarks, including:
 - a. Leaks (type, location)
 - b. Repair/replacement performed to remedy excessive leakage
 6. Signed by Contractor and Engineer to represent that test has been satisfactorily completed

END OF SECTION

SECTION 40 91 19

INSTRUMENTATION EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Work in this section includes the following:
 - 1. Level Switch (Float Switch)
 - 2. Chemical Tank Low Level Switch (Float Switch)
 - 3. Submersible Level Sensor (Pressure Transducer)
 - 4. Ultrasonic Level Sensor
 - 5. Pressure Indicator
 - 6. Pressure Switch
 - 7. Insertion Style Magnetic Flowmeter (Insertion Magmeter)
 - 8. Inline Magnetic Flowmeter (Inline Magmeter)
 - 9. Inline Rotary Flowmeter (Turbine Flowmeter)
 - 10. Onsite Fill Station Rotary Flowmeter
 - 11. Amperometric Chlorine Analyzer

1.2 SUMMARY

- A. Work and materials specified in this section include instrumentation, mounting hardware, integration, ancillary equipment, replacement parts, and training as required for wastewater treatment plant instrumentation. The instrumentation shall include level, flow, and pressure elements, as well as all appurtenances required to create a complete system. A full description of the requirements of each instrument may be found in this specification with details in the accompanying instrument list. The company supplying this equipment and services shall be the same company as that used in the Related Sections and shall be referred to as the "Integrator."
- B. Related sections:
 - Section 01 30 00: Administrative Requirements.
 - Section 01 33 00: Submittal Procedures.
 - Section 01 70 00: Execution and Closeout Requirements.
 - Section 01 78 23: Operation and Maintenance Data.
 - Section 26 05 00: Basic Electrical Materials and Methods.
 - Section 40 05 53: Identification for Process Piping, Water and Wastewater Equipment.
 - Section 40 96 20: Instrument List.

1.3 REFERENCE STANDARDS

- A. All equipment and materials shall conform to the latest revised editions of applicable standards published by each organization.
- B. All electrical equipment and materials, and the design, construction, installation, and application thereof, shall comply with all applicable provisions of the National Electrical Code (NEC), the Occupational Safety and Health Act (OSHA), and any applicable federal, state, and

local ordinances, rules and regulations.

- C. All materials and equipment specified herein shall be approved by the Underwriter's Laboratories (UL) for the purpose for which they are used and shall bear the testing agencies' label.
- D. American Water Works Association:
 - AWWA C207: Steel Pipe Flanges for Waterworks Service—Sizes 4 in. through 144 in.
 - AWWA C704: Propeller-Type Meters for Waterworks Applications.
 - AWWA M6: Water Meters—Selection, Installation, Testing, and Maintenance. AWWA
 - M33: Flowmeters in Water Supply.
- E. International Society of Automation (ISA):
 - ISA-RP12.06: Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation Part 1: Intrinsic Safety.
- F. National Electrical Manufacturers Association:
 - NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

1.4 COORDINATION

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

1.5 RESPONSIBILITY OF CONTRACTOR AND INTEGRATOR

- A. The Integrator shall be fully and completely responsible for supplying the instrumentation, starting up, configuring, calibrating, and integrating the instruments with the control panels as specified herein and shall be enjoined by the Contractor as a Subcontractor.
 - 1. The headworks wetwell and influent pump station wetwell are Class I Division 1 areas. As such, the Integrator is responsible for intrinsically safe instrumentation and circuitry in accordance with the requirements of Article 504 of the NEC where Contract Documents show replacement of existing with new.
- B. The assignment of specific responsibilities herein to the Integrator shall not, in any way and under any conditions, diminish or usurp the Contractor's full and complete responsibility for all work performed and all materials installed under the contract. The contract between the Contractor and the Integrator shall specifically require that the Integrator conform to and meet all requirements specified herein.
- C. At the option of the Integrator, a manufacturer's field service technician may be used to provide services such as startup, calibration, and warranty service required by this specification. The assignment of specific responsibilities to the manufacturer's field service technician shall not, in any way and under any conditions, diminish or usurp the Contractor's full and complete responsibility for all work performed and all materials installed under the contract.

1.6 INSTRUMENTATION DESCRIPTION

- A. Provide wastewater treatment plant instrumentation consisting of all instruments detailed in the instrument list. The Integrator shall supply all mounting hardware and replacement parts required for proper operation. Additionally, the Integrator shall provide ancillary equipment and supplies as shown on the drawings and as specified herein.
- B. Provide all services required to integrate these instruments with the associated control panel to create a complete system. This shall include coordination of the instrumentation power and signal requirements with the control panel, final termination of the signal and power cables to

the instrument, proper placement of required jumpers and DIP switches, configuration, setup, and testing.

- C. Provide all services required to integrate these instruments with the process and with the physical plant to create a complete system. This shall include coordination of the instrumentation location, connection, and mechanical mounting requirements with the Contractor.
- D. Provide startup, configuration, and calibration of the instrumentation. Each instrument shall be configured so that it reliably provides accurate information to the control system and operator.
- E. Provide training on the care and maintenance of each instrument. Create a list of recommended maintenance procedures required for each instrument. Create a list of recommended replacement parts for the instrumentation supplied.
- F. Provide warranty service for the instrumentation.

1.7 INSTRUMENT SELECTION

- A. The instruments provide the information required for the operators and the control system to make sound judgments regarding process control. Accuracy, dependability, ease of operation, and longevity are paramount in this endeavor. The Integrator is encouraged to propose instrumentation solutions that provide better accuracy, dependability, ease of operation, and longevity, provided each instrument conforms to the minimum requirements of this specification.

1.8 INTEGRATION WITH OTHER EQUIPMENT AND DEVICES

- A. The Integrator shall be solely and completely responsible for the integration of the control panel with all instrumentation as indicated and implied by the plans and these specifications.
- B. Only instrumentation with operating and connection characteristics as defined by the Integrator and approved by the Engineer shall be installed. Instrumentation with operating characteristics other than as defined by the Integrator and approved by the Engineer shall be removed and proper instrumentation shall be installed at no additional cost to the Owner.

1.9 SUBMITTALS

- A. Section 01 33 00–Submittal Procedures: Requirements for submittals.
- B. Product Data: The Integrator shall develop, and the Contractor shall submit to the Engineer, for review and approval, the following project data:
 - 1. A schedule of materials for the system listing all instrumentation, mounting hardware, ancillary equipment, and replacement parts to be provided.
 - 2. Technical data sheets for each instrument.
 - 3. Instrument installation diagrams for each instrument: These diagrams (typically supplied by the manufacturer with the data sheets) shall detail the mounting hardware required to secure each unit to the railing, pipe, or tank as required. If the manufacturer's mounting hardware is not to be used, the Integrator shall provide an AutoCAD drawing in both paper and electronic format of the plan for mounting the hardware. A list of the type of mounting material to be used and the reason for the variance shall also be supplied in both paper and electronic format.
 - 4. Interconnecting wiring diagrams, submitted for the panel, complete with terminal numbers,

and showing all instrumentation.

- C. Shop Drawings: The Integrator shall develop shop drawings detailing the electrical terminations and configurations required for each instrument. Installation details shall include the size, number, type, and location of all interconnecting wiring between the panel, and all instrumentation and sensors that must be connected to the panel. Shop drawings shall be submitted to the Contractor for review and approval. After approval by the Contractor, copies of all shop drawings shall be provided to the Engineer for review and approval.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Include separate Paragraphs for additional certifications.
- F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
- I. Qualifications Statement:
 - 1. Coordinate following Subparagraph with requirements specified in QUALIFICATIONS Article.
 - 2. Submit qualifications for manufacturer

1.10 CLOSEOUT SUBMITTALS

- A. Section 01 70 00–Project Closeout: Requirements for submittals
- B. The Integrator shall develop, and the Contractor shall submit to the Engineer, for review and approval, the following project data prior to substantial completion:
 - 1. User manuals for each instrument.
 - 2. Instrument calibration sheets for all instrumentation, a separate sheet for each instrument in a standardized format. Each instrument calibration sheet shall detail the following information:
 - a. Terminating control panel (e.g., "PCP")
 - b. Instrument designation (egg, "FIT-101")
 - c. Description
 - d. Manufacturer
 - e. Model number (complete)
 - f. Serial number
 - g. Options
 - h. Appurtenances associated with the instrument
 - i. DIP switch and configuration settings
 - j. Discrete/Analog
 - k. Output signal (ego "4-20 mA")
 - l. Full range of operation possible
 - m. Configured range of operation or setpoint if switch
 - n. Calibration requirements and notes on calibration
 - o. Calibration information including date and who calibrated
 - p. General notes
- C. Operation and Maintenance (O&M) Data
 - 1. Furnish manufacturer's installation, lubrication, operation and maintenance manuals,

- bulletins, and spare parts lists.
- 2. Submit bound copies of O&M manuals for each device, including project record documents, instructions for adjustments, calibration and preventative maintenance.
- 3. Include copies of all submitted documentation in Adobe Acrobat PDF format, supplied on compact disc (CD) or USB media format.
- 4. The Integrator shall prepare and assemble detailed operation and maintenance (O&M) manuals in accordance with the requirements of Section 01 78 23-Operation and Maintenance Data. The manuals shall contain data for the instrumentation, which shall include but not be limited to the following:
 - a. Schedule of materials.
 - b. Technical data sheets and user manuals.
 - c. Instrument installation drawings.
 - d. Instrument calibration sheets.
 - e. Calibration requirements.
 - f. Listing of recommended spare parts.
 - g. Listing of recommended maintenance tools and equipment.

1.11 QUALITY ASSURANCE

- A. Performance Verification Testing:
 - 1. The Integrator shall calibrate and certify each instrument is within the accuracy required. Analytical instrument calibrations should be traceable to NIST standards.
 - 2. The Integrator shall test all instrumentation. The Integrator shall test to the maximum and minimum range of operation using plant tanks, piping, equipment, and hardware. Simulations or "bench-top" testing shall not be permitted if the test is deemed non-destructive and practical. Testing shall verify the operation of the transmitter or switch as well as the operation of local indicators.
 - 3. All instrumentation tests shall be non-destructive. Tests potentially harmful to the system shall be simulated outside the system to the best extent possible.
- B. 7-Day Acceptance Testing:
 - 1. Following the performance verification testing and the operator training, the Owner shall continuously test the control system for a period of seven (7) days. The test shall include the requirements for complete plant functionality to include all instrumentation, control, and operator interface issues.
 - 2. The Owner may maintain an observation log of system performance during this phase of testing. The observation log may be reviewed with the Integrator. At the Owner's discretion, waivers may be issued and recorded to clear specific observation if the Integrator explains how the observed behavior does not materially affect the required functionality or performance of the system.
 - 3. All deficiencies shall be corrected and retested unless waived by the Owner.
 - 4. Successful completion of the 7-day acceptance testing is required before the instrumentation and control system shall be considered substantially complete.

1.12 MAINTENANCE MATERIALS

- A. Provide any special tools or instrumentation necessary for normal operation and maintenance.
- B. Maintenance material shall be suitably packaged with labels indicating the contents of each package. The material shall be delivered to the Owner prior to system commissioning.

1.13 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five (5) years' documented experience, unless otherwise specified.

1.14 WARRANTY

- A. In accordance with the requirements of Section 01 70 00-Execution and Closeout Requirements, the Contractor shall guarantee each system to be free of defects in design, materials and workmanship for a period of one (1) year following the date of acceptance, by formal action of the Owner, of all work under the contract.
- B. As part of the guarantee, the Contractor and the Integrator shall indemnify and hold harmless the Owner, the Consultant and their officers, agents and employees against and from all claims and liability arising from all damage and injury due to defects in the control systems.
- C. The Contractor shall cause the Integrator to make any and all repairs, replacements, modifications and adjustments within thirty-six (36) hours of notification. Should the Integrator fail to begin the work within 16 hours or fail to complete the work within 36 hours, the Owner may proceed to undertake or complete the work. In such event, the Contractor and his surety shall be liable for all costs incurred by the Owner.

1.15 DELIVERY, STORAGE, AND HANDLING

- A. Deliver instrumentation and control devices individually wrapped for protection and in suitable packaging to protect against damage.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect equipment from dirt, water, construction debris, and traffic. Provide space heaters if required, to prevent condensation and keep equipment dry.

PART 2 PRODUCTS

2.1 LEVEL SWITCH (FLOAT SWITCH)

- A. Tag Numbers:
 - 1. LS104
- B. General: The level switch shall measure level of the fluid at a single point (point-level measurement). The level switch shall be used to check for filling of a tank or basin.
- C. Performance characteristics:
 - 1. The float switch shall have a single pole double throw (SPDT) switch that is rated at 1 Amp for 120 VAC/150 VDC 25 Watts max non-inductive, or 12 W max inductive and a mechanical life of 10 million operations.
 - 2. The float installation depth shall be per the Water and TOC elevations shown on design drawings. A SPDT relay shall change state upon activating the float.
 - 3. The float cable shall be rated "continuous service" for flexibility and longevity.
- D. Power requirements: NONE.
- E. Connection requirements:
 - 1. The float switch shall be mounted as shown on the Electrical drawings. Mounting

hardware shall be supplied with the float switch and coordinated with the Contractor per the requirements of the drawings.

2. The Integrator shall provide stainless steel cabling and weighted anchor to mount the float switches.
3. The float switch (signal) cable shall be of sufficient length to reach the local junction box as shown on the plan and elevation/section drawings plus have a minimum of 3ft. of cable excess. This excess cable shall be coiled and secured in a manner such that it will not adversely affect the operation of the float nor be a hindrance. The signal cable shall have connections for common, normally open, normally closed, and ground.

F. Materials:

1. The float shall consist of a 5½ in. diameter, 316 stainless steel ball.
2. The float shall be mercury free.
3. All mounting hardware shall be 316 stainless steel. All suspension cable fittings shall be flared and incorporate strain relief jacketing. Cable mounting clips shall be provided with each float switch assembly.
4. The float switch signal cable shall be 16 gauge, 4 cond., SEOW.
5. The float switch shall be UL recognized.

G. Manufacturers:

1. Contegra: Model FS90
2. Siemens: Model 9G-EF
3. Engineer approved equal

H. Qualifications:

1. The float switch manufacturer shall have float switches of this type in similar flowing mediums for a minimum of five (5) years.

I. Warranty:

1. The float switch shall be warranted against defective workmanship or materials for a period of two (2) years from date of shipment.

2.2 CHEMICAL TANK LOW LEVEL SWITCH (FLOAT SWITCH)

A. Tag Numbers:

1. Nil (covered in Section 46 33 13, "Sodium Hypochlorite Generating Equipment," Paragraph 2.8)

B. General: The chemical tank low level switch shall measure level of the fluid at a single point (point-level measurement). The float switch shall be used to detect a low level inside the calcium thiosulfate chemical drum (55 gallon) for the dechlorination system.

C. Performance characteristics:

1. The float switch shall have a single pole double throw (SPDT) switch that is rated at 1 Amp for 120 VAC with a mechanical life of 10 million operations.
2. The float installation depth shall be per the Water and TOC elevations shown on design drawings.. A SPDT relay shall change state upon activating the float.
3. The float cable shall be rated "continuous service" for flexibility and longevity.

D. Power requirements: NONE

E. Connection requirements:

1. The float switch shall be mounted as shown on the mechanical and electrical drawings. Mounting hardware shall be supplied with the float switch and coordinated with the Contractor per the requirements of the drawings.
2. The Integrator shall provide stainless steel cabling at weights to mount the float switches.
3. The float switch (signal) cable shall be of sufficient length to reach the local junction box as shown on the electrical plan drawings plus have a minimum of 3 ft of cable excess. This excess cable shall be coiled and secured in a manner such that it will not adversely affect the operation of the float switch nor be a hindrance. The signal cable shall have connections for common, normally open, normally closed, and ground.
4. The float switch shall be compatible with mounting in a 55 gallon drum. Contractor shall coordinate with drum manufacturer for drum dimensions.

F. Materials:

1. The float material, cable, assemblies, and accessories shall be compatible with and suitable for use with 30% (w/v) calcium thiosulfate solution.
2. The float shall consist of a corrosion resistant body.
3. The float shall be mercury free.
4. All mounting hardware shall be corrosion resistant. All suspension cable fittings shall be flared and incorporate strain relief jacketing.
5. The float shall include a manufacturer recommended weight.

G. Manufacturer:

1. Warrick Controls: Series M
2. Engineer approved equal

H. Qualifications:

1. The float switch manufacturer shall have float switches of this type in similar flowing mediums for a minimum of five (5) years.

I. Warranty:

1. The float switch shall be warranted against defective workmanship or materials for a period of two (2) years from date of shipment.

2.3 SUBMERSIBLE LEVEL SENSOR (PRESSURE TRANSDUCER) - NOT USED

2.4 ULTRASONIC LEVEL TRANSMITTER/CONTROLLER

A. Tag Numbers:

1. LT101 and LT102.

B. MANUFACTURERS

1. Siemens or equal.

C. DESCRIPTION

1. Contactless material/fluid level measurement, where level is calculated based on the measurement of the travel time (temperature compensated) of an ultrasonic signal transmitted from and received by the same sensor.

D. TRANSMITTER/CONTROLLER

1. Microprocessor based with backlit LCD integral display of measured values in

engineering metric units, sensor and electronics failure mode and annunciation, field programmable, menu driven type software limit and control settings (e.g., configuration of fixed hydraulic structure, units, range, zero and span adjustment), self calibration, non volatile memory, remote mounted as indicated.

2. Environmental Requirements:

- a. Enclosure: Corrosive resistant, metal or polycarbonate, horizontal or vertical surface mounted, NEMA rated, suitable for location, as listed.
- b. Operating Temperature: Minus 20 degrees C to 50 degrees C, 0 to 95 percent relative humidity.

E. Control Interface

1. Analog Output Signals:

- a. AO1: Level, 4 20 mA, linear and proportional to range analog current signal, isolated into load between 250 and 1,000 Ω .

F. Connections: Minimum two threaded openings for cable/raceway entries suitable for ½" NPT sized fittings.

G. LEVEL SENSOR

1. Ultrasonic type with build in temperature compensation, contactless fluid level measurement, where level is calculated based on the measurement of the travel time (temperature compensated) of an ultrasonic signal transmitted from and received by the same sensor.
 - a. Range: As listed.
 - b. Beam angle: less than 12 degrees.
 - c. Transmission distance (sensor to transmitter): minimum 200 m.
 - d. 2-inch NPT bracket connection.
2. Process connection, type and size as listed:
 - a. Threaded, NPT sized connection
 - b. Suspended, less than 100 mm for 0 to 10 m range, less the 150 mm for 0 to 20 m range.
 - c. Flange type, 100 mm or 150 mm in diameter, ANSI Class 150.
 - d. Split flange type, 100 mm or 150 mm in diameter, ANSI Class 150, complete with gasket kit.
3. Process Measurement Performance Requirements:
 - a. Accuracy: Plus or minus 0.5 percent of calibrated span.
 - b. Resolution: 2 mm.
 - c. Process Fluid Temperature: 0 to 40 degrees C.
 - d. Mounting: Vertical position, sensor mounting/ housing type (flange, nozzles, etc.) as listed.
4. Environmental Requirements:
 - a. Enclosure: Sealed, capable of withstanding accidental submersion, corrosion resistant, polycarbonate, PVDF or metal, chemically compatible sensor facing, NEMA rated, suitable for location, as listed.
 - b. Operating Temperature: Minus 40 to 50 degrees C, 0 to 95 percent relative humidity.

H. SENSOR MOUNTING

1. Per Contract Drawings.

I. ACCESSORIES

1. Sun shield
2. Mounting brackets/hardware for sensor/transmitter.

2.5 PRESSURE INDICATOR

- A. Tags: Various see P&IDs
- B. General: Each pressure indicator transducer shall measure and display the pressure of fluid. An isolation ring ("iso-ring") shall be required to isolate the pressure indicator from solids in the process flow. The pressure indicator shall be used to check for over-pressure on the outlet of a pump or pressure reservoir.
- C. Performance characteristics:
 - 1. The pressure setting shall be per the drawings.
 - 2. The repeatability of the setpoint shall be within 1% of the range.
 - 3. The pressure indicator shall be suitable for operation at temperatures from -25°C to 65°C .
 - 4. Pressure sensing element shall consist of a diaphragm-sealed piston actuator. This actuator shall be capable of withstanding overpressure bursts up to 3,000 psi.
 - 5. The indicator shall be a 4 $\frac{1}{2}$ in. hermetically sealed, chemical and heat resistant unit.
- D. Power requirements: NONE.
- E. Connection requirements:
 - 1. Sized to mate with the isolation ring, nominally $\frac{1}{4}$ in. NPT.
- F. Materials:
 - 1. 316 SST connections to isolation ring.
 - 2. The casing shall be rated NEMA 4X.
- G. Manufacturers:
 - 1. Ashcroft: Model 1279.
 - 2. Engineer approved equal.
- H. Qualifications:
 - 1. The pressure indicator manufacturer shall have sensors of this type in similar flowing mediums for a minimum of five (5) years.
- I. Warranty:
 - 1. The pressure indicator shall be warranted against defective workmanship or materials for a period of two (2) years from date of shipment.

2.6 PRESSURE SWITCH

- A. Tag Numbers:
 - 1. PS102.
- B. General: The pressure switch shall measure pressure of the fluid at a single point. The pressure switch shall be used to regulate fluid pressure in a pipe network.
- C. Performance characteristics:
 - 1. The pressure switch shall have a diaphragm actuated single pole double throw (SPDT) switch that is rated for 15 Amp with a mechanical life of 10 million operations.
 - 2. The switch installation shall be per the instrument list. A SPDT relay shall change state upon activating the switch.

3. Range: Noted setpoint shall fall between 20 percent and 80 percent of range.
4. Overpressure Proof Pressure: 400 percent of rated maximum static pressure, at a minimum.
5. Operating Temperature Range: 0 °F to 150 °F.
6. Repeatability: $\pm 1\%$ of full range.

D. Power requirements: Pressure switches shall be powered by 24Vdc circuitry.

E. Connection requirements:

1. The pressure switch shall be mounted as shown on the mechanical drawings. Mounting hardware shall be supplied with the pressure switch and coordinated with the Contractor per the requirements of the Drawings.
2. Electrical Connection: $\frac{3}{4}$ -inch FNPT
3. Pressure Connection: $\frac{1}{4}$ -inch FNPT

F. Materials:

1. Enclosure: Epoxy coated, aluminum, NEMA 4X rated
2. Actuator Seal: Teflon
3. Diaphragm: Teflon

G. Manufacturers:

1. Aschcroft: Type 400, B Series
2. United Electric: 400 Series
3. Engineer approved equal

H. Qualifications:

1. The pressure switch manufacturer shall have pressure switches of this type in similar flowing mediums for a minimum of five (5) years.

I. Warranty:

1. The pressure switch shall be warranted against defective workmanship or materials for a period of two (2) years from date of shipment.

J. Warranty:

1. The flowmeter shall be warranted against defective workmanship or materials for a period of two (2) years from date of shipment.

2.7 INLINE MAGNETIC FLOWMETERS ("INLINE MAGMETER")

A. Tag Numbers:

1. FE101/FIT101, FE102 /FIT102

B. General: The inline magnetic flowmeter shall measure the flow of fluid through a pipe. The operation shall be based on Faraday's Law of induction typically utilizing DC bipolar-pulsed coil excitation to induce a magnetic field in the process flow.

C. Performance characteristics:

1. The flowmeter shall be ranged from 0-80 gpm.
2. The accuracy of the flow measurement shall be greater than 0.5% of rate from 1 to 39 ft./s. Accuracy shall be traceable to the U.S. National Institute of Standards and Technology (NIST).

3. Calibration Range: 0 -1500 gpm.
 4. The flowmeter shall be suitable for operation at process temperatures from 0 °F to 140 °F.
- D. Power requirements:
1. The flowmeter shall be powered by the local transmitter.
 2. The transmitter shall be powered by 120 VAC.
- E. Connection requirements:
1. The flowmeter shall be flange-mounted directly in-line with pipe with 150 pound flanges.
 1. The nominal size is shown on the Drawings. The Integrator shall coordinate this connection with the Plans and piping contractor. All fittings and insertion connectors shall be the responsibility of the Contractor.
 2. The transmitter shall supply a 4-20 mA level signal output proportional to the flow.
 3. The flowmeter shall be rated IP68 for sensor submergence with IP68 approved cable glands, conduit connections, and/or conduit plugs.
 4. Jacketed cables shall be grounded in the manner recommended by the manufacturer.
 5. The transmitter shall be remote from the flowmeter; the manufacturer shall make the connection between the flow sensor and the transmitter.
- F. Transmitter:
- a. Indication of flow rate and totalized flow at transmitter.
 - b. Accuracy: 0.4% $\pm$ 1 mm/s
 - c. Output signal: 4-20 mA proportional to flow
 - d. Display: Background illumination with alphanumeric text, 3 x 20 characters
 - e. Enclosure: Fiberglass-reinforced polyamide, NEMA 4X (IP 67)
 - f. Ambient Temperature: From -4 to 122 °F
 - g. Power Requirement: 115 VAC, 60 Hz
 2. The transmitter shall be remote mounted inside the chlorine generation building as shown on the electrical drawings. It shall be equipped with an alphanumeric backlit display to show the flow rate.
 3. An isolated analog 4-20 mA output shall be available to transmit the flow to the PLC. A separate pulse output shall be available to simultaneously transmit the total flow to the PLC.
- G. Sensor
1. Size: as indicated on drawings
 2. Measuring Range: 0 to 10 m/s
 3. Accuracy: 0.2 % $\pm$ 2.5 mm/s
 4. Operating Pressure: Max. 16 bar (Max. 150 psi)
 5. Ambient temperature: From -40 to 158 °F
 6. Liner: Polyurethane
 7. Electrode Material: Type 316 Stainless Steel.
 8. Electrodes: Hastelloy for Measurement; Hastelloy Built-in grounding electrodes
 9. Body Material: Carbon steel, with corrosion resistant two-component epoxy coating
- H. Manufacturers:
1. Emerson: Rosemount Series
 2. Siemens: Sitrans Series
 3. Sparling: Tigermag EP Series
 4. Endress & Hauser: Proline Series

5. Engineer approved equal

I. Qualifications:

1. The flowmeter manufacturer shall have magnetic flowmeters of similar type in similar flowing mediums for a minimum of five (5) years.

J. Warranty:

1. The flowmeter shall be warranted against defective workmanship or materials for a period of two (2) years from date of shipment.

2.8 INLINE ROTARY FLOWMETERS ("TURBINE FLOWMETER") – Not Used

2.9 AMPEROMETRIC CHLORINE ANALYZER

A. Tag Numbers:

1. CLA101

B. General: The amperometric chlorine analyzer shall measure the total residual chlorine concentration in aqueous solutions continuously. The method of measuring total residual chlorine shall be consistent with 40 CFR 136.3(a) Table 1B (17-Electrode). The chlorine analyzer shall be contained in a wall-mounted package including:

1. Three-Electrode Amperometric Chlorine sensor:
 - a. Gold cathode.
 - b. Stainless steel counter electrode.
 - c. Silver/silver chloride reference electrode.
 - d. pH buffered electrolyte.
 - e. Sensor membrane to filter chlorine species selectively and to provide interface between the electrochemical cell and the sample.
2. Chlorine sensor flow cell with integrated flow sensor and control valve.
3. pH flow cell with grab sample port.
4. Digital gateway for communication between probes and controller.
5. Stainless steel instrument mounting panel:
 - a. Length: 19.0 in.
 - b. Width: 19.5 in.
 - c. Depth: 5.95 in.
6. SC-200 digital controller/transmitter by Hach
7. Optional Accessories:
 - a. pH sensor
 - b. Pressure Regulator Sample Condition Kit Assembly: Part #9159900

C. Performance characteristics:

1. Measurement range: 0 to 20 ppm total residual chlorine.
2. Total Residual Chlorine:
 - a. Low Limit Of Detection (LOD): 003 ppm or better
 - b. Limit Of Quantitation (LOQ): 009 ppm or better
 - c. Repeatability/precision: 30 ppb or 3%, whichever is greater
 - d. Response time: 100 s for 90% change at a stable temperature and pH
 - e. Interferences: Chlorine Dioxide, Ozone, and chalk deposits
3. Drift: less than 10% with regular calibration (Calibration shall be weekly to quarterly depending on the application, given stable sample temperature and pH of water sample).
4. Specificity/Selectivity: Non-specific to a certain chlorine form, responds to any chlorine species and other oxidizers as noted in the interferences section above.

5. Calibration method: One and two point calibration shall be available, optionally, to the user.
 6. Verification procedure: One-point process calibration (slope) against a standard reference method.
 7. Operational Criteria
 - a. Operating temperature: 41 to 113 °F.
 - b. Relative humidity: 0-95%, non-condensing.
 8. Sample Requirements
 - a. Maximum back pressure:
 - 1) 0.5 bar, no pressure impulses and/or vibrations.
 - b. Temperature: 33 to 113 °F.
 - c. Temperature compensation range: 41 to 113 °F.
 - d. Flow: 7.9-13.2 gal/hr, 10.6 gal/hr-optimal.
 9. Storage Requirements
 - a. Electrolyte: 59 to 77 °F.
 - b. Chlorine sensors: 32 to 122 °F dry without electrolyte.
 - c. Panel: 4 to 149 °F.
- D. Power requirements:
1. The SC-4500 controller shall be powered by 120VAC. .
 2. The digital gateway shall be powered by 12 VDC from the controller.
 3. The sensors shall be powered by the digital gateway.
- E. Connection requirements:
1. The flowmeter shall be inserted into the flow stream. The connection to the process piping shall be made using an insertion fitting. The Integrator shall coordinate this connection with the piping contractor. All fittings and insertion connectors shall be the responsibility of the Contractor.
 2. The transmitter shall supply a 4-20 mA level signal output proportional to the flow.
 3. The flowmeter shall be rated IP68 for sensor submergence with IP68 approved cable glands, conduit connections, and/or conduit plugs.
 4. Jacketed cables shall be grounded in the manner recommended by the manufacturer.
- F. Transmitter:
1. The total residual chlorine analyzer sensor shall interface to the controller through a digital gateway.
- G. Materials:
1. The flow element shall be made of a material recommended for wastewater use by the manufacturer.
 2. The sensor shaft lining shall be polyurethane or approved equal.
 3. The electrode material shall be 316 stainless steel, or approved equal.
 4. EMC: CE compliant for conducted and radiated emissions CISPR 11 (Class A limits), EMC Immunity EN 61326-1 (Industrial limits).
 5. Safety: General Purpose UL/CSA 61010-1 with cETLus safety mark.
 6. NEMA 4X/IP65 Water and Dust Ingress Ratings.
- H. Manufacturers:
1. Hach: Model CLT10sc Reagentless Total Chlorine Analyzer.
 2. Engineer approved equal.

- I. Qualifications:
 - 1. The manufacturer shall have amperometric chlorine analyzers of similar type in similar flowing mediums for a minimum of five (5) years.
- J. Warranty:
 - 1. The amperometric chlorine analyzer shall be warranted against defective workmanship or materials for a period of two (2) years from date of shipment.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The Integrator shall be responsible for coordinating the installation of each instrument with the Contractor. This shall include installation of the instrumentation, mounting hardware, and ancillary equipment. The instrumentation shall be physically installed by the Contractor or, at the option of the Contractor, by the Integrator in accordance with the installation drawings.
- B. Installation shall include all elements and instruments and all interconnecting wiring between all sensors, instrumentation, junction boxes, and panels. All wiring between panels and instruments shall be labeled at both ends for ease of servicing.
- C. All terminations shall be made with solderless pressure connectors. All wiring shall be in accordance with the requirements of Division 26 Electrical Specifications. Technicians skilled and experienced in the installation of instrumentation and control systems shall make the terminations.
- D. Grounding shall follow NEC and manufacturer requirements. Control signal ground wires shall be electrically connected to ground at a single location so as not to induce ground loops. When powering instrumentation from panels other than their associated control panel, isolation shall be used to interface with the instrument control signal at the control panel. Control signal grounding of instrumentation and equipment shall conform to the manufacturer's standards.
- E. Wiring in hazardous locations shall meet the requirements of the NEC. Installation of instrumentation located in Class I Division 1 locations shall conform to Article 504 of the NEC for Intrinsically Safe Systems. For information on wiring practices, refer to the NEC and ISA-RP12.06–Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation Part 1: Intrinsic Safety. Personnel familiar with the installation of instrumentation in hazardous areas shall perform the installation.
- F. Equipment Locations: The locations of equipment and instrumentation are approximate. The exact locations shall be governed by structural conditions, site conditions, and physical interferences of related systems.
 - 1. Install instrumentation so that access to device ports, enclosures and interface points are readily accessible.
 - 2. Where job conditions require changes in 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, Contractor shall make such changes without additional cost to the Owner.
 - 3. Contractor is responsible for reviewing the minimum and maximum upstream/downstream pipe diameters for each instrument and shall make changes as required to the design to accommodate these clearances without additional cost to the

District.

- G. Install in accordance with NECA "Standard of Installation."
- H. Install instrumentation plumb. Anchor and secure in accordance with manufacturer recommendations and as specified elsewhere.
- I. Install, calibrate and test individual components.
- J. Install instrumentation in accordance with manufacturer recommendations.
- K. Make electrical wiring interconnections.
- L. Install instrumentation nameplates.
- M. Provide grounding and bonding of instrumentation in accordance with manufacturer's requirements and as specified elsewhere.

3.2 CALIBRATION AND STARTUP

- A. The Integrator shall calibrate all instruments after completion of installation. Each instrument shall be configured to be in the range required for the specific application. Instruments that cannot be properly calibrated or that are found to exceed the specified range or accuracy shall be removed and replaced.
- B. The Integrator shall be solely and completely responsible for all maintenance of the instrumentation from time of start-up to the date of acceptance, by formal action of the Owner, of all work under the contract. The Integrator shall correct all deficiencies and defects and make any and all repairs, replacements, modifications, and adjustments as malfunctions or failures occur. The Integrator shall perform all such work required to cause and maintain proper operation of the instrumentation and to properly maintain the control system.
- C. The Contractor and the Integrator shall anticipate that the Owner may delay acceptance of all work under the contract if, in the judgment of the Owner, malfunctions or failures in operation of the instrumentation occur after start-up. Both the Contractor and the Integrator shall not be entitled to an extension of time or to any claim for damages because of hindrances, delays, or complications caused by or resulting from delay by the Owner in accepting the work because of malfunctions or failures in proper operation of the instruments.
- D. General: Prior to commissioning, calibrate devices according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.
- E. Calibration Points: Each instrument shall be calibrated at 20%, 40%, 60%, 80% and 100% of span using calibrated test instruments to simulate inputs. The test instruments shall have accuracies traceable to National Institute of Testing Standards.
- F. 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 prior to commissioning.
- G. Field Calibration: Instruments that were not bench-calibrated shall be calibrated in the field to ensure proper operation in accordance with the instrument loop diagrams or specification data sheets.
- H. Calibration Tags: A calibration and testing tag shall be affixed to each piece of equipment or

system indicating date and name of calibration firm. Calibration firm shall sign the tag when calibration is complete affirming calibration has occurred and is ready to be put into service.

I. Amperometric Chlorine Analyzer:

1. Contractor will include the manufacturer's services to perform start-up on instrument to include basic operational training and certification of performance of the instrument.
2. Contractor will include a manufacturer's Service Agreement that covers all the manufacturer's recommended preventative maintenance, regularly scheduled calibration, and any necessary repairs beginning from the time of equipment startup through to end user acceptance/plant turnover and the first 12 months of end-user operation post turnover.
3. Items 1 and 2 are to be performed by manufacturer's factory-trained service personnel. Field service and factory repair by personnel not employed by the manufacturer is not allowed.
4. Use of manufacturer's service parts and reagents is required. Third-party parts and reagents are not approved for use.

3.3 ADJUSTING

- A. Each device shall be field tested, adjusted and tuned to operate with the process loop. Field test results shall be recorded and submitted to the Owner for their records.

3.4 FIELD TESTING AND COMMISSIONING

A. Electrical Tests

1. Insulation Tests
 - a. Perform resistance measurements through all bolted connections with low-resistance ohmmeter.
 - b. Measure insulation resistance of each control circuit-to-ground.
 - c. Perform an insulation resistance test at 1,000 volts dc on all control wiring. For units with solid-state components, follow manufacturer's recommendations.
2. Test Values: Control wiring insulation test resistance shall be a minimum of two megohms.
3. Check electrical circuits for continuity and for short circuits.

B. Each hardwired point shall be tested and approved with a point verification test prior to the start of the operational tests.

1. Point testing shall include point to point testing of all field connected devices and where modifications have been made to factory provided control panels.
2. Point testing shall not occur until after calibration of devices has occurred.
3. Make corrections and repairs where found prior to proceeding to operational testing.

C. Operational Tests:

1. Procedures, Forms, and Checklists:
 - a. Conduct all testing in accordance with, and documented on, Engineer accepted procedures, forms, and checklists.
 - b. Describe each test item to be performed.
 - c. Have space after each test item description for sign off by appropriate party after satisfactory completion.

3.5 OPERATION AND MAINTENANCE TRAINING

- A. The Integrator shall conduct specifically organized training sessions in operation and maintenance of the instruments for personnel employed by the Owner. The training sessions shall be conducted to educate and train the personnel in maintenance and operation of all instruments. Plant staff trained solely at the Integrator's expense shall possess the capability to fully maintain each instrument. Training shall include, but not be limited to, the following:
 - 1. Normal maintenance procedures
 - 2. Troubleshooting
 - 3. Calibration
 - 4. Testing
- B. A minimum of one (1) training session of four (4) hours in duration shall be conducted onsite following start-up of the instrumentation. The Integrator shall prepare and assemble specific instruction materials for the training session and shall supply such materials to the Owner at least four (4) weeks prior to the time of the training.
- C. The Integrator shall be completely responsible for ensuring the Owner's staff is fully able to perform necessary maintenance on the analytical sensors. This shall include, but is not limited to, preparing reagents, replacing junctions, changing chemical solutions within the analytical sensors, calibrating the transmitter, and all services necessary to provide a working, dependable measurement. Due to the variability in maintenance times of different manufacturer's sensors, the above time may be insufficient. The Integrator shall be responsible for providing such time as required to teach proficiency with the analytical instruments provided. Failure to provide sufficient training on the maintenance of the analytical equipment shall be grounds for warranty service by the Integrator at no cost to the Owner.

END OF SECTION

SECTION 40 92 13
MECHANICAL APPURTENANCES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Chemical Injectors
 - 2. Static Mixers
 - 3. Pulsation Dampeners
 - 4. Inlet Strainers
- B. Related Sections:
 - Section 01 30 00: Administrative Requirements
 - Section 01 33 00: Submittal Procedures
 - Section 01 43 33: Manufacturers Field Services
 - Section 01 60 00: Product Requirements
 - Section 01 70 00: Project Closeout
 - Section 40 91 19: Instrumentation Equipment

1.2 REFERENCE STANDARDS - NOT USED.

1.3 PREINSTALLATION MEETINGS

- A. Section 01 30 00 – Administrative Requirements: Requirements for preinstallation meeting.

1.4 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.
- B. Product Data:
 - 1. Submit manufacturer information for system materials and component equipment, including performance characteristics.
 - 2. Documentation showing compatibility with process fluid and service specified and indicated.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
 - 2. Submit shop drawing data for accessory items.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
- G. Qualifications Statement: Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Project Closeout: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations of mechanical appurtenances.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 – Project Closeout: Requirements for maintenance materials.

1.7 QUALITY ASSURANCE

- A. Services of Manufacturer's Representative shall be as stated in Section 01 43 33 – Manufacturers Field Services and specified herein.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three years' documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 – Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing them in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.10 WARRANTY

- A. Section 01 70 00 – Project Closeout: Requirements for warranties.

PART 2 PRODUCTS

2.1 CHEMICAL INJECTORS

- A. General:
 - 1. Chemical Injector configuration shall provide a single feed point into the center of the water main.
 - 2. Materials of construction shall be compatible with chemical solution and be capable of withstanding maximum pump discharge line pressure and water main pressure.
 - 3. Chemical Injectors shall include an integrated spring check valve to prevent backflow into chemical solution feed system.
- B. Filter Effluent Disinfection Solution Chemical Injector:
 - 1. General:

- a. Filter Effluent Disinfection Solution Injector shall deliver disinfectant solution to the center of the Filter Effluent flow stream at all filter effluent and chemical dosing flow rates specified herein to meet disinfection requirements.
 - b. Location: Downstream of Filter Effluent Pumps, as indicated on Drawings.
 2. Manufacturers:
 - a. SAF-T-FLO Water Services, Inc., Model IQ-50-E-5-8-S-H.
 - b. Engineer approved equal.
 3. Performance and Design Criteria:
 - a. Liquids:
 - 1) Injection Fluid: 0.4% chlorine, mixed oxidant solution
 - 2) Process Water: Treated wastewater
 - b. Flow Rates:
 4. Injector: 71 gallons per hour
 5. Process: 900 gallons per minute
 - a. Maximum Working Pressure: 150 psi
 - b. Pipe Connections:
 - 1) Process Flow Pipe Size: 8 in.
 - 2) Chemical Feed Pipe Size: ½ in.
 - 3) Injector Assembly:
 - a) Process Main Connection Size: ¾ in. MNPT
 - b) Feed Pipe Connection Size: ½ in. MNPT
 - 4) Threaded connections, assembly materials, and backflow prevention devices shall be capable of withstanding maximum pipe pressures.
 6. Materials:
 - a. Chemical Feed Pipe Material: Schedule 80 PVC
 - b. Injector Assembly:
 - 1) Injector Seal: EPDM
 - 2) Body Material: 316 Stainless Steel
 - c. Process Flow Pipe Material: Ductile Iron Pipe
- C. Recycled Water Disinfection Solution Chemical Injector:
 1. General:
 - a. Recycled Water Disinfection Solution Injector shall deliver disinfectant solution to the center of the Recycled Water Influent flow stream at all Recycled Water and chemical dosing flow rates specified herein to meet disinfection requirements.
 - b. Location: Upstream of Recycled Water Chlorine Contact Basin, as indicated on Drawings.
 2. Manufacturers:
 - a. Koflo Corporation, Model QP-.5-3.
 - b. Engineer approved equal.
 3. Performance and Design Criteria:
 - a. Liquids:
 - 1) Injection Fluid: 0.4% chlorine, mixed oxidant solution.
 - 2) Process Water: Treated wastewater.
 - b. Flow Rates:
 - 1) Injector: 3.7gallons per hour.
 - 2) Process: 56 gallons per minute.
 - c. Maximum Working Pressure: 150 psi.
 - d. Pipe connections:
 - 1) Chemical Feed Pipe Size: ½ in.
 - 2) Process Flow Pipe Size: 2 in.
 - 3) Threaded connections, assembly materials, and backflow prevention devices shall be capable of withstanding maximum pipe pressures.
 4. Materials:
 - a. Chemical Feed Pipe Material: Schedule 80 PVC.
 - b. Injector Assembly:

- 1) Body Material: PVC.
 - 2) Process Main Connection Size: ½ in. MNPT.
 - 3) Feed Pipe Connection Size: ½ in. FNPT.
- c. Process Flow Pipe Material: PVC.

2.2 STATIC MIXERS

- A. General:
1. Static mixers shall be inline type mixers to create sufficient turbulence to thoroughly mix the chemical injection fluid with the process fluid.
 2. Static mixers shall include flange fittings or coupler fittings to allow simple removal and cleaning.
- B. Recycled Water Static Mixer:
1. Manufacturers:
 - a. Koflo Corporation, Model KD-1010 2-80-4-4.2-9.I(.50).
 - b. Engineer approved equal.
 2. Performance and Design Criteria:
 - a. Liquids:
 - 1) Injection Fluid: 0.4% chlorine, mixed oxidant solution.
 - 2) Process Water: Treated wastewater.
 - b. Flow Rates:
 - 1) Injection Fluid: 3.7 gallons per hour.
 - 2) Process Water: 56 gallons per minute.
 - c. Maximum Working Pressure: 150 psi.
 - d. Maximum Headloss: 5 psi @ 56 gpm.
 - e. Maximum Length: 26 in.
 - f. Process Main Connection Size: 2 in. Van Stone Flange.
 - g. Chemical Injector Assembly Size: ½ in. FNPT.
 - h. Threaded connections, assembly materials, and backflow prevention devices shall be capable of withstanding maximum pipe pressures.
 3. Materials:
 - a. Body Material: PVC.
 - b. Flange Material: PVC.
 - c. Chemical Injector Assembly Material: PVC.

2.3 PULSATION DAMPENERS

- A. General:
1. Pulsation dampeners shall reduce or eliminate fluid pulsation resulting from positive displacement pumps that may affect proper function of downstream instrumentation, including chlorine analyzers.
- B. Manufacturers:
1. Blacoh Fluid Controls, Inc., Model: Hybrid Valve H10-025-VV-ET.
 2. Engineer approved equal.
- C. Performance and Design Criteria:
1. Integrated back-pressure valve.
 2. Integrated chargeable air bladder.
 3. Maximum Working Pressure: 150 psi.
 4. Inlet/Outlet Connection size: ½ in. NPT.
- D. Materials:
1. Body material: PVC.
 2. Bladder material: EPDM.

3. Diaphragm material: PTFE.
4. Spring material: Zinc plated carbon steel.

2.4 INLET STRAINERS

- A. General:
 1. Inlet strainers shall be installed on the inlet/suction end of sample tubing and small diameter (1 in. and below) piping to reduce intake of debris from the sample solution.
- B. Manufacturers:
 1. Morrison Bros. Co., Model: 934-0500 AS
 2. Engineer approved equal
- C. Performance and Design Criteria:
 1. Mesh Size: 20
- D. Materials:
 1. Body and Screen material: 316 Stainless Steel

PART 3 EXECUTION

3.1 INSTALLATION

- A. Prior to installation, protect stored appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, vandalism, etc.
- B. Clean all debris and foreign materials from inside of piping before installing appurtenances.
- C. Clean out debris and foreign material from openings and seats, test operating mechanisms to check functioning, and check nuts and bolts for tightness.
- D. Erect and support appurtenances in respective positions free from distortion and strain during handling and installation.
- E. Inspect material for defects in workmanship and material.
- F. Repair appurtenances and other equipment that do not operate easily or are otherwise defective at no additional cost to the Owner.
- G. Field Testing:
 1. Pressure test appurtenances with pipeline pressure testing.
- H. Contract Closeout:
 1. Provide in accordance with Section 01 70 00–Execution and Closeout Requirements.

END OF SECTION

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SECTION 40 94 00
CONTROL STRATEGY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Loop descriptions
 - a. Specific control requirements and functional description for individual control loops
 - b. Alarm notifications

PART 2 INFLUENT PUMPING SYSTEM

2.1 INFLUENT PUMPING SYSTEM *(EXISTING SYSTEM DESCRIBED FOR INFORMATION PURPOSES)*

- A. The Influent Pumping System I/O and logic is contained solely within PCP-300. It is comprised of one (1) band screen, one (1) grinder, and three (3) pumps. These pumps are controlled by starters housed within the MCC 3 in the Blower Room.
- B. Instruments associated with the Influent Pumping System include one (1) flow meter and one (1) level transmitter

2.2 EQUIPMENT AND INSTRUMENTATION

EQUIPMENT, INSTRUMENTS, AND I/O NAME	HMI TAG NAME	ALARM	LOG	SPAN /NOTES
M301 BAND SCREEN				
Band Screen Fault		Fault		
M303 Grinder				
Grinder Fault		Fault		
FIT 303 Influent Flowmeter (Parshall Flume)				
Influent Flow	INFLUENT FLOW			0-XXXX MGD
LT 304 Influent Wet Well Level				
Influent Wet Well Level	INFLUENT LEVEL			0-XXX Feet
Influent Pump P301				
Influent Pump P301 in Auto	P301 IN AUTO			
Influent Pump P301 Running	P301 RUNNING			
Influent Pump P301 Fault	P301 FAULT	Fault		
Influent Pump P301 Start	P301 START COMMAND			
Influent Pump P302				
Influent Pump P302 in Auto	P302 IN AUTO			
Influent Pump P302 Running	P302 RUNNING			

Influent Pump P302 Fault	P302 FAULT	Fault		
EQUIPMENT, INSTRUMENTS, AND I/O NAME	HMI TAG NAME	ALARM	LOG	SPAN /NOTES
Influent Pump P302 Start	P302 START COMMAND			
Influent Pump P303				
Influent Pump P303 in Auto	P303 IN AUTO			
Influent Pump P303 Running	P303 RUNNING			
Influent Pump P303 Fault	P303 FAULT	Fault		
Influent Pump P303 Start	P303 START COMMAND			
PLC 300				
Influent Flow Total Today	INFLUENT FLOW TODAY			
Influent Flow Total Yesterday	INFLUENT FLOW YESTERDAY			
Influent Wet Well Level Lead Pump Start Setpoint	INFLUENT START SP			
Influent Wet Well Level Pumps Stop Setpoint	INFLUENT STOP SP			
Influent Pump Lag Timer	INFLUENT LAG DELAY SP			
Influent Pump Standby Timer	INFLUENT STANDBY DELAY SP			
Influent Wet Well High Level Alarm	INFLUENT HIGH ALARM			
Influent Wet Well Low Level Alarm	INFLUENT LOW ALARM			
Influent Wet Well High-High Alarm	INFLUENT HIGH_HIGH ALARM			
Influent Wet Well Low-Low Alarm	INFLUENT LOW_LOW ALARM			
Influent Pump Lead/Lag Alternate Selection	INFLUENT LEAD			0=Alternate, 1=pump 301, 2=pump 302, 3=pump 303
Influent Pump P301 Fail-to-Start	INFLUENT P301 FTS	ALARM		
Influent Pump P302 Fail-to-Start	INFLUENT P302 FTS	ALARM		
Influent Pump P303 Fail-to-Start	INFLUENT P303 FTS	ALARM		

2.3 LOCAL CONTROL

- A. Each of the influent pumps can be locally controlled by the motor control center (MCC) mounted hand/off/auto (HOA) switch.

2.4 CONTROL SYSTEM AUTO

- A. From the human-machine interface (HMI), any of the three (3) pumps can be selected as the

lead pump, or they can be put in auto rotate. The Lead/Lag/Standby selection rotates at the time all pumps are stopped.

- B. The lead pump will be called to run on level rising above the Pump Lead Start setpoint. The lag pump will be called to run on level rising above the Pump Lag Start setpoint. The standby
- C. pump will be called to run on level rising above the Pump Standby Start setpoint. Should the level fall below the Pump Stop setpoint, all pumps will stop.
- D. Lead, Lag or Alternating Start can be selected from the HMI. Lead selection for a pump means the selected lead pump will always start first and the other pumps (lag and standby) will only start if needed. Alternating Start means after each pumping cycle, the Lead/Lag/Standby Pump selection will automatically switch between pumps.

2.5 ALARMS AND SPECIAL CONDITIONS

- A. During any pumping sequence, a pump fail-to-start or a pump fault will automatically take that pump out of rotation and notify the operator of the alarm condition. The lag becomes lead and the standby becomes lag and the failed pump is OOS (out of service).
- B. Influent Wet Well High Level will immediately call all pumps to run and notify the operator of the alarm condition.
- C. Influent Wet Well Low Level will prevent a pump from running.
- D. A fault on the band screen or a fault on the grinder will notify the operator.
- E. The health of the wet well level will be monitored; if there is an out-of-range value, the operator will be notified.

2.6 FLOWS AND PUMP RUNTIMES

- A. The flow rate will be displayed on the HMI.
- B. The day's total flow will be calculated from midnight to midnight and displayed as that day's current flow.
- C. The previous days' total flow will be displayed until midnight of the following day.
- D. The total runtime hours for each pump will be displayed.

PART 3 BACKWASH FILTER SYSTEM *(EXISTING SYSTEM DESCRIBED FOR INFORMATION PURPOSES, ONLY RETURN PIPEWORK REPLACEMENT IS INCLUDED IN CONTRACT SCOPE)*

3.1 BACKWASH FILTER SYSTEM

- A. The PLC I/O associated with the filter backwash pumps and the filter valves and the logic is contained solely within PLC-200. The I/O associated with Filter Backwash Air Blower is in PLC 300.
- B. The filter backwash system is composed of two (2) filter backwash pumps, two (2) filter backwash return pumps, one (1) filter backwash air blower, four (4) pneumatic filter backwash air valves, four (4) pneumatic filter BW valves, and (four 4) pneumatic filter BW effluent valves.

- C. Instruments associated with the Influent Pumping System includes four (4) filter high level float switches and one (1) filter backwash basin high level float switch.

3.2 EQUIPMENT AND INSTRUMENTATION

EQUIPMENT, INSTRUMENTS, AND I/O NAME	HMI TAG NAME	ALARM	SPAN /NOTES
Filter Backwash Pump P205			
Filter Backwash Pump P205 in Auto	P205 IN AUTO		
Filter Backwash Pump P205 Running	P205 RUNNING		
Filter Backwash Pump P205 Fault	P205 FAULT	Fault	
Filter Backwash Pump P205 Start	P205 START COMMAND		
Filter Backwash Pump P206			
Filter Backwash Pump P206 in Auto	P206 IN AUTO		
Filter Backwash Pump P206 Running	P206 RUNNING		
Filter Backwash Pump P206 Fault	P206 FAULT	Fault	
Filter Backwash Pump P206 Start	P206 START COMMAND		
Backwash Return Pump P203			
Backwash Return Pump P203 in Auto	P203 IN AUTO		
Backwash Return Pump P203 Running	P203 RUNNING		
Backwash Return Pump P203 Fault	P203 FAULT	Fault	
Backwash Return Pump P203 Start	P203 START COMMAND		
Backwash Return Pump P204			
Backwash Return Pump P204 in Auto	P204 IN AUTO		
Backwash Return Pump P204 Running	P204 RUNNING		
Backwash Return Pump P204 Fault	P204 FAULT	Fault	
Backwash Return Pump P204 Start	P204 START COMMAND		
Filter Backwash Air Blower BLO304			
Backwash Air Blower BLO304 in Auto	BLO304 IN AUTO		PLC 300
Backwash Air Blower BLO304 Running	BLO304 RUNNING		PLC 300
Backwash Air Blower BLO304 Fault	BLO304 FAULT		PLC 300
Backwash Air Blower BLO304 Start	BLO304 START COMMAND		PLC 300
Filter Effluent Valves			
MOV201 F1 Effluent valve Full Open	MOV201 F1 Effluent Open		
MOV201 F1 Effluent valve Full Close	MOV201 F1 Effluent Open		
MOV201 F1 Effluent valve Open	MOV201 F1 Effluent Open Cmd		

cmnd			
MOV201 F1 Effluent valve Close cmnd	MOV201 F1 Effluent Open Cmd		
MOV202 F2 Effluent valve Full Open	MOV202 F2 Effluent Open		
MOV202 F2 Effluent valve Full Close	MOV202 F2 Effluent Open		
MOV202 F2 Effluent valve Open cmnd	MOV202 F2 Effluent Open Cmd		
MOV202 F2 Effluent valve Close cmnd	MOV202 F2 Effluent Open Cmd		
MOV203 F3 Effluent valve Full Open	MOV203 F3 Effluent Open		
MOV203 F3 Effluent valve Full Close	MOV203 F3 Effluent Open		
MOV203 F3 Effluent valve Open cmnd	MOV203 F3 Effluent Open Cmd		
MOV203 F3 Effluent valve Close cmnd	MOV203 F3 Effluent Open Cmd		
MOV204 F4 Effluent valve Full Open	MOV204 F4 Effluent Open		
MOV204 F4 Effluent valve Full Close	MOV204 F4 Effluent Open		
MOV204 F4 Effluent valve Open cmnd	MOV204 F4 Effluent Open Cmd		
MOV204 F4 Effluent valve Close cmnd	MOV204 F4 Effluent Open Cmd		
Filter Backwash Valves			
MOV205 F1 Backwash valve Full Open	MOV205 F1 BW Open		
MOV205 F1 Backwash valve Full Close	MOV205 F1 BW Open		
MOV205 F1 Backwash valve Open cmnd	MOV205 F1 BW Open Cmd		
MOV205 F1 Backwash valve Close cmnd	MOV205 F1 BW Open Cmd		
MOV206 F2 Backwash valve Full Open	MOV206 F2 BW Open		
MOV206 F2 Backwash valve Full Close	MOV206 F2 BW Open		
MOV206 F2 Backwash valve Open cmnd	MOV206 F2 BW Open Cmd		
MOV206 F2 Backwash valve Close cmnd	MOV206 F2 BW Open Cmd		
MOV207 F3 Backwash valve Full Open	MOV207 F3 BW Open		
MOV207 F3 Backwash valve Full Close	MOV207 F3 BW Open		
MOV207 F3 Backwash valve Open cmnd	MOV207 F3 BW Open Cmd		
MOV207 F3 Backwash valve Close cmnd	MOV207 F3 BW Open Cmd		

MOV208 F4 Backwash valve Full Open	MOV208 F4 BW Open		
MOV208 F4 Backwash valve Full Close	MOV208 F4 BW Open		
MOV208 F4 Backwash valve Open cmnd	MOV208 F4 BW Open Cmd		
MOV208 F4 Backwash valve Close cmnd	MOV208 F4 BW Open Cmd		
Filter Backwash Air Valves			
MOV209 F1 Backwash Air valve Full Open	MOV209 F1 BW Air Open		
MOV209 F1 Backwash Air valve Full Close	MOV209 F1 BW Air Open		
MOV209 F1 Backwash Air valve Open cmnd	MOV209 F1 BW Air Open Cmd		
MOV209 F1 Backwash Air valve Close cmnd	MOV209 F1 BW Air Open Cmd		
MOV 210 F2 Backwash Air valve Full Open	MOV 210 F2 BW Air Open		
MOV 210 F2 Backwash Air valve Full Close	MOV 210 F2 BW Air Open		
MOV 210 F2 Backwash Air valve Open cmnd	MOV 210 F2 BW Air Open Cmd		
MOV 210 F2 Backwash Air valve Close cmnd	MOV 210 F2 BW Air Open Cmd		
MOV 211 F3 Backwash Air valve Full Open	MOV 211 F3 BW Air Open		
MOV 211 F3 Backwash Air valve Full Close	MOV 211 F3 BW Air Open		
MOV 211 F3 Backwash Air valve Open cmnd	MOV 211 F3 BW Air Open Cmd		
MOV 211 F3 Backwash Air valve Close cmnd	MOV 211 F3 BW Air Open Cmd		
MOV 212 F4 Backwash Air valve Full Open	MOV 212 F4 BW Air Open		
MOV 212 F4 Backwash Air valve Full Close	MOV 212 F4 BW Air Open		
MOV 212 F4 Backwash Air valve Open cmnd	MOV 212 F4 BW Air Open Cmd		

MOV 212 F4 Backwash Air valve Close cmnd	MOV 212 F4 BW Air Open Cmd		
PLC 200			
LS201 F1 Filter High	LS201 F1 High Alarm		
LS202 F2 Filter High	LS202 F2 High Alarm		
LS203 F3 Filter High	LS203 F3 High Alarm		
LS204 F4 Filter High	LS204 F4 High Alarm		
LS205 Filter BW Basin Low	LS205 F4 BW Basin Low		
LS206 Filter BW Basin High	LS205 F4 BW Basin High		
P203 BW Return Pump Fail-to-Start	P203 BW Return FTS		
P204 BW Return Pump Fail-to-Start	P204 BW Return FTS		

3.3 LOCAL CONTROL

- A. Only one (1) filter can be backwashed at a time.
- B. Select the filter to backwash with the "Filter Selector" switch, for example, turn the filter selector switch to "F2."
- C. Open both the backwash air valve and backwash valve for the selected filter with the appropriate 3-position selector switch to Open.
- D. Close the Effluent Valve for the selected filter with the 3-position selector switch to Close.
- E. Start the backwash blower with the 3-selector position switch "Backwash Blower BLO204" to Hand.
- F. Start one (1) of the two (2) backwash pumps (P205 or P206) by rotating the selected 3-position switch to Hand.
- G. After one (1) minute, shut off Backwash Blower BLO204.
- H. After two (2) more minutes, shut off the Backwash Water Pump.
- I. Close the Backwash and BW Air valves.
- J. Repeat for each of the four (4) filters.

3.4 CONTROL SYSTEM AUTO

- A. The PLC control panel is wired to allow for automatic backwash in the future, but at this time, there is no automatic backwash for any of the filters.
- B. From the HMI either of the two Backwash Return Pumps (P203 and P204) can be selected as the lead pump or they can be put in auto rotate mode. The lead pump will rotate between the two at the time all pumps are de-energized and all permissives are met. Only one (1) pump will run at a time.
- C. On High Level Switch (LS206) the Lead Backwash Return Pump shall be energized and latched in until the Low Level Switch (LS205) is toggled.

3.5 ALARMS AND SPECIAL CONDITIONS

- A. Filter High Level switches will alarm on HMI.

PART 4 PLANT EFFLUENT CHLORINE CONTACT BASIN (NEW WORK INCLUDED IN CONTRACT SCOPE)

4.1 PLANT EFFLUENT CHLORINE CONTACT BASIN

- A. The PLC I/O associated with the Chlorine Contact Basin is split between PLC-100 and PLC-200. The logic is contained in PLC-100. It is comprised of two (2) filter effluent pumps, two (2) disinfection metering pumps (chlorine), and one (1) dechlorination metering pump.
- B. Instruments associated with the Chlorine Contact Basin include one (1) Effluent flow meter, one (1) level transmitter in the effluent pump station, one (1) combination Cl₂ residual/pH analyzer in the Chlorine Contact Basin and one (1) low level switch for the Dechlorinating Day tank.
- C. The chlorine used for disinfection is manufactured on site utilizing equipment and controls from "MIOX." MIOX has a PLC and HMI and is a stand-alone vendor-supplied package.

4.2 EQUIPMENT AND INSTRUMENTATION

EQUIPMENT, INSTRUMENTS, AND I/O NAME	HMI TAG NAME	ALARM	LOG	SPAN /NOTES
PLC 200				
Filter Effluent Pump P201				
Filter Effluent Pump P201 in Auto	P201 IN AUTO			PLC-200
Filter Effluent Pump P201 Running	P201 RUNNING			PLC-200
Filter Effluent Pump P201 Fault	P201 FAULT	Fault		PLC-200
Filter Effluent Pump P201 Start	P201 START COMMAND			PLC-200
Filter Effluent Pump P202				
Filter Effluent Pump P202 in Auto	P202 IN AUTO			PLC-200
Filter Effluent Pump P202 Running	P202 RUNNING			PLC-200
Filter Effluent Pump P202 Fault	P202 FAULT	Fault		PLC-200
Filter Effluent Pump P202 Start	P202 START COMMAND			PLC-200
RW Transfer Pump P208				
RW Transfer Pump P208 in Auto	P208 IN AUTO			PLC-200
RW Transfer Pump P208 Running	P208 RUNNING			PLC-200
RW Transfer Pump P208 Fault	P208 FAULT			PLC-200
RW Transfer Pump P208 Start	P208 START COMMAND			PLC-200
Filter Effluent				
Filter Effluent Flow Total Today	INFLUENT FLOW TODAY			

Filter Effluent Flow Total Yesterday	INFLUENT FLOW YESTERDAY			
Filter Effluent Wet Well Level Lead Pump Start Setpoint	INFLUENT START SP			
Filter Effluent Wet Well Level Pump Stop Setpoint	INFLUENT STOP SP			
Filter Effluent Wet Well Level Lag Pump Start Setpoint	INFLUENT LAG DELAY SP			
Filter Effluent Wet Well High Level Alarm	INFLUENT HIGH ALARM			
Filter Effluent Wet Well Low Level Alarm	Filter Effluent LOW ALARM			
Filter Effluent Pump Lead/Lag Alternate Selection	Filter Effluent LEAD			0=Alternate, 1=pump 301, 2=pump 302, 3=pump 303
Filter Effluent Pump P201 Fail-to-Start	Filter Effluent P301 FTS	ALARM		
Filter Effluent Pump P202 Fail-to-Start	Filter Effluent P302 FTS	ALARM		
Chlorine Resid Setpoint	Cl ₂ Setpoint			
Chlorine Resid Deadband	Cl ₂ Deadband			
Chlorine Flow Bias	Cl ₂ Bias			
Chlorine High Alarm	Cl ₂ High Alarm	Alarm		
Chlorine Low Alarm	Cl ₂ Low Alarm	Alarm		
Temperature High Alarm	Temp High Alarm	Alarm		
pH High Alarm	pH High Alarm	Alarm		
pH Low Alarm	pH Low Alarm	Alarm		
Chlorine Metering Pumps				
Chlorine Metering Pump P105	Speed Control			PLC-100
Chlorine Meter Pump P106	Speed Control			PLC-100
Dechlorination Meter Pump				
Dechlorination Metering Pump P107	Speed Control			PLC-100

4.3 LOCAL CONTROL

- A. Each of the Filter Effluent Pumps can be locally controlled by the HOA at the MCC.
- B. Each metering pump can be controlled locally from the HMI on each pump.

4.4 CONTROL SYSTEM AUTO-FILTER EFFLUENT PUMPS

- A. From the HMI, either of the two (2) Filter Effluent Pumps can be selected as the lead pump, or they can be put in auto rotate. The auto lead/lag rotates at the time all pumps are stopped.
- B. The lead pump will be called to run on level rising above the Pump Lead Start setpoint. The lag pump will be called to run on level rising above the Pump Lag Start setpoint. Should the level fall below the Pump Stop setpoint, all pumps will stop.

- C. Lead, Lag or Alternating Start can be selected from the HMI. Lead selection for a pump means the selected Lead Pump will always start first and the other Pumps (Lag) will only start if needed. Alternating Start means after each pumping cycle, the Lead/Lag/Standby Pump selection will automatically switch between pumps.

4.5 RECYCLE WATER TRANSFER PUMP, P208, CONTROL SYSTEM AUTO

- A. The Recycled Water Transfer Pump, P208, will be called to run on level in the Recycle Water Storage Tank-1, LT101, falling below the operator selected pump start setpoint. The level in the Filter Effluent Pump Station (LT201) will be monitored and used as a permissive for energizing this pump.
- B. The Recycled Transfer Water Pump, P208, will be de-energized on level in the Recycle Water Storage Tank-1, LT101, rising above the operator selected pump Stop Setpoint.
- C. P208 has a HOA switch to allow for local control.
- D. During a pumping sequence for services with a single pump, P208, pump fail-to-start or pump fault will alarm the operator.

4.6 CONTROL SYSTEM CHLORINE METERING PUMPS

- A. The disinfection metering pump speed will be manually controlled by the operator at the pump. The operator will either select P105 or P106 to be the duty pump at a screen on PLP-100. The duty pump will run with the FE pumps (P201 or P202) are running. The operator will monitor (CLA201) and alter the speed of the pump or the selected duty pump to achieve the desired chlorine residual.
- B. The chlorine metering pumps will shut down when a low level signal is generated by the OSG solution tank.
- C. Chlorine Residual Monitoring
 - 1. Monitor chlorine residual. Display residual in milligrams per liter (X.X mg/L). Shut down well pumps if chlorine residual alarm occurs.
 - a. Chlorine residual
 - 2. Provide analog input for the following:
 - a. Chlorine residual, this shall be calculated based on the chlorine contact time and retention time which is calculated from FIT101, and the basin volume (which varies depending on LT101). There shall be an option to override the CT determination of the chlorine residual to allow the operator to manually input their own chlorine residual.
 - b. Chlorine contact time
 - 3. Provide HMI status indication for the following:
 - a. Chlorine residual
 - b. Chlorine contact time
 - 4. Provide HMI alarm indication for the following:
 - a. Chlorine residual is higher than high set point
 - b. Chlorine residual is lower than low set point.
 - c. Enable chlorine residual alarm and shutdown 15 minutes (adjustable 0 – 60 minutes) after recycled water transfer pump (P208) starts.
- D. pH Monitoring
 - 1. Monitor pH. Display pH (X.X pH).
 - a. pH
 - 2. Provide analog input for the following:

- a. pH
3. Provide HMI status indication for the following:
 - a. pH
4. Provide HMI alarm indication for the following:
 - a. pH is higher than high set point
 - b. pH is lower than low set point.
 - c. Enable pH alarm and shutdown 15 minutes (adjustable 0 – 60 minutes) after well pump starts.

E.

PART 5 RECYCLED WATER CHLORINE CONTACT BASIN (NEW WORK INCLUDED IN CONTRACT SCOPE)

5.1 RECYCLED WATER CHLORINE CONTACT BASIN

- A. Recycled water chlorine contact basin I/O and logic is contained solely within PLC-100. It is comprised of one (1) Recycle Water Transfer Pump (already discussed in Part 4 above), and two (2) Recycled Water Distribution Pumps, as well as a Recycled Water disinfection metering pump.
- B. Instruments associated with the Recycled water chlorine contact basin include one (1) Recycled Water flow meter, one (1) Recycled Water Storage Tank-1 level transmitter, one (1) Recycled Water to distribution flow meter, one (1) combination Cl₂/pH meter, one (1) plant water high pressure switch.

5.2 EQUIPMENT AND INSTRUMENTATION

EQUIPMENT, INSTRUMENTS, AND I/O NAME	HMI TAG NAME		ALARM	LOG	SPAN /NOTES
PLC 100					
Recycled Water Distribution Pump P101					
Recycled Water Pump P101 in Remote/Auto	P101 IN REMOTE/AUTO				
Recycled Water Pump P101 Running	P101 RUNNING				
Recycled Water Pump P101 Fault	P101 FAULT		Fault		
Recycled Water Pump P101 Speed Output	P101 SPEED				
Recycled Water Pump P101 Speed Input	P101 SPEED				
Recycled Water Pump P101 Start	P101 START COMMAND				
Recycled Water Distribution Pump P102					
Recycled Water Pump P102 in Remote/Auto	P102 IN REMOTE/AUTO				
Recycled Water Pump P102 Running	P102 RUNNING				
Recycled Water Pump P102 Fault	P102 FAULT		Fault		
Recycled Water Pump P102 Speed Output	P101 SPEED				

EQUIPMENT, INSTRUMENTS, AND I/O NAME	HMI TAG NAME		ALARM	LOG	SPAN /NOTES
Recycled Water Pump P102 Speed Input	P101 SPEED				
Recycled Water Pump P102 Start	P102 START COMMAND				
Chlorine Metering Pump P108					
Chlorine Metering Pump P108	Speed Control				
PLC 100					
Recycle water storage tank-1 level	LT-101				000-00 Feet
Recycle water Pressure switch PS102	PS102				
Recycled Water Transfer Flow Rate	FIT-101				000-xxx GPM
Recycled Water Transfer Flow Total Today FIT101	RECYCLED TRANSFER FLOW TODAY				
Recycled Water Transfer Flow Total Yesterday FIT101	RECYCLED TRANSFER FLOW YESTERDAY				
Recycled Water Distribution Flow Rate	FIT-102				000-xxx GPM
Recycled Water Distribution Flow Total Today FIT102	RECYCLED DISTRIBUTION FLOW TODAY				
Recycled Water Distribution Flow Total Yesterday FIT102	RECYCLED DISTRIBUTION FLOW YESTERDAY				
Recycled Water Cl2	CLA101				0-5
Recycled Water pH	CLA101-pH				0-14
Recycled Water Pump Lead- Alternate Selection	Recycled Lead				0=Alternate, 1=P101, 2=P102
Recycled Water Wet Well Level Pump Start Setpoint	Recycled START SP				
Recycled Water Wet Well Level Pump Stop Setpoint	Recycled STOP SP				
Recycled Water Wet Well High Level Alarm	Recycled HIGH ALARM				
Recycled Water Wet Well Low Level Alarm	Recycled LOW ALARM				
Recycled Water Pump P104 Fail- to-Start	Recycled P301 FTS		ALARM		
Recycle Water to Distribution Flow Rate	FIT102	AI1-4			000=xxx GPM
Recycled Water to Distribution Flow Total Today FIT102	Recycled FLOW TODAY				
Recycled Water to Distribution Flow Total Yesterday FIT102	Recycled FLOW YESTERDAY				
Chlorine Resid Setpoint	Cl ₂ Setpoint				0-5

EQUIPMENT, INSTRUMENTS, AND I/O NAME	HMI TAG NAME		ALARM	LOG	SPAN /NOTES
Chlorine Resid Deadband	Cl ₂ Deadband				
Chlorine Flow Bias	Cl ₂ Bias				
Chlorine High Alarm	Cl ₂ High Alarm		Alarm		
Chlorine Low Alarm	Cl ₂ Low Alarm		Alarm		
CT Low Alarm	CT Low		Alarm		

5.3 LOCAL CONTROL

- A. The Recycled Water Transfer Pump (P208) and the two (2) Recycled Water Pumps (P101 and P102) each have HOA switches at the motor starters in Source MCC allowing for local control.
- B. The Cl₂ metering pump, P108, can be controlled manually from the faceplate on the pump.

5.4 RECYCLED WATER DISTRIBUTION PUMPS (P101 AND P102)

- A. From the HMI, either of the two (2) pumps can be selected as the lead pump or they can be put in auto rotate mode. The lead pump will rotate between the two at the time all pumps are de-energized and all permissives are met. Only one pump will run at a time.
- B. The lead pump will be called to run on low level indication from the level transducer (LT-102) in the Recycled Water Tank, Tank-2. Tank-2 is the 250,000 gallon recycled water storage tank located at the MUSD tank site on Little Lake Road. There is also a backup float switch (LS-104) as redundancy in case LT-102 is offline. The level as indicated on LT-101 will be used a permissive for running the pumps.
- C. The lead pump will be de-energized on high level indication from the shutoff float switch in the Recycled Water Tank, Tank-2 or if high pressure is experienced at pressure switch PS102.
- D. Each pump shall utilize a three-position Hand-Off-Auto switch mounted at its Starter at the motor control center.
 - a. In Hand, the Starter shall run a speed manually set through the Starter's integral keypad.
 - b. In Off, the Starter shall not run. PLC control shall be locked out.
 - c. In Auto, a well pump shall start when the tank level falls to the pump "on" set point. The pump is stopped when the tank level has risen to the pump shut-off set point OR if a turbidity or chlorine residual alarm occurs.
 - d. Provide adjustable 0-5 minute time delay for turbidity and chlorine residual shutdown.
 - e. Alarm shutdown requires manual reset.
2. Provide digital output for the following:
 - a. P101 speed
 - b. P102 speed
3. Provide HMI status indication for the following:
 - a. P101 Running
 - b. P101 Failed.
 - c. P102 Running
 - d. P102 Failed.
4. Provide HMI indication of the following analog parameters:
 - a. LT101
 - b. LT102

- c. LS104
- 5. Provide HMI alarm indication for the following:
 - a. P101 failed
 - b. P102 failed
 - c. P101 not-in-auto
 - d. P102 not-in-auto

5.5 CHLORINE METERING PUMP CONTROL SYSTEM AUTO

- A. The chlorine metering pumps will be flow paced, with a bias as needed. The speed of the Cl₂ metering pump (P108) will be varied proportionally to the Recycled Water flow rate to the Cl₂ contact channels, (FIT101), continuously. The actual Cl₂ value (CLA101) will be compared to the setpoint value periodically. The setpoint will be calculated by a target contact time of 450 mg-min/L which is a function of the chlorine residual, contact channel volume and the inflow. If the absolute difference is greater than the Deadband, then a bias will be added or subtracted to the flow pace value. The frequency of comparing the actual to the setpoint will be based on the flow rate and the approximate time for water to flow from entering the contact channels to exiting the channels. This will vary with flow rate.
- B. Definitions
 - 1. Q = WW Effluent flow rate (FIT101)
 - 2. Q_{max} = xx MGD = xx GPM
 - 3. Q_{CL} (mA) = $(4 + Q/Q_{max} * 16) + X$
 - 4. DB = Dead Band +/- as it relates to actual resid Cl to SP
 - 5. X = Bias or Trim for Cl output = $((Cl_2 \text{ (actual)} - SP / (DB \text{ span})) * (\text{max Bias mA.value}))$
- C. The chlorine metering pumps will shut down when a low level signal is generated by the OSG solution tank.

5.6 ALARMS AND SPECIAL CONDITIONS

- A. During a pumping sequence for P101 or P102, a pump fail-to-start or a pump fault will automatically take that pump out of rotation, the other pump becomes lead and the operator is notified of the alarm condition.
- B. Should the chlorine residual level as indicated from CLA101 fall above or below the operator alarm setpoints the operator will be notified and the recycled water transfer pump will stop.
- C. For Title 22 Compliance a contact time (CT) of 450 mg-min/L must be maintained. The CT will be an operator adjustable set-point but cannot be set to below 450 mg-min/L. This will be displayed on HMI, this is a function of the chlorine residual and the detention time in the CCT (which is a function of the flow from FIT101 and the CCT volume). The chlorine residual will vary depending on variations in flow and contact channel volume to maintain the target CT. If the chlorine residual setpoint is not satisfied by an adjustable time period, then an alarm is generated, then the recycled water transfer pump will be interlocked off and the distribution pumps will stop (but will be available in remote/manual operation). The operator will then need to manually close the valve at the recycled water pump common main discharge to the distribution system, and open the non-compliant water return valve. The operator must then run the pumps to empty the basin to the low water cutout. After the basin is emptied the CT alarm is acknowledged, the RW transfer pump interlock can be removed and recycled water production can resume.
- D. Should the level in the Recycled Water Storage Tank-1 (LT 101) rise or fall above or below the

operator alarm setpoints, the operator shall be notified.

5.7 Analyzer Pump Control (SAM101)

- A. Pump shall utilize a three-position Hand-Off-Auto switch mounted at its control panel.
 - 1. In Hand, the pump will run continuously.
 - 2. In Off, the pump shall not run. PLC control shall be locked out.
 - 3. In Auto, pump starts when the waste tank level rises above the pump "on" set point. The pump stops when the waste tank level has fallen to the pump shut-off set point.
- B. Provide digital output for the following:
 - 1. Pump call
- C. Provide digital input for the following:
 - 1. Pump running
 - 2. Pump failed
 - 3. Pump HOA not-in-auto
- D. Provide HMI status indication for the following:
 - 1. Pump Running
 - 2. Pump Failed.
 - 3. Not-in-auto.
- E. Provide HMI alarm indication for the following:
 - 1. Pump failed
 - 2. Pump not-in-auto

PART 6 ONSITE CHLORINE GENERATION SYSTEM (OSG) *(NEW WORK INCLUDED IN CONTRACT SCOPE)*

6.1 ONSITE GENERATION SYSTEM

- A. The OSG is a proprietary system that contains its own integral instrumentation, PLC, control loops and requires a display screen on the unit. The Contractor is responsible with engaging the system supplier to ensure a fully operable, safe and code compliant system is installed and coordinated with other components of the project.
- B. The signals generated from the OSG system will be relayed to PLC-100 via ethernet. Some of these signals will then need to be relayed by the Contractor's integrator/programmer to PLC-300 which will initiate call out alarms as indicated in Section 9.4. The Contractor is responsible for coordinating these signals between the OSG system to the other plant systems to ensure overall system compatibility. At minimum the following signals are required:
 - 1. OSG system running (ethernet)
 - 2. OSG system in remote/automatic (ethernet)
 - 3. OSG system fault alarm (discrete signal)
 - a. Alarm to be generated if brine tank low level switch is initiated, if the solution tank low level is initiated, if there's an issue with the OSG electrolyzer, if water softener fails, if water heater fails.
 - 4. Hydrogen gas high level alarm (discrete signal)
 - 5. Hydrogen gas concentration (analog signal)
 - 6. Solution tank low level (ethernet) – solution tank level is used to control chlorine metering pumps.

- C. The Contractor shall provide a submittal of all the available signals that can be relayed to the PLC via ethernet from the OSG system by the Contractor for the customer/engineer to approve other alarms/signals that may need to be relayed for a fully safe and operable system.
- D. Chlorine Feed Pump Control
 - 1. Pumps shall utilize keypad switches mounted on the pump assembly.
 - a. In Manual, the pumps run continuously.
 - b. In Off, the pumps shall not run. PLC control shall be locked out.
 - c. In Auto, the feed pumps shall turn on when a filter effluent pump is running. Pump speed is varied by the operator. For plant effluent disinfection the operator selects which pump is in duty (P105 and P106). For P108, the pump speed shall be varied to increase run speed when the chlorine residual is less than the chlorine residual setpoint to achieve the desired contact time (which is a function of the flow from FE101 and the chlorine residual at CLA101). The pump slows down when the contact time exceeds setpoint, or there is a High Chlorine alarm.
 - 2. Provide HMI status indication for the following:
 - a. Pump Running (P108, P105 and P106)
 - b. Duty Pump Selected (P105 and P106)

6.2 CHLORINE GENERATING BUILDING ALARMS

- A. There are intrusion switches and smoke detectors in the new chlorine generator building that will be connected to the PLC in PCP 100. The status of these switches will be conveyed to the PLC in PCP-300 over the CAT 5 network. There will be two discrete inputs to existing security alarm system from a digital output from the PLC in the office / blower building. One for smoke and one for intrusion.
- B. There is a hydrogen gas detector alarm in the chlorine generating building. Should a high level alarm be activated then the onsite chlorine generation system will be shut down.

PART 7 COAGULANT DOSING SYSTEM (*NEW WORK INCLUDED IN CONTRACT SCOPE*)

7.1 COAGULANT DOSING SYSTEM

- A. The OSG is a proprietary system that contains its own integral instrumentation, PLC, control loops and operator interface touch screen. The Contractor is responsible with engaging the system supplier to ensure a fully operable, safe and code compliant system is installed and coordinated with other components of the project.
- B. HMI to be shown at PLC100 as indicated on P&ID I-105. Contractor to confirm signals that can be relayed from the specified coagulant dosing system to the HMI and indicate these signals in the PLC submittal for engineer/owner approval. The HMI must display a system fault alarm, system running status, system in remote, coagulant flow and speed setting at minimum.
- C. The Coagulant Dosing System needs to be operational for Title 22 Compliance. If the coagulant dosing system is not operational, the RW transfer pump and OSG system will shut off. The Contractor is responsible for coordinating these soft interlocks from the coagulant dosing system to the interlocked equipment via PLC100.

PART 8 AIRLIFT MIXED LIQUOR RETURN (MLR) AND ANOXIC AIR MIXER SYSTEMS

8.1 Airlift mixed liquor return (MLR)

- A. The airlift MLR pump (P-109) will be operated from the airlift control panel in the filter backwash control building. From this control panel the operator can set the pump to run automatically or can control the pump manually via the HOA switch and start/stop buttons. HMI located at PLC-200 will present MOV216 in remote status, fail alarm, on status and will have a run output command. HMI located at PLC-200 will also allow the operator to adjust the pump run-time based on opening the air solenoid valve functions (MOV216) including open frequency (X times every every) and run duration (how long it runs when it opens before closing) In automatic mode based on a timer associated with the solenoid valve. It is recommended at start-up that the pump is set to open once every hour and the duration is set for 48 minutes this configuration will be adjusted by operators to optimize denitrification.
- B. Solenoid Valve Control.
1. Default position is closed. Valve opens energized from the airlift control panel
 2. Provide output for the following:
 - a. Valve open

8.2 Anoxic Air Mixer

- A. The anoxic air mixer (MX-110) has no control elements, it is supplied with air via the header and the operator shall throttle the plug valve upstream of the mixer to adjust mixing intensity.

PART 9 MISCELLANEOUS EQUIPMENT

9.1 MISCELLANEOUS EQUIPMENT

- A. There are some miscellaneous controls associated with the clarifier, aeration blowers, standby generator, belt filter press, and dryer. There is also an Autodialer for operator notification of significant alarms.

9.2 EQUIPMENT AND INSTRUMENTATION

EQUIPMENT, INSTRUMENTS, AND I/O NAME	HMI TAG NAME	ALARM	LOG	SPAN /NOTES
M201 Sludge and Skimmer Drive for Clarifier				
Clarifier M201 in Auto	M201 IN AUTO			PLC 200
Clarifier M201 Running	M201 RUNNING			PLC 200
Clarifier M201 Fault	M201 FAULT	Fault		PLC 200
Clarifier M201 Start	M201 START COMMAND			PLC 200
Clarifier M201 High Torque	NS201 High Torque			PLC 200
Clarifier M201 High High Torque	NS202 High-High Torque			PLC 200
MOV213 Scum Airlift				
MOV213 Scum Airlift Solenoid	MOV213 SCUM			PLC 200
MOV214 WAS Airlift				
MOV214 WAS Airlift Solenoid	MOV214 WAS			PLC 200
AIT201 Turbidity				

EQUIPMENT, INSTRUMENTS, AND I/O NAME	HMI TAG NAME	ALARM	LOG	SPAN /NOTES
AIT201 Turbidity	AIT201 TURB			PLC200
AIT201 Dissolved Oxygen				
AIT201 Dissolved Oxygen	AIT201 DO			PLC200
LS207 Filter Gallery Flood Switch				
LS207 Filter Gallery Flood Switch	LS203 Flood			PLC200
Aeration Blower BLO301				
Aeration Blower BLO301 in Auto	BLO301 IN AUTO			PLC300
Aeration Blower BLO301 Running	BLO301 RUNNING			PLC300
Aeration Blower BLO301 Fault	BLO301 FAULT	Fault		PLC300
Aeration Blower BLO301 Start	BLO301 START COMMAND			PLC300
Aeration Blower BLO302				
Aeration Blower BLO302 in Auto	BLO302 IN AUTO			PLC300
Aeration Blower BLO302 Running	BLO302 RUNNING			PLC300
Aeration Blower BLO302 Fault	BLO302 FAULT	Fault		PLC300
Aeration Blower BLO302 Start	BLO302 START COMMAND			PLC300
Aeration Blower BLO303				
Aeration Blower BLO303 in Auto	BLO303 IN AUTO			PLC300
Aeration Blower BLO303 Running	BLO303 RUNNING			PLC300
Aeration Blower BLO303 Fault	BLO303 FAULT	Fault		PLC300
Aeration Blower BLO303 Start	BLO303 START COMMAND			PLC300
Aeration Blower BLO303 Speed Cmnd	BLO303 SPEED			PLC300
Standby Generator				
Standby Generator in Auto	GENERATOR IN AUTO			PLC300
Standby Generator Running	GENERATOR RUNNING			PLC300
Standby Generator Fault	GENERATOR FAULT	Fault		PLC300
Standby Generator Low-Fuel	GENERATOR LOW FUEL			PLC300
M305 Belt Filter Press				
M305 Belt Filter Press Fault	M305 BELT PRESS FAULT			PLC300
M306 Dryer				
M306 Dryer Fault	M306 DRYER FAULT			PLC300
ARI301 Chart Recorder				
ARI301 Turbidity	ARI301 TURBIDITY			PLC300
ARI301 Dissolved Oxygen	ARI301 DO			PLC300
Alarm Dialer				

EQUIPMENT, INSTRUMENTS, AND I/O NAME	HMI TAG NAME	ALARM	LOG	SPAN /NOTES
YA301	EFFLUENT FAILURE			PLC300
YA302	INFLUENT FAILURE			PLC301
YA303	TEMP			PLC302
YA304	DRYER			PLC303
YA305	CHLORINE			PLC304
YA306	GENERATOR			PLC305
YA307	BLOWER			PLC306
YA308	PIPE GALLERY			PLC307
YA309	OSG			PLC308
YA310	FILTER LEVEL			PLC309
YA311	DECHLOR LOW			PLC310
YA312	RECYCLED WATER PUMPS			PLC311
YA313	RECYCLE TANK-1 HIGH LEVEL			PLC312
YA314	RECYCLE WATER Cl ₂			PLC313
YA315	DO			PLC314
YA316	RECYCLE WATER TANK-2 HIGH LEVEL			PLC315

9.3 LOCAL CONTROL

- A. Aeration Blowers, BLO301, BLO302, and BLO303 are only controlled locally. BLO301 and BLO302 have soft starters with the HOA switch mounted on the door. BLO303 has a VFD and is controlled by a local controller. The status of the blowers will be monitored by the new PLC and any fault condition will require notification to the operator.
- B. There is no control of the Standby Generator, but there is monitoring of significant alarm conditions. When one occurs, the operator shall be notified.
- C. The Clarifier Motor (M201) can be controlled locally from the HOA switch at MCC 2.
- D. The Belt Filter Press, Dryer and the new OSG units are all locally controlled, but each has an alarm output(s) to the PLC. The operator shall be notified for any of the following alarm conditions.
 - 1. Belt Press Fault M304
 - 2. Dryer Fault M305
 - 3. OSG alarm
 - 4. OSG high H₂ Level Alarm
 - 5. OSG high Gas Alarm
- E. There is a flood level switch in the filter gallery, LS203. The operator shall be notified on high level.

9.4 AUTODIALER

- A. The Autodialer has only 16 digital channels, all wired to outputs in PLC-300. The logic will group

multiple alarms to form a single alarm call out to the on-call operator(s) for each channel. The grouping for each channel is stated below. The Contractor shall engage a system integrator to program the auto-dialers and co-ordinate system signals from the associated equipment/alarms.

1. Channel 1 Effluent Failure
 - a. P201 Fault
 - b. P201 Fail-to-start
 - c. P202 Fault
 - d. P202 Fail-to-start
 - e. High Turbidity
2. Channel 2 Influent Failure
 - a. P301 Fault
 - b. P301 Fail-to-start
 - c. P302 Fault
 - d. P302 Fail-to-start
 - e. P303 Fault
 - f. P303 Fail-to-start
 - g. M301 Fault
 - h. M303 Fault
 - i. Influent High Alarm Level
 - j. LT301 Fail
3. Channel 3 Not used
4. Channel 4 Dryer
 - a. M305 Dryer Fault
5. Channel 5 Effluent Chlorine (new alarms required by contract scope)
 - a. Effluent High Cl₂ Alarm
 - b. Effluent Low Cl₂ Alarm
6. Channel 6 Generator
 - a. Generator Running
 - b. Generator Fault
 - c. Generator Low Fuel
7. Channel 7 Blower
 - a. BLO301 Fault
 - b. BLO302 Fault
 - c. BLO303 Fault
8. Channel 8 Pipe Gallery
 - a. P205 Fault
 - b. P206 Fault
 - c. P203 Fault
 - d. BLO304 Fault
 - e. Filter Gallery Flood Switch
9. Channel 9 OSG (new alarms required by contract scope)
 - a. OSG Alarm
 - b. H₂ Level High
 - c. Gas Alarm
10. Channel 10 Filter Level
 - a. LS201 F1 High Level
 - b. LS202 F1 High Level
 - c. LS203 F1 High Level
 - d. LS204 F1 High Level
11. Channel 11 Other Chemicals
 - a. LS101 Dechlorination low level
 - b. Fault from coagulant dosing system via PLC-100
12. Channel 12 Recycle Water Transfer and Distribution Pumps (new alarms required by contract scope)
 - a. P208 Fault
 - b. P208 FTS

- c. P101 Fault
- d. P101 FTS
- e. P102 Fault
- f. P102 FTS
- 13. Channel 13 Recycle Water Tank-1 High level (new alarms required by contract scope)
 - a. Recycle Water Tank-1 High
- 14. Channel 14 Recycle Water CI2 (new alarms required by contract scope)
 - a. Recycle Water CI2 High
 - b. Recycle Water CI2 Low
 - c. Recycle Water CT Low
- 15. Channel 15—PLC Fail
 - a. PLC 100 Fail
 - b. PLC 200 Fail
 - c. PLC 300 Fail
- 16. Channel 16 Recycle Water Tank-2 High level (new alarms required by contract scope)
 - a. Recycle Water Tank-2 High

9.5 Flowmeter Monitoring

- A. Monitor flow. Display totalization in gallons. Provide totalizer reset.
- B. Provide HMI status indication for the following:
 - 1. FIT101 flow
 - 2. FIT102 flow

END OF SECTION

SECTION 40 94 43

PROCESS CONTROLS AND PROGRAMMABLE LOGIC PROCESS CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

- A. The station control, communication, and telemetric/SCADA systems are delegated design items. The Contractor shall retain the services of a Control Systems Integrator (CSI) to install and configure the SCADA system.
- B. The CSI is responsible for designing, furnishing, installing, programming, testing, integration with existing SCADA system, and commissioning a complete and functional system, including but not limited to PLC, telemetric/SCADA equipment, controllers, analog and discrete input/output modules, instruments, low-voltage and line-voltage relays, human machine interface (HMI) graphics displays, power supplies, transformers, enclosures, mounting hardware, terminations and wiring for all components including interface with field equipment and devices such as pumps, starters/variable frequency drives, sensors, transducers, actuators, valves, gates, etc.

1.2 REFERENCES

- A. International Society of Automation (ISA):
 - 1. S5.1, Instrumentation Symbols and Identification.
 - 2. PR12.6, Installation of Intrinsically Safe Systems for Hazardous Locations
 - 3. S5.4, Standard Instrument Loop Diagrams.
 - 4. S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
 - 5. S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. ICS 1, Industrial Control and Systems: General Requirements.
 - 2. ICS 2, Industrial Control Devices, Controllers and Assemblies.
 - 3. ICS 3, Industrial Control and Systems: Factory Built Assemblies.
 - 4. ICS 4, Industrial Control and Systems: Terminal Blocks.
 - 5. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 6. ICS 6, Industrial Control and Systems: Enclosures.
 - 7. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 8. IA 2.2, Programmable Controllers - Equipment Requirements and Tests.
 - 9. IA 2.3, Programmable Controllers - Programming Languages.

1.3 DEFINITIONS

- A. Analog Signals: 4-20mA DC two-wire circuits conforming to ANSI/ISA S50.1.
- B. Control Loop: The control scheme describing the control of a single process variable or a group of related process variables. The control loop includes the relevant part of the process, the process variable sensor and associated transmitter(s), the input signals, the controller, the control output signal, and the actuator.
- C. Controller: A primary element that functions to provide loop control. Controllers have provisions for a process variable input signal, a control output signal, setpoint adjustment, tuning of the PID control parameters and provide for an interface of the values within the

process variables and the setpoints. They are panel mounted programmable logic controllers, which are microprocessor-based systems having provisions for multiple inputs and outputs for both discrete and analog control capability, with the ability for advanced Human Machine Interface.

- D. Discrete Signals: Two state based logic signals that are either DC or 120-Vac.
- E. HMI: Human Machine Interface.
- F. Loop Tuning: Part of the control system startup and commissioning process and includes the process of adjusting the gain, reset and rate parameters to obtain effective and stable response of the system to changes in the setpoint or external disturbances.
- G. PID: Control action, Proportional-Integral-Derivative. Control feed-back or feed-forward algorithm used as a mechanism to tune a system for intended operation.
 - 1. Proportional determines the reaction to the error.
 - 2. Integral determines the reaction based on the sum of the errors.
 - 3. Derivative determines the reaction to the rate at which the rate has been changing.
- H. PLC: Programmable Logic Controller.
- I. SCADA: Supervisory Control and Data Acquisition. A SCADA System is a group of computers and servers running software dedicated for SCADA purposes. This SCADA software collects and exchanges data over industrial networks with PLCs, device level controllers, and all other connected or networked devices. The SCADA software will allow for control, trending, graphic display, alarming, alarm tracking, historical logging of values in a database and reporting of collected data.

1.4 SYSTEM DESCRIPTION

- A. Configuration:
 - 1. Programmable controllers shall be incorporated into fully assembled control panels for controlling, communicating with, and monitoring of controls, control systems, instrumentation, and SCADA system with all required components and programming for a fully functional system.
 - 2. Programmable controller shall use a combination of discrete, analog, PID functions, programmable logic and programmable algorithms to control, annunciate and interface with connected systems.
 - 3. Programmable controller shall be part of a completely assembled control panel with all components required for operation, including all associated components shown and where specified in other sections. Control panels shall be assembled by a UL508A certified contractor and contain labeling indicating UL508A compliance with a unique UL serial number.
 - 4. Supply network hardware, network interconnections, communication hardware, interface components and all necessary programming for a fully functional system.
 - 5. Coordinate instrumentation requirements, including but not limited to interface voltages, wiring requirements and termination requirements to ensure compatibility between instrumentation, control panels and connected PLC's.
 - 6. Coordinate communication protocols to ensure proper data transfer and compatibility between all connected devices, including but not limited to; instrumentation, modems, radios, connected devices and control panels.
- B. Special Requirements:
 - 1. Operators shall be able to access the SCADA system from any web-enabled device.

1.5 SUBMITTALS

- A. Shop Drawings:
 - 1. Provide shop drawings indicating the arrangement and layout of panel, component spacing and enclosure size. Indicate electrical characteristics and connection requirements, including layout of completed assemblies, interconnecting cabling, dimensions, weights, and external power requirements.
 - 2. A comprehensive narrative describing the operation of the system as a whole as well as functions of the various components of the system. The intent is for the current or future users and operators of the system to be able to refer back to this document and clearly understand the operation and functions of the system.
 - 3. Point-to-Point wiring diagrams identifying each terminal of every component, type and quantity of wiring or connection between points, and function of each component, including all field devices, equipment, and instruments.
- B. Product Data: Submit catalog data for each component specified showing electrical characteristics and connection requirements.
- C. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.
- D. Manufacturer's Field Reports: Indicate activities on site, adverse findings, and recommendations.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents:
 - 1. Record actual locations of controller cabinets and input and output devices connected to system. Include interconnection wiring and cabling information, and terminal block layouts in controller cabinets. Include copy of as-built drawings.
 - 2. Provide one (1) USB thumb drive with digital format copies of the PLC and HMI programs.
- B. Operation and Maintenance Data: Submit bound copies of operating and programming instructions, and include card replacement, adjustments, and preventive maintenance procedures and materials.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five (5) years documented experience.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Conform to specified service conditions during and after installation of programmable controllers.

1.9 MAINTENANCE SERVICE

- A. Furnish service and maintenance of programmable controllers for 3 three years from project close out.

PART 2 PRODUCTS

2.1 ENCLOSURE

- A. Provide a NEMA 12 enclosure. Reserve space within the enclosure for the UPS, Ethernet Switch, Cellular Modem, and PLC.
- B. PLC enclosure shall be appropriately sized to accommodate all I/O modules, power supplies, communication equipment, etc. as specified within this section and as necessary to perform the required functions.
- C. Provide a Ground Fault Circuit Interruptor (GFCI), 15-amp duplex receptacle in the enclosure. To be used as a service outlet with both outlets available.
- D. Install pertinent final I/O lists, elementary diagrams, and PLC card wiring diagrams in the enclosure. Drawings shall be laminated.

2.2 PROGRAMMABLE CONTROLLER

- A. The existing PLC is an Allen Bradley MicroLogix 5380. New PLC must have similar functionality and must be capable of integrating with the existing control system.
- B. Provide PLC unit with the following features:
 - 1. 120V input power.
 - 2. CPU/motherboard.
 - 3. Power supply module with battery backup.
 - 4. Mixed I/O discrete modules.
 - 5. Mixed I/O analog modules.
 - 6. Metal chassis sized to house all components.
 - 7. Provide all modules, cards, power supplies, transformers, relays, etc. as required for the sequence of operation.
- C. Coordinate type and quantity of PLC inputs and outputs with type and quantity of instruments, input devices, output devices, field devices, and field equipment.

2.3 ETHERNET SWITCH

- A. Provide DIN-rail mounted Ethernet switch for mounting in PLC enclosure. The switch shall be Layer 2 with a minimum of 8 copper ports.
- B. Switch shall be completely compatible and optimized by the CSI for use with the supplied PLC and other networked equipment.
- C. Furnish and install Category 6A Ethernet cable to connect networked PLC, HMI, and cellular modem.
- D. Manufacturer – Moxa-EDS-G508E, or equal.

2.4 UNINTERRUPTIBLE POWER SUPPLY (UPS)

- A. PLC power supply shall be backed up by the UPS. The required capacity of the UPS shall be determined by the load requirements of the PLC and its peripherals. As a minimum, the UPS shall maintain power to the entire panel, all communication devices and modules, all relays, all loop power supplies, all indicators, the PLC, and all PLC I/O that is powered from the panel.

- B. It is preferred that the UPS be located in the same enclosure as the PLC, DIN-Rail mounted, unless panel size or cooling requirements make it impractical. In that case, it shall be located on a wall shelf located above the PLC enclosure. Shelf shall be provided by the Contractor.
- C. Manufacturer - APC, or equal.

2.5 CELLULAR SYSTEM

- A. Configure cellular router for remote access to the HMI graphics and alarm callouts. Provide antenna, cables, connectors, grounding, etc. compatible with the system as required for a complete installation.
- B. Coordinate with Owner to add new line to existing cellular plan.
- C. Manufacturer – DIGI IX10, or equal.

2.6 INDUSTRIAL WORKSTATION

- A. Provide an industrial workstation (IPC) to host the HMI application in accordance with the following specifications:
 - 1. Dual-core processor with 4 GB of RAM and 10GB of available storage space.
 - 2. KVM and accessories.
 - 3. Panel mounted IPC or shelf mounted with wall-mounted folding arm monitor.
- B. HMI application manufacturer - Ignition customized build, or equal.
- C. A diagram of the system and its functions shall be graphically displayed on the screen in accordance with the contract drawings. Conduct a workshop with the Owner to define graphics standards including layout, colors, and other key elements.
- D. Configure the HMI for remote access monitoring only via cellular communication. Collaborate with the Owner to determine the number of accounts and credentials needed.
- E. Configure an alarm callout list and establish a communication schedule, specifying recipients and timing with input from the Owner.

2.7 RELAYS AND AUXILIARY MODULES

- A. Provide all line-voltage and low-voltage relays, control modules, isolation relays/modules, etc. as required for the sequency of operation.

2.8 FIELD INSTRUMENTS, DEVICES, AND EQUIPMENT

- A. Refer to Section 40 91 19, Instrumentation Equipment.

2.9 CONDUITS AND WIRING

- A. Contractor design scope includes sizing, type, and quantity of wiring for power and control of all instruments, devices, sensors, relays, modules, power supplies, etc. that are part of the station SCADA system.
- B. Once size, type, and quantity of wiring has been determined, review the size and quantity of conduits shown on electrical site plans to verify and confirm the information. Adjust the size and quantity of conduits if necessary to accommodate the wiring systems.

2.10 SOURCE QUALITY CONTROL

- A. Test programmable controller in accordance with NEMA IA 2.2.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned programmable controller components.
- B. Extend existing programmable controller installations using materials and methods as specified.
- C. Clean and deliver existing programmable controllers to be salvaged to owner.
- D. Disconnect and remove existing Remote Terminal Unit (RTU) and communication equipment.

3.2 INSTALLATION

- A. Do not install products until building interior is enclosed and major construction is complete.
- B. Install and connect control panel assembly.
- C. Connect and configure input and output devices.
- D. Establish network communications over SCADA network.
- E. Participate in commissioning activities that include testing and verify that all controls and systems function as intended.

3.3 FIELD QUALITY CONTROL

- A. Procedures, Forms, and Checklists:
 - 1. Conduct all testing in accordance with, and documented on, Engineer accepted procedures, forms, and checklists.
 - 2. Describe each test item to be performed.
- B. Perform operational testing on control systems to verify proper operation and field wiring connections to verify intended system function as part of the project commissioning.
- C. Calibrate connected devices and adjust programming characteristics, where required to provide a fully functional system.

3.4 TESTING AND COMMISSIONING

- A. After installation and programming has been completed, provide testing and commissioning of the entire system, including functional testing of all instruments, input devices, output devices, and equipment. Final testing shall demonstrate that all functions of input devices and all functions of output devices, as well as equipment and devices connected to input and output, are being performed properly. If any part of the system is not operating correctly, the Contractor shall identify the cause, resolve the issue, and repeat the testing in its entirety to demonstrate a complete and functional system.

3.5 FIELD SERVICES

- A. Install, prepare and start up programmable controller.

3.6 DEMONSTRATION AND TRAINING

- A. At the conclusion of work, after all power and control equipment have been installed, energized, programmed, tested, commissioned, and are ready for use, provide training for client staff.
- B. Furnish four (4) hours of instruction, to be conducted at project site with manufacturer's representative. Coordinate with Owner for times and locations of training. Training times and locations shall be as directed by the Owner.
- C. Training shall cover detailed instruction on standard, preventative and emergency maintenance repairs including but not limited to:
 - 1. Uploading/downloading program
 - 2. Review of functionality
 - 3. Battery replacement
 - 4. Module replacement
 - 5. Troubleshooting

3.7 PLC LOOP DESCRIPTIONS

- A. General - Provide programming of the PLC/SCADA/Telemetry systems to enable the monitoring and control described below and as required by the drawings and specifications:
 - 1. For each loop being issued a control command, a FAIL TO START, FAIL TO INITIALIZE or FAIL TO RESPOND execution alarm shall be generated upon failure of device to execute command within a user adjustable time delay for response from 2 seconds to 99 seconds.
 - a. The initial time delay is
 - b. set for 12 seconds.
 - 2. Each HMI screen has a time-out period where the HMI defaults back to READ ONLY mode upon there being no user activity for during the time-out period.
 - a. The HMI screens last in-use is the screen displayed as read-only.
 - b. The initial time-out period is 5 minutes.
 - 3. Where data changes occur, the data shall be displayed at the HMI.
 - 4. Where an event triggers an alarm, an alarm shall be displayed at the HMI and the alarm data shall be indicated at the HMI.
 - 5. Upon an alarm being generated, the operator has the ability to ACKNOWLEDGE SELECTED, or ACKNOWLEDGE ALL.
 - a. Operator can acknowledge an alarm based on the operator's login credentials.
 - b. Operator can add a note to the alarm at any time.
 - c. Upon an alarm being acknowledged, the alarm state remains static until the alarm condition is cleared.
 - 6. Upon an alarm being generated, and after a user adjustable time period where the alarm has not been acknowledged, the central SCADA system software calls system operators and managers over a land based or cellular phone line and verbally indicates the current alarm using a synthesized voice.
 - a. The default time for the remote alarm delay to acknowledge alarm is 5 minutes.
 - b. A recipient must enter a user issued unique personal identification number (PIN) to acknowledge the alarm.
 - c. If the recipient fails to acknowledge the alarm, the HMI software calls the next recipient on the calling tree list until the alarm is acknowledged.

- d. The software has a user adjustable method of scheduling the calling tree such that operators and managers are notified in a step wise fashion based on specific dates and times.
 - e. Coordinate with the District to identify specific alarms to be included in the notification list.
- B. Well Pump Control – not used see Section 40 94 00
- C. Analyzer Waste Pump Control – not used see Section 40 94 00
- D. Chlorine Feed Pump Control – not used see Section 40 94 00
- E. Solenoid Valve Control – not used see Section 40 94 00
- F. Flowmeter Monitoring – not used see Section 40 94 00
- G. Chlorine Residual Monitoring – not used see Section 40 94 00
- H. pH Monitoring – not used see Section 40 94 00
- I. Reservoir Level Monitoring – not used see Section 40 94 00

END OF SECTION

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SECTION 40 95 12F

PROCESS CONTROL PANELS AND HARDWARE

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes requirements for:
 - 1. Fabrication and assembly of all instrumentation enclosures, control panels, and components provided under this contract, including but not limited to:
 - a. Custom built instrumentation and SCADA control panels, including, remote telemetry units (RTU), master telemetry units (MTU), and local control panels (LCP)
 - b. Control components
- B. Related Sections:
 - 1. The Contract Documents are a single integrated document, and as such all divisions and sections apply. It is the responsibility of the Contractor and its subcontractors to review all sections to ensure a complete and coordinated project.

1.2 REFERENCES, SPECIFICATIONS, AND CODES

- A. Control panels shall comply with the requirements of NEC, NEMA, and UL.

1.3 DEFINITIONS

- A. Specific Definitions:
 - 1. The term "panel" in this section is interchangeable with the term "enclosure."

1.4 SYSTEM DESCRIPTION

- A. Panel Dimensions:
 - 1. Minimum dimensions are scalable from or as indicated on Drawings and are based upon manufacturer's noncertified information. It is the responsibility of the Contractor or manufacturer to design and size all panels, with approval from the engineer:
 - a. Size panels to provide space for all equipment, wiring, terminations, and other items in the panel, including space for future build out.
 - b. Maximum Panel Depth:
 - 1) 24 inches, unless otherwise indicated
- B. For PLC equipment, provide equipment as described in this specification section. See specification Section 40 94 43–Programmable Logic Controllers.

1.5 QUALITY ASSURANCE

- A. Assemble panels, enclosures, and rack systems along with all internal and external devices, wiring, equipment, and materials in a facility that is recognized by Underwriters Laboratories (UL) to assemble and certify UL-labeled control panels:
 - 1. Provide all components and equipment with UL 508 listing.
 - 2. All control panels shall be labeled as follows, unless the equipment in the panel and the design in the Contract Documents cannot be reasonably modified to meet the requirements for the specified labeling:
 - a. UL 508A for general control panels not in hazardous locations
 - b. UL 698 for control panels in hazardous locations.

- c. UL 698A for control panels not in hazardous locations, but contain intrinsically safe barriers for devices located in hazardous locations
- B. Unlisted, complex, and unique equipment may be evaluated and approved by a third party testing agency, with prior approval by the Owner. Provide report documenting the testing standard, specification, method of testing and that the equipment and materials meet appropriate designated standards or have been tested and found suitable for use in a specified manner.
 - 1. Provide fuses for all equipment that is not UL listed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Crate all panels for shipment using a heavy framework and skids:
 - 1. Provide wrapped waterproof flexible material for covering materials, where applicable, to protect against physical damage in transit.
 - 2. Provide suitable shipping stops and cushioning material for all instruments shipped with the panel to prevent damage due to mechanical shock during shipment.
 - 3. For large panels, provide removable lifting lugs to facilitate handling.

1.7 PROJECT SITE CONDITIONS

- A. Provide enclosures suitable for the location and environmental conditions in which they are located, and in the NEMA types in accordance with Project Specifications.

PART 2 PRODUCTS

2.1 GENERAL

- A. The Contractor/vendor shall provide the stations to satisfy the functional requirements in the relevant mechanical equipment and instrumentation and control specifications. Each station shall be fabricated with UL-labeled components.
- B. The controls shall be 120 V maximum. Where the electrical power supply is 240 V, single-phase or 480 V, 3-phase, the system shall be provided with a fused control power transformer.
- C. Each panel shall be provided with identified terminal strips for the connection of external conductors. The Contractor shall provide sufficient terminal blocks to connect 10 percent additional conductors for future use.
- D. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals.
- E. Enclosures
 - 1. Enclosures shall be NEMA 4X stainless steel for outdoor, corrosive, or wet areas.
 - 2. Enclosures shall be NEMA 12 for dry indoor, non-corrosive areas.
 - 3. Outdoor mounted panels shall be provided with thermostatically controlled heaters.
 - 4. Provide screened weep holes for draining condensation.

2.2 MANUFACTURERS

- A. Manufacturers are listed below in the individual component paragraphs.
- B. Provide instruments and other components performing similar functions of the same type, model, or class, and from one (1) manufacturer.

2.3 MATERIALS

- A. Construct and finish enclosures using materials capable of withstanding the mechanical, electrical, and thermal stresses, as well as the effects of humidity and corrosion that are likely to be encountered in normal service:
 1. Enclosures shall be NEMA 250 type as indicated in Panel Drawings.
 2. Enclosures shall have the following properties:
 - a. NEMA 1:
 - 1) Steel
 - b. NEMA 4:
 - 1) Steel with gasketed door, rain tight
 - c. NEMA 4X:
 - 1) Stainless steel Type 316 (unless indicated Type 304 on Drawings)
 - d. NEMA 12:
 - 1) Steel with gasketed door, dust-tight
 - e. NEMA 7:
 - 1) Cast aluminum
- B. Bolting Material:
 1. Commercial quality ½-inch diameter, stainless steel hex-head grade five bolts, nuts and washers, with unified coarse (UNC) threads
 2. Carriage bolts for attaching end plates
 3. All other bolted joints shall have S.A.E. standard lock washers

2.4 MANUFACTURED UNITS

- A. Panels/Enclosures:
 1. Manufacturers:
 - a. Hoffman Engineering or approved equal
 2. Panel Assembly:
 - a. General guidelines for panel fabrication include:
 - 1) Continuous welds ground smooth
 - 2) Exposed surfaces free of burrs and sharp edges
 - 3) Base formed of heavy channel iron, either galvanized or powder coated, minimum ½-inch holes at 12-inch spacing to accommodate anchoring of freestanding enclosures to floor
 - b. Construct enclosure and mounting panel using stretcher level sheet metal having minimum thickness not less than the following sizes (U.S. Standard Gauge):
 - 1) Use heavier sheet metal to meet seismic requirements at the project site or when required due to equipment requirements.

Enclosure Height (inches)	Minimum Enclosure Steel Thickness	Minimum Back Mounting Panel Thickness
Up to 57	12	12
57-69	12	10
69-82	12 except 10 on back	10
82 or more	10	10

- c. Construct supporting frame structure with angled, channeled, or folded rigid section of sheet metal, rigidly attached to and having essentially the same outer dimensions as the enclosure surface and having sufficient torsional rigidity to resist the bending moments applied by the enclosure surface when it is deflected.
- d. Provide stiffeners for back mounting panels in enclosures larger than 4 feet. In addition, secure the panels in place by collar studs welded to the enclosure.

- e. Door Construction:
 - 1) Turned-back edges suitably braced and supported to maintain alignment and rigidity without sagging.
 - a) Sufficient width to permit door opening without interference with rear projection of flush mounted instruments
 - b) Heavy gauge piano type continuous stainless steel hinges
 - c) For NEMA 12, 4, and 4X, provide oil resistant neoprene sealing gasket and adhesive to seal cover to enclosure.
 - d) Gasket installed to seal against roll lip on the enclosure opening
 - 2) Latches:
 - a) For panels each door provided with a three (3)-point latching mechanism and locking handle with rollers on the ends of the latch rods. Latch rods connected to a common door handle, hold doors securely, forming a compressed seal between door and gasket, at the top, side, and bottom.
 - i. Provide padlock for each enclosure with padlock provisions.
 - ii. Include an oil-tight key-locking, three (3)-point latching mechanism on each door:
 - A) Provide two (2) keys per panel.
 - B) All locks shall be keyed the same.
 - iii. For large type NEMA 4 and NEMA 4X cabinets, not available with three (3)-point latching hardware, provide multiple clips and padlock hasps.
 - iv. Provide quick release latches for all NEMA 4 and 4X enclosures.
 - v. Panel Cut-Outs:
 - A) Cut, punch, or drill cutouts for instruments, devices, and windows. Smoothly finish with rounded edges.
 - B) Allow a minimum of 3-inch envelope around all displays, controllers, and monitors.
 - C) Reinforce around cut-outs with steel angles or flat bars for the following:
 - (1) Large panel cutouts (for example, openings for local operator interfaces)
 - (2) Pilot device groupings, where the removed metal exceeds 50 percent of the available metal
- B. Outdoor Panels: Supplementary requirements for panels located outdoors are as follows:
 - 1. All enclosures located outdoors shall be explicitly designed and rated for outdoor service by the manufacturer.
 - 2. Bases: Provide heavy channel, gasketed iron bases, flanges up, for anchoring to pad.
 - 3. Provide exterior drip edge for top of door frame.
 - 4. Provide thermostatically controlled heater.
- C. Arrangement of Components:
 - 1. Arrange panel internal components for external conduit and piping to enter into panel either from above or below.
 - 2. Arrange panel instruments and control devices in a logical configuration associating pushbutton and selector switches with related readout devices.
 - 3. Mount internal control components on an internal back-panel. Devices may be mounted on the side-panel only by special permission from the Engineer.
 - 4. All control panel mounted operator interface devices shall be mounted between 4 feet and 6 feet above finished floor.
- D. Disconnect Switches
 - 1. See over-current protection in Paragraph 2.4, E, below.

E. Over Current Protection:

1. Main Over-current Device:
 - a. Where the electrical power supply voltage to the control panel is more than 120V AC, provide the panel with a flange mounted disconnect handle operating a molded case circuit breaker, and provide a control power transformer for 120V AC circuits:
 - 1) Mechanically interlocked the disconnect switch with the control enclosure doors so that no door can be opened unless the power is disconnected, and the disconnect switch cannot be closed until all doors are closed.
 - 2) Disconnect switch shall be lockable in the OFF position.
 - 3) Provide means to defeat the interlock.
 - 4) Disconnect switches shall be heavy duty, fusible, single throw. Fuses shall be provided.
 - b. Control Panels Supplied with 120V AC:
 - 1) Provide an internal breaker with the line side terminals covered by a barrier.
 - 2) Provide a nameplate prominently positioned on the control panel identifying the location of the power source and a warning statement requiring the source to be disconnected before opening the door to the enclosure.
2. Selection and Ratings of Protective Devices:
 - a. Interrupting Ratings: Not less than the system maximum available fault current at the point of application
 - b. Voltage Rating: Not less than the voltage of the application
 - c. Select current rating and trip characteristics to be suitable for:
 - 1) Maximum normal operating current
 - 2) Inrush characteristics
 - 3) Coordination of the protective devices to each other and to the source breaker feeding the panel
3. Provide a separate protective device for each powered electrical device:
 - a. An individual circuit breaker or fuse for each 120V AC instrument installed within its respective control panel and clearly identified for function.
 - b. An individual fuse for each PLC discrete output—provide with individual fuse with blown fuse indication external of the I/O card:
 - 1) Size external fuse to open before any I/O card mounted fuses.
 - 2) An individual fuse for each discrete input loop
 - 3) An individual ½-ampere fuse for each 4 to 20 mA analog loop powered from the control panel
 - 4) Install protective devices on the back mounting panel and identify by a service nameplate in accordance with the wiring diagrams.
4. Control Circuit Breakers
 - a. DIN Rail Mounting on 35mm rail
 - b. Manual OPEN-CLOSE toggle switch
 - c. Rated 250 VAC
 - d. Interrupting Rating:
 - 1) 10kA or available fault current at the line terminal, whichever is higher
 - e. Current ratings:
 - 1) As required for the application.
5. Fuse Holders:
 - a. Fused Terminal Blocks
 - b. DIN Rail mounting on 35mm rail
 - c. Suitable for specified AWG wire
 - d. Rated for 10 amperes at 600 volts
 - e. Screw terminal type
 - f. 8mm
 - g. Finger safe protection for all terminals for conductors
 - h. Terminals:
 - 1) Plainly identified to correspond with markings on the diagrams Permanent machine printed terminal identification.

- i. Wire size 22-12 AWG
 - j. Color:
 - 1) Grey
 - k. Indication:
 - 1) 120VAC NEON
 - l. Indication:
 - 1) 24VDC LED
- F. Conductors and Cables:
- 1. Power and Control Wiring:
 - a. Materials:
 - 1) Stranded, soft annealed copper
 - b. Insulation:
 - 1) 600-volt Type MTW
 - c. Minimum Sizes:
 - 1) Primary Power Distribution:
 - a) 12 AWG
 - 2) Secondary Power Distribution:
 - a) 14 AWG
 - 3) Control:
 - a) 16 AWG
 - d. Color:
 - 1) AC Power (Line and Load):
 - a) Black
 - 2) AC Power (Neutral):
 - a) White
 - 3) AC Control:
 - a) Red
 - 4) DC Power and Control:
 - a) Blue.
 - 5) DC Power common white with blue stripe
 - 6) Ground:
 - a) Green
 - 7) DC Power common white with blue stripe
 - 8) Ground:
 - a) Green
- G. Signal Cables:
 - 1. Materials:
 - a. Stranded, soft annealed copper
 - 2. Insulation:
 - a. 600-volt, PVC outer jacket
 - 3. Minimum Size:
 - a. 18 AWG paired
 - 4. Overall aluminum shield (tape)
 - 5. Copper drain wire
 - 6. Color:
 - a. Two Conductors:
 - 1) Positive (+): White, red
 - 2) Negative (-): Black
 - b. Three Conductors:
 - 1) Positive (+): White
 - 2) Negative (-): Black
 - 3) Signal: Red
 - c. Insulate the foil shielding and exposed drain wire for each signal cable with heat shrink tubing.

- H. Conductor Identification:
 - 1. Identify all conductors and cables with wire markers.
 - 2. Readily identified without twisting the conductor
- I. General Wiring Requirements:
 - 1. Wiring Methods:
 - a. Wiring methods and materials for panels shall be in accordance with the NEC requirements for general purpose (no open wiring) unless otherwise specified.
 - 2. Install all components in accordance with the manufacturer's instructions included in the listing and labeling.
 - 3. Where the electrical power supply voltage to the control panel is more than 120V AC, provide the panel with a flange-mounted disconnect and control power transformer. Mechanically interlock the disconnect switch with the control enclosure doors so that no door can be opened unless the power is disconnected, and the disconnect cannot be closed until all doors are closed.
 - a. Provide means to defeat this interlock.
 - 4. Control panels supplied with 120V AC:
 - a. Provide an internal breaker with the line side terminals covered by a barrier.
 - b. Provide a nameplate prominently positioned on the control panel identifying the location of the power source and a warning statement requiring the source to be disconnected before opening the door to the enclosure.
 - 5. Provide a nameplate on the cover of the control panel identifying all sources of power supply and foreign voltages within the control panel.
 - 6. Provide transformers, protective devices, and power supplies required to convert the supply voltage to the needed utilization voltage.
 - 7. Provide surge protection device on input supply power.
 - 8. Provide nonmetallic ducts for routing and organization of conductors and cables:
 - a. Size ducts for ultimate build-out of the panel, or for 25 percent spare, whichever is greater.
 - b. Provide separate ducts for signal and low voltage wiring from power and 120V AC control wiring:
 - 1) 120V AC:
 - a) Grey colored ducts
 - 2) 24V DC:
 - a) White colored ducts
 - 9. Cables shall be fastened with cable mounting clamps or with cable ties supported by any of the following methods:
 - a. Screw-on cable tie mounts
 - b. Hammer-on cable tie mounting clips
 - c. Fingers of the nonmetallic duct
 - 10. The free ends of cable ties shall be cut flush after final adjustment and fastening.
 - 11. Provide supports at the ends of cables to prevent mechanical stresses at the termination of conductors.
 - 12. Support panel conductors where necessary to keep them in place.
 - 13. Wiring to rear terminals on panel-mount instruments shall be run in nonmetallic duct secured to horizontal brackets run adjacent to the instruments.
 - 14. Conductors and cables shall be run from terminal to terminal without splice or joints.
 - a. Exceptions:
 - 1) Factory-applied connectors molded onto cables shall be permitted. Such connectors shall not be considered as splices or joints.
 - 15. The control panel shall be the source of power for all 120V AC devices interconnected with the control panel including, but not limited to:
 - a. Instruments and both mounted in the control panel and remotely connected to the control panel
 - b. Solenoid valves

2.5 PANEL COMPONENTS

A. Pilot Devices:

1. General:
 - a. Provide operator pushbuttons, switches, and pilot lights, from a single manufacturer.
 - b. Size:
 - 1) 30.5 mm
 - c. Heavy duty oil tight
 - d. Pushbuttons:
 - 1) Contacts Rated: NEMA A600
 - 2) Furnish one (1) spare normally open and normally closed contact with each switch.
 - e. Selector Switches:
 - 1) Contacts Rated:
 - a) NEMA A600
 - 2) Knob type
 - 3) Furnish one (1) spare normally open contact and normally closed contact with each switch.
 - 4) Provisions for locking in the OFF position where lockout provisions are indicated
 - f. E-Stop Pushbuttons
 - 1) Maintained position
 - 2) Mushroom head
 - 3) Red color
 - g. Pilot Lights:
 - 1) Type:
 - a) LED
 - 2) Push to test.
 - 3) Lamp Color:
 - a) As indicated on schematics
2. Indoor and Outdoor Areas:
 - a. NEMA Type 4/13
 - b. Manufacturers and Products: One (1) of the following:
 - 1) Allen-Bradley; Type 800T or equal
3. Corrosive Areas:
 - a. NEMA 4X.
 - b. Corrosion resistant
 - c. Exterior parts of high impact strength fiberglass reinforced polyester or multiple-layer epoxy coated zinc.
 - d. Manufacturers and Products: One (1) of the following: Allen-Bradley; Type 800H or equal
4. Hazardous (Classified) Areas/Class 1 Division 2:
 - a. NEMA 4X
 - b. Corrosion resistant
 - c. Exterior parts of high impact strength fiberglass reinforced polyester or multiple-layer epoxy coated zinc:
 - 1) All contacts contained within a hermetically sealed chamber:
 - a) Pushbuttons
 - b) Selector switches
 - c) Push-to-test contacts on pilot lights
 - d) UL listed and labeled for Class I Division 2 areas.
 - e) Manufacturers and Products: One (1) of the following:
 - i. Allen-Bradley; Type 8001-1 or equal

B. Signal Isolators and Converters:

1. Furnish signal isolators that provide complete isolation of input, output, and power input:

- a. Minimum Isolation Level:
 - 1) 1.5 kV AC/50-Hz for at least 1 minute
 - b. Adjustable span and zero
 - c. Accuracy:
 - 1) ± 1 percent of span
 - d. Ambient Temperature Range:
 - 1) Minus 20 °C to plus 65 °C
2. Manufacturers and Products:
- a. One (1) of the following:
 - b. Phoenix Contact; MCR Series or equal
- C. Relays:
1. General:
- a. For all types of 120V AC relays, provide transient surge protection across the coil of each relay.
 - b. For all types of 24V DC relays, provide a free-wheeling diode across the coil of each relay.
2. General Purpose:
- a. Magnetic control relays.
 - b. NEMA A300 Rated:
 - 1) 300 volts
 - 2) 10 amps continuous
 - 3) 7,200 VA make
 - 4) 720 VA break
 - c. Plug-in type
 - d. LED indication for relay energized
 - e. Coil Voltages:
 - 1) As required for the application
 - f. Minimum Poles:
 - 1) 1PDT
 - g. Touch Safe Design:
 - 1) All connection terminals to be protected against accidental touch
 - h. Enclose each relay in a clear plastic heat and shock-resistant dust cover.
 - i. Quantity and type of contact shall be as shown on Drawings or as needed for system compatibility.
 - j. Relays with screw-type socket terminals.
 - k. Provide additional (slave/interposing) relays when the following occurs:
 - 1) The number or type of contacts shown exceeds the contact capacity of the specified relays.
 - 2) Higher contact rating is required in order to interface with starter circuits or other equipment.
 - l. DIN rail mounting on 35-mm rail
 - m. Ice cube type relays shall be provided with retainer clips to secure relay in socket.
 - n. Integrated label holder for device labeling
 - o. Manufacturers and Products:
 - 1) One (1) of the following:
 - a) Phoenix Contact; PLC series
 - b) Potter and Brumfield; Type KRP or KUP
 - c) IDEC; R* Series (* = H, J, R, S, U).
 - d) Allen-Bradley; Type 700 H Series
 - e) Square D; Type K
3. Terminal Block Relays
- a. Terminal block relays are not to be used without specific approval from the Engineer.
4. Time Delay:
- a. Provide time delay relays to control contact transition time.
 - b. Contact Rating:

- 1) 240 volts
 - 2) 10 amps continuous
 - 3) 3,600 VA make
 - 4) 360 VA break
 - c. Coil Voltage:
 - 1) As required for the application
 - d. Provide pneumatic or electronic type with on-delay, off-delay, and on/off delay:
 - 1) For off-delay use the power off time delay relays. Where the required timing range exceeds capability of the off-delay relay use signal off-delay where power loss will not cause undesirable operation or pneumatic time delay relays.
 - e. Minimum Poles:
 - 1) 2PDT
 - f. Units include adjustable dial with graduated scale covering the time range in each case.
 - g. Minimum Timing Range:
 - 1) 0.1 second to 10 minutes, or as required for the application
 - h. Manufacturers and Products:
 - 1) One (1) of the following:
 - a) IDEC; GT3 series
 - b) Agastat Type; Series 7000 Series (Pneumatic)
 - c) Allen-Bradley; Type 700 HR Series
 - d) Or equal
- D. Terminal Blocks:
1. Din rail mounting on 35-mm rail
 2. Suitable for specified AWG wire
 3. Rated for 30 amperes at 600 volts
 4. Screw terminal type
 5. Provide mechanism to prevent wire connection from loosening in environments where vibration is present. This mechanism shall not cause permanent deformation to the metal body.
 6. Finger safe protection for all terminals for conductors
 7. Construction:
 - a. Polyamide insulation material capable of withstanding temperature extremes from - 40 °C to +105 °C., terminals:
 - b. Plainly identified to correspond with markings on the diagrams:
 - 1) Permanent machine printed terminal identification
 - 2) Disconnect type field signal conductor terminals with socket/screw for testing
 - 3) Identify terminals suitable for use with more than one (1) conductor.
 - 4) Position so that the internal and external wiring does not cross, to provide unobstructed access to the terminals and their conductors.
 - 5) Provide minimum 25 percent spare terminals.
 - 6) Manufacturers:
 - a) Entrelec or equal
 8. Fuses (Holders) and Circuit Breakers:
 - a. Fuse Holders:
 - 1) Modular Type:
 - a) DIN rail mounting on 35-mm rail
 - b) Touch Safe Design:
 - i. All connection terminals to be protected against accidental touch
 - c) Incorporates blown fuse indicator
 - d) Provide Nameplate Identifying each fuse.
 - e) Manufacturers:
 - f) Entrelec or equal
- E. Power Supplies:

1. Design power supply systems so that either the primary or backup supply can be removed, repaired, and returned to service without disrupting the system operation. Each power supply shall have output power of 120 Watt minimum.
 2. Convert 120V AC to 24V DC or other DC voltages as required for the application.
 3. Provide backup 24V DC power supply units to supply the load automatically upon failure of the primary supply.
 4. Provide power supply arrangement that is configured with several modules to supply adequate power in the event of a single module failure.
 5. Provide automatic switchover upon module failure.
 6. Alarm contacts monitored by the PLC.
 7. Sized to provide 40 percent excess rated capacity.
 8. UL 508C listed to allow full rated output without de-rating.
 9. Provide fuse or short-circuit protection.
 10. Provide a minimum of one (1) set of dry contacts configured to change state on failure for monitoring and signaling purposes.
 11. Output Regulation:
 - a. ± 0.05 percent for a 10 percent line change or a 50 percent load change: With remote voltage sensing.
 12. Operating Temperature Range:
 - a. 0 to 50 °C
 13. DIN rail mounting on 35-mm rail
 14. Provide self-protecting power supplies with a means of limiting de current in case of short circuit.
 15. Manufacturer:
 - a. Sola or Phoenix Contact Quint4 or equal
- F. Industrial Ethernet Switches:
1. IP Ethernet switch
 2. Four (4) 100/100BaseTX RJ-45 Ports or more as needed
 3. -40C to 70C Operating temperature range
 4. Auto sensing 10/100BaseTX
 5. DIN rail mountable enclosure
 6. 24VDC Input voltage
 7. Include minimum of one (1) 1000BaseSX Multimode GB Fiber Optic Port (ST Connector) only as needed or required by Project Drawings.
 8. Manufacturer N-Tron or equal
- G. Wire Duct:
1. Provide flame retardant plastic wiring duct, slotted with dust cover.
 2. Type:
 - a. Wide slot
 - b. Narrow slot
 - c. Round hole
 3. Manufacturer: Panduit or equal
- H. Uninterruptable Power Supply (UPS)
1. The UPS system shall be designed to protect the PLC and instruments from line disturbances. In normal operation, the UPS shall supply filtered and regulated AC power to the load. Upon failure of the incoming (Line) AC power, the load shall continue to be supplied by the UPS.
 2. The interruption to the critical load upon failure or restoration of the commercial AC source shall not exceed 4 milliseconds. Upon restoration of Line AC, the battery(s) shall be recharged.
 3. A manually operated switch shall be provided to transfer the load from UPS power to Line AC to facilitate maintenance without de-energizing the system.
 4. The UPS system shall meet the following requirements:

- a. Input/output voltage: 120 VAC, single-phase, 60 HZ
 - b. 500 VA minimum
 - c. Battery lifetime: 3 years
5. UPS shall be sized to supply full load power for 20 minutes. Contractor shall submit supporting documentation for approval showing the submitted UPS meets this requirement.

2.6 ACCESSORIES

- A. Provide panels with an inside protective pocket to hold the Panel Drawings. Ship panels with one (1) copy of accepted Shop Drawings including, but not limited to, schematic diagram, connection diagram, and layout drawing of control wiring and components in a sealed plastic bag stored in the panel drawing pocket.
1. Provide 15-inch floor stands or legs where needed or as indicated in Specifications.
 2. Provide nameplate to each panel as indicated on Drawings.
- B. Provide a nameplate with the following markings that is plainly visible after installation:
1. Manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the panel can be identified
 2. Supply voltage, phase, frequency, and full-load current
 3. Short-circuit current rating of the panel based on one of the following:
 - a. Short-circuit current rating of a listed and labeled assembly
 - b. Short-circuit current rating established utilizing an approved method
- C. Lighting:
1. Provide one (1) luminaire for each section on the interior of the panel, spaced evenly along the top-front of the enclosure door opening(s)
 2. Covered or guarded
 3. Provide on-off door-activated switches where indicated on Drawings.
 4. Provide 18-watt fluorescent lamp for indoor enclosures less than 30 inches wide.
 5. Provide 40-watt fluorescent lamp for enclosures larger than 30 inches wide:
 - a. Provide additional fixtures for every 36 inches of width.
- D. Receptacles:
1. Provide one (1) duplex receptacle located every 4 feet of enclosure width, spaced evenly along the back mounting panels.
 2. GFCI, 125-volt, single-phase, 15-ampere
- E. Grounding: Provide the following:
1. Grounding strap between enclosure doors and the enclosure
 2. Equipment grounding conductor terminals
 3. Provide equipment ground bus with lugs for connection of all equipment grounding wires.
 4. Bond multi-section panels together with an equipment grounding conductor or an equivalent grounding bus.
 5. Identify equipment grounding conductor terminals with the word "GROUND," the letters "GND," or the letter "G," or the color green.
 6. Signal (24V DC) Grounding: Terminate each drain wire of a signal (shielded) cable to a unique grounding terminal block, or common ground bus at the end of the cable as shown on the loop drawings.
 7. Ensure the continuity of the equipment grounding system by effective connections through conductors or structural members.
 8. Design so that removing a device does not interrupt the continuity of the equipment grounding circuit.
 9. Provide an equipment-grounding terminal for each incoming power circuit, near the phase conductor terminal.
 10. Size ground wires in accordance with NEC and UL standards, unless noted otherwise.

11. Connect all exposed, noncurrent-carrying conductive parts, devices, and equipment to the equipment grounding circuit.

2.7 SPARE PARTS

- A. Provide a minimum of 10 percent spare lamps (minimum 2) and one (1) spare lens for each color pilot lamp in each panel.

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 40 96 14

I-O LIST

Panel	Type	IO Description	Signal	New (N) or Existing (E) Equipment	P&ID
Chlorine Generation Building					
PCP-100	AO	PE Disinfection Metering Pump P105	SPEED	N	I-101
PCP-100	AO	PE Disinfection Metering Pump P106	SPEED	N	I-101
PCP-100	AO	RW Disinfection Metering Pump P108	SPEED	N	I-103
PCP-100	AI	RW Transfer FIT101	FLOW	N	I-103
PCP-100	AI	RW Effluent CLA101	Cl ₂	N	I-103
PCP-100	AI	RW Effluent CLA101	pH	N	I-103
PCP-100	AI	RW Storage Tank-1 LT101	LEVEL	N	I-103
PCP-100	CELL	RW Storage Tank-2 LT	LEVEL	N	I-103
PCP-100	DI	RW Pump P101	REM	N	I-103
PCP-100	DO	RW Pump P101	FAIL	N	I-103
PCP-100	DI	RW Pump P101	ON	N	I-103
PCP-100	DO	RW Pump P101	RUN	N	I-103
PCP-100	AO	RW Pump P101	SPEED	N	I-103
PCP-100	AI	RW Pump P101	SPEED	N	I-103
PCP-100	DI	RW Pump P102	REM	N	I-103
PCP-100	DO	RW Pump P102	FAIL	N	I-103
PCP-100	DI	RW Pump P102	ON	N	I-103
PCP-100	DO	RW Pump P102	RUN	N	I-103
PCP-100	AO	RW Pump P102	SPEED	N	I-103
PCP-100	AI	RW Pump P102	SPEED	N	I-103
PCP-100	DI	RW Pump Station Pressure Switch PS102	HIGH PRESSURE	N	I-103
PCP-100	AI	RW Pump Station FIT102	FLOW	N	I-103

Panel	Type	IO Description	Signal	New (N) or Existing (E) Equipment	P&ID
PCP-100	AI	H2 Gas Detector	H ₂ LEVEL	N	I-104
PCP-100	DI	H2 Gas Detector	FAIL	N	I-104
PCP-100	DI	Chlorine Generation System	ALARM	N	I-104
PCP-100	Ethernet	Chlorine Generation System	ETHERNET	N	I-104
PCP-100	DI	Coagulation System	FAULT	N	I-105
PCP-100	AI	Coagulation System Pump	SPEED	N	I-105
PCP-100	AI	Coagulation System	FLOW	N	I-105
PCP-100	DI	Coagulation System	IN-REMOTE	N	I-105
PCP-100	DI	Coagulation System	RUNNING	N	I-105
PCP-100	DO	Coagulation System Spray Water Solenoid	OPEN	N	I-105
PCP-100	DI	Coagulation System Spray Water Solenoid	CLOSED	N	I-105
PCP-100	AI	Coagulation System FIT103	FLOW	N	I-105
Backwash Filter Treatment Building					
PCP-200	DI	FE Pump P201	IN AUTO	E	I-101
PLC-200	DI	EFE Pump P201	RUNNING	E	I-101
PCP-200	DI	FE Pump P201	FAULT	E	I-101
PCP-200	DO	FE Pump P201	START	E	I-101
PCP-200	DI	FE Pump P202	IN AUTO	E	I-101
PCP-200	DI	FE Pump P202	RUN	E	I-101
PCP-200	DI	FE Pump P202	FAULT	E	I-101
PCP-200	DO	FE Pump P202	START	E	I-101
PCP-200	DI	RW Transfer Pump P208	IN AUTO	N	I-101
PCP-200	DI	RW Transfer Pump P208	RUN	N	I-101
PCP-200	DI	RW Transfer Pump P208	FAULT	N	I-101

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Panel	Type	IO Description	Signal	New (N) or Existing (E) Equipment	P&ID
PCP-200	DO	RW Transfer Pump P208	START	N	I-101
PCP-200	AI	FE Pump Station LT201	LEVEL	E	I-101
PCP-200	DI	Filter Backwash LS207	HIGH LEVEL	E	I-102
PCP-200	DI	Clarifier Sludge Collector & Scum Skimmer Drive Motor M201	IN AUTO	E	I-102
PCP-200	DI	Clarifier Sludge Collector & Scum Skimmer Drive Motor M201	RUN	E	I-102
PCP-200	DI	Clarifier Sludge Collector & Scum Skimmer Drive Motor M201	FAULT	E	I-102
PCP-200	DO	Clarifier Sludge Collector & Scum Skimmer Drive Motor M201	START	E	I-102
PCP-200	DI	Clarifier Sludge Collector & Scum Skimmer Drive Motor M201, Torque Switch NS201	HIGH TORQUE	E	I-102
PCP-200	DI	Clarifier Sludge Collector & Scum Skimmer Drive Motor M201, Torque Switch NS202	HIGH-HIGH TORQUE	E	I-102
PCP-200	DI	Scum Skimmer Limit Switch MS201	EVENT	E	I-102
PCP-200	DI	BW P205	IN AUTO	E	Not Shown
PCP-200	DI	BW P205	RUNNING	E	Not Shown
PCP-200	DI	BW P205	FAULT	E	Not Shown
PCP-200	DI	BW P206	IN AUTO	E	Not Shown
PCP-200	DI	BW P206	RUNNING	E	Not Shown
PCP-200	DI	BW P206	FAULT	E	Not Shown
PCP-200	DI	BW Return P203	IN AUTO	E	Not Shown
PCP-200	DI	BW Return P203	RUNNING	E	Not Shown
PCP-200	DI	BW Return P203	FAULT	E	Not Shown
PCP-200	DI	BW Return P204	IN AUTO	E	Not Shown
PCP-200	DI	BW Return P204	RUNNING	E	Not Shown
PCP-200	DI	BW Return P204	FAULT	E	Not Shown
PCP-200	DI	F1 Effluent Open, MOV201	OPEN	E	Not Shown

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Panel	Type	IO Description	Signal	New (N) or Existing (E) Equipment	P&ID
PCP-200	DI	F1 Effluent Close, MOV201	CLOSE	E	Not Shown
PCP-200	DI	F2 Effluent Open, MOV202	OPEN	E	Not Shown
PCP-200	DI	F2 Effluent Close, MOV202	CLOSE	E	Not Shown
PCP-200	DI	F3 Effluent Open, MOV203	OPEN	E	Not Shown
PCP-200	DI	F3 Effluent Close, MOV203	CLOSE	E	Not Shown
PCP-200	DI	F4 Effluent Open, MOV204	OPEN	E	Not Shown
PCP-200	DI	F4 Effluent Close, MOV204	CLOSE	E	Not Shown
PCP-200	DI	F1 Backwash Open, MOV205	OPEN	E	Not Shown
PCP-200	DI	F1 Backwash Close, MOV205	CLOSE	E	Not Shown
PCP-200	DI	F2 Backwash Open, MOV206	OPEN	E	Not Shown
PCP-200	DI	F2 Backwash Close, MOV206	CLOSE	E	Not Shown
PCP-200	DI	F3 Backwash Open, MOV207	OPEN	E	Not Shown
PCP-200	DI	F3 Backwash Close, MOV207	CLOSE	E	Not Shown
PCP-200	DI	F4 Backwash Open, MOV208	OPEN	E	Not Shown
PCP-200	DI	F4 Backwash Close, MOV208	CLOSE	E	Not Shown
PCP-200	DI	F1 BW Air Open, MOV209	OPEN	E	Not Shown
PCP-200	DI	F1 BW Air Close, MOV209	CLOSE	E	Not Shown
PCP-200	DI	F2 BW Air Open, MOV210	OPEN	E	Not Shown
PCP-200	DI	F2 BW Air Close, MOV210	CLOSE	E	Not Shown
PCP-200	DI	F3 BW Air Open, MOV211	OPEN	E	Not Shown
PCP-200	DI	F3 BW Air Close, MOV211	CLOSE	E	Not Shown
PCP-200	DI	F4 BW Air Open, MOV212	OPEN	E	Not Shown
PCP-200	DI	F4 BW Air Close, MOV212	CLOSE	E	Not Shown

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Recycled Water Project

Panel	Type	IO Description	Signal	New (N) or Existing (E) Equipment	P&ID
PCP-200	DO	Scum Air Lift Pump SOV, MOV 213	OPEN	E	Not Shown
PCP-200	DO	WAS Air Lift Pump SOV, MOV 214	OPEN	E	Not Shown
PCP-200	DI	BW Blower BLO304 HOA	HOA	E	Not Shown
PCP-200	DI	MLR Airlift Pump, MOV216	REM	N	I-102
PCP-200	DO	MLR Airlift Pump, MOV216	FAIL	N	I-102
PCP-200	DI	MLR Airlift Pump, MOV216	ON	N	I-102
PCP-200	DO	MLR Airlift Pump, MOV216	RUN	N	I-102
PCP-200	DO	MLR Airlift Pump, MOV216	RUN FREQ	N	I-102
PCP-200	DO	MLR Airlift Pump, MOV216	RUN DURATION	N	I-102
PCP-200	AI	Aeration Basin DO Sensor, AIT201	DO	E	I-102
PCP-200	AI	PE Chlorine Contact Basin Turbidity Sensor, AIT201	TURBIDITY	E	I-102
PCP-200	DI	BW Basin LS206	HIGH LEVEL	E	Not Shown
PCP-200	DI	BW BASIN LS205	LOW LEVEL	E	Not Shown
PCP-200	DI	F1 Chamber LS201	HIGH LEVEL	E	Not Shown
PCP-200	DI	F2 Chamber LS202	HIGH LEVEL	E	Not Shown
PCP-200	DI	F3 Chamber LS203	HIGH LEVEL	E	Not Shown
PCP-200	DI	F4 Chamber LS204	HIGH LEVEL	E	Not Shown
Office/Blower Building					
PCP-300	DI	Aeration Blower BLO301	AUTO	E	I-102
PCP-300	DI	Aeration Blower BLO301	RUN	E	I-102
PCP-300	DI	Aeration Blower BLO301	FAULT	E	I-102
PCP-300	DO	Aeration Blower BLO301	START	E	I-102
PCP-300	DI	Aeration Blower BLO302	AUTO	E	I-102

Panel	Type	IO Description	Signal	New (N) or Existing (E) Equipment	P&ID
PCP-300	DI	Aeration Blower BLO302	RUN	E	I-102
PCP-300	DI	Aeration Blower BLO302	FAULT	E	I-102
PCP-300	DO	Aeration Blower BLO302	START	E	I-102
PCP-300	DI	Aeration Blower BLO303	AUTO	E	I-102
PCP-300	DI	Aeration Blower BLO303	RUN	E	I-102
PCP-300	DI	Aeration Blower BLO303	FAULT	E	I-102
PCP-300	DO	Aeration Blower BLO303	START	E	I-102
PCP-300	AI	Aeration Blower BLO303	SPEED	E	I-102
PCP-300	AO	Aeration Blower BLO303	SPEED	E	I-102
PCP-300	AO	DO and Turbidity Chart Recorder ARI301	DO, TURB	E	I-102
PCP-300	DO	Effluent Failure Alarm YA301	ALARM	E	I-102
PCP-300	DO	Influent Failure Alarm YA302	ALARM	E	I-102
PCP-300	DO	Temperature Alarm YA303	ALARM	E	I-102
PCP-300	DO	Dryer Alarm YA304	ALARM	E	I-102
PCP-300	DO	Chlorine Alarm YA305	ALARM	N	I-102
PCP-300	DO	Generator Alarm YA306	ALARM	E	I-102
PCP-300	DO	Blower Alarm YA307	ALARM	E	I-102
PCP-300	DO	Pipe Gallery Alarm YA308	ALARM	E	I-102
PCP-300	DO	OSG Alarm YA309	ALARM	N	I-102
PCP-300	DO	Filter Level Alarm YA310	ALARM	E	I-102
PCP-300	DO	Dechlorination Low Alarm YA311	ALARM	E	I-102
PCP-300	DO	RW Pump Alarm YA312	ALARM	N	I-102
PCP-300	DO	Recycle Tank High Level Alarm YA313	ALARM	N	I-102

Panel	Type	IO Description	Signal	New (N) or Existing (E) Equipment	P&ID
PCP-300	DO	RW Chlorine Alarm YA314	ALARM	N	I-102
PCP-300	DO	DO Alarm YA315	ALARM	E	I-102
Existing Plant Water / Dechlorination Shed					
PCP-200	AI	PE CLA201	CL2	E	I-101
PCP-200	AI	PE CLA201	pH	E	I-101
PCP-200	AO	PE Dechlorination Metering Pump P107	SPEED	E	I-101
PCP-200	DI	RW to Plant Water Pressure Switch PS 101	LOW PRESSURE	E	I-101

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INSTRUMENTATION LIST

P&ID Page	Designation	Description	Power	Signal(s)	Type	New or Existing
I-101	PI-105	PE Disinfection Metering Pump 105 Pressure Indicator	NA	NA	Pressure Indicator	New
I-101	PI-106	PE Disinfection Metering Pump 106 Pressure Indicator	24 VDC	NA	Pressure Indicator	New
I-101	CLA-201	Plant Effluent Chlorine Analyzer	12 VDC	AI, DI	Reagentless Chlorine Analyzer	Existing
I-101	PI-201	Plant Effluent Sample Pump 201 Pressure Indicator	NA	NA	Pressure Indicator	New
I-101	LT-201	Filter Effluent PS Level	24 VDC	AI	Level Transmitter	Existing
I-101	PI-107	PE Dechlorination Pump Discharge Pressure Indicator	24 VDC	NA	Pressure Indicator	Existing
I-101	PI-101	RW to Plant Water Pressure Indicator	24 VDC	DI	Pressure Indicator	Existing
I-101	PS-101	RW to Plant Water Pressure Switch	24 VDC	DI	Pressure Switch	Existing
I-102	ARI-301	DO and Turbidity Chart Recorder	24 VDC	AO	DO and Turbidity Recorder	Existing
I-102	LS-207	Filter BW Level Float Switch	24 VDC	DI	Level Float Switch	Existing
I-102	LS	Filter BW Sump Pump Level Float Switch	24 VDC	DI	Level Float Switch	Existing
I-102	NS-201	Clarifier Sludge Collector & Scum Skimmer Drive Motor M201, Torque Switch	24 VDC	DI	Torque Switch	Existing
I-102	NS-202	Clarifier Sludge Collector & Scum Skimmer Drive Motor M201, Torque Switch	24 VDC	DI	Torque Switch	Existing
I-102	MS-201	Scum Skimmer Counter	24 VDC	DI	Counter	Existing
I-102	AIT-201	DO & Turbidity Indicating Transmitter	24 VDC	AI	Transmitter	Existing
I-102	AE-201	Aeration Basin DO Sensor	24 VDC	AI	DO Sensor	Existing
I-102	AE-202	PE Chlorine Contact Basin Turbidity Sensor	24 VDC	AI	Turbidity Sensor	Existing
I-103	PI-108	RW Disinfection Metering Pump 108 Pressure Indicator	24 VDC	NA	Pressure Indicator	New
I-103	FIT-101	Recycled Water Transfer Flow Indicating Transmitter	120VAC	AI	Flow Indicating Transmitter	New
I-103	FE-101	Recycled Water Transfer Flow Meter	24 VDC	AI	Inline Magmeter	New
I-103	CLA-101	Recycled Water Chlorine Analyzer	12 VDC	AI, DI	Reagentless Chlorine Analyzer	New
I-103	PI-101	RW Sample Pump 101 Pressure Indicator	24 VDC	NA	Pressure Indicator	Existing
I-103	PS-102	Recycled Water High Pressure Switch	24 VDC	DI	Pressure Switch	New
I-103	FE-102	RW Transfer Flow Meter	24 VDC	AI	Inline Magmeter	New
I-103	FIT-102	RW Transfer Flow Indicating Transmitter	120VAC	AI	Flow Indicating Transmitter	New
I-103	LT-101	RW Tank-1 Level Transmitter	24 VDC	AI	Pressure Transducer	New
I-103	PD-217	Differential Pressure Indicator	24 VDC	NA	Differential Pressure Indicator	New
I-103	PI-217A	PRV217 Pressure Indicator	24 VDC	NA	Differential Pressure Indicator	New
I-103	PI-217B	PRV217 Pressure Indicator	24 VDC	NA	Differential Pressure Indicator	New
I-103	LT-102	Recycled Water Tank-2 Level Transmitter	24 VDC	CELL	Level Transmitter	New
Not Shown	LS-104	Recycled Water Tank-2 Level Switch	24 VDC	CELL	Level Switch	New
I-104	PI-109	Water Strainer Inlet Pressure Indicator	24 VDC	NA	Pressure Indicator	New
I-104	PI-110	Water Strainer Outlet Pressure Indicator	24 VDC	NA	Pressure Indicator	New
I-104	LS-101	Brine Tank Level Float Switch	24 VDC	DI	Float Switch	New
I-104	LS-102	NaOCl Solution Storage Tank Level Float Switch	24 VDC	DI	Float Switch	New
I-104	AEC	H ₂ Gas Detector with Controller	24 VDC	AI,DI	Gas Detector	New
I-105	FE-103	Coagulation System Flow Meter	24 VDC	AI	Flow Meter	New
I-105	FIT-103	Coagulation System Flow Indicating Transmitter	24 VDC	AI	Flow Indicating Transmitter	New
I-105	PI-111	Coagulation Dosing Pump Discharge Pressure Indicator	24 VDC	NA	Pressure Indicator	New
I-105	PI-112	Coagulation Dosing Skid Pressure Indicator	24 VDC	NA	Pressure Indicator	New
I-105	FE-104	Plant Water to Coagulation System Flow Meter 1	24 VDC	NA	Flow Meter	New
I-105	FE-105	Plant Water to Coagulation System Flow Meter 2	24 VDC	NA	Flow Meter	New
I-105	LS-103	Plant Water to Coagulation System Level Switch	24 VDC	NA	Level Switch	New
Not Shown	LT-304	Influent PS Level	24 VDC	AI	Pressure Transducer	Existing
Not Shown	LS-201	Filter 1 High Level Switch	24 VDC	DI	Float Switch	Existing
Not Shown	LS-202	Filter 2 High Level Switch	24 VDC	DI	Float Switch	Existing
Not Shown	LS-203	Filter 3 High Level Switch	24 VDC	DI	Float Switch	Existing
Not Shown	LS-204	Filter 4 High Level Switch	24 VDC	DI	Float Switch	Existing
Not Shown	LS-205	Filter Backwash Basin Pump Off Level Switch	24 VDC	DI	Float Switch	Existing
Not Shown	LS-206	Filter Backwash Basin Pump On Level Switch	24 VDC	DI	Float Switch	Existing
Not Shown	FE-201	Filter Effluent Flowmeter	24 VDC	AI	Submerged Magmeter	Existing
Not Shown	FIT-201	Filter Effluent Flow Indicating Transmitter	120 VAC	AI, DI	Flow Indicating Transmitter	Existing

SECTION 44 42 56

VERTICAL TURBINE PUMPS

PART 1 GENERAL

1.1 GENERAL

- A. Recycled Water Transfer Pump.

1.2 REFERENCES

A. Reference Standards:

1. American Bearing Manufacturers Association (ABMA):
 - a. ABMA 9; Load Ratings and Fatigue Life for Ball Bearings
 - b. ABMA 11: Load Ratings and Fatigue Life for Roller Bearings
2. ASTM International (ASTM):
 - a. ASTM A36: Standard Specification for Carbon Structural Steel
 - b. ASTM A536: Standard Specification for Ductile Iron Castings
 - c. ASTM B584: Standard Specification for Copper Alloy Sand Castings for General Applications
3. Hydraulic Institute (HI):
 - a. HI 9.6.4: Rotodynamic Pumps for Vibration Measurements and Allowable Values
 - b. HI 14.6: Rotodynamic Pumps for Hydraulic Performance Acceptance Tests
4. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. IEEE 112: Standard Test Procedure for Polyphase Induction Motors and Generators
5. National Electrical Manufacturer's Association (NEMA):
 - a. NEMA MG 1: Motors and Generators
6. National Fire Protection Association (NFPA):
 - a. NFPA 70: National Electrical Code
7. Underwriters Laboratories Inc. (UL):
 - a. UL 83: Standard for Safety for Thermoplastic-Insulated Wire and Cables
 - b. UL 674: Standard for Safety for Electric Motors and Generators for Use in Division I Hazardous (Classified) Locations
 - c. UL 2111: Standard for Safety for Overheating Protection for Motors

1.3 DEFINITIONS

- A. EXP: Explosion-proof enclosure.
- B. Inverter Duty Motor: Motor meeting applicable requirements of NEMA MG 1, Section IV, Parts 30 and 31.
- C. Motor Nameplate Horsepower: That rating after any derating required to allow for extra heating caused by the harmonic content in the voltage applied to the motor by its controller.
- D. ODP: Open drip-proof enclosure.
- E. TEFC: Totally enclosed, fan-cooled enclosure.
- F. TENV: Totally enclosed, nonventilated enclosure.

- G. WPI: Open weather protected enclosure, Type I.
- H. WPII : Open weather protected enclosure, Type II.

1.4 PRE-INSTALLATION MEETING

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

1.5 SUBMITTALS

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

- B. Product Data:

1. Make, model, weight, and horsepower of each equipment assembly
2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction
3. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions.
4. Pump maximum downthrust or upthrust in pounds.
5. Motor data including:
 - a. Descriptive information.
 - b. Nameplate data in accordance with NEMA MG 1.
 - c. Additional Rating Information:
 - Service factor.
 - Locked rotor current.
 - No load current.
 - Adjustable frequency drive motor load classification (for example, variable torque) and minimum allowable motor speed for that load classification.
 - Guaranteed minimum full load efficiency and power factor.
 - d. Enclosure type and mounting (such as, horizontal, vertical).
 - e. Dimensions and total weight.
 - f. Conduit box dimensions and usable volume as defined in NEMA MG 1 and NFPA 70.
 - g. Bearing type.
 - h. Bearing lubrication.
 - i. Bearing life.
 - j. Description, ratings, and wiring diagram of motor thermal protection.
 - k. Motor sound power level in accordance with NEMA MG 1.
 - l. Maximum brake horsepower required by the equipment driven by the motor.
 - m. Description and rating of submersible motor moisture sensing system.
6. Factory Functional and Performance Test Reports: Factory test data for each pump shall be submitted, reviewed, and approved by Engineer prior to shipment of equipment.
7. Anchorage and bracing:
 - a. List of mechanical, and electrical equipment requiring Contractor-designed anchorage and bracing, unless specifically exempted.
 - b. Manufacturers' engineered seismic hardware product data.
 - c. Submittal will be rejected if proposed anchorage method would create an overstressed condition of supporting member. Revise anchorages and strengthening of structural support so there is no overstressed condition.

- d. Anchorage and Bracing Calculations: For attachments, braces, and anchorages, include IBC and Project-specific criteria as noted on General Structural Notes on Drawings, in addition to manufacturer's specific criteria used for design; sealed by a civil or structural engineer registered in the State of California.
 - e. Manufacturer's hardware installation requirements.
 - C. Shop Drawings:
 - 1. Detailed structural, mechanical, and electrical drawings showing equipment dimensions, size, and locations of connections and weights of components.
 - 2. Assembly and installation drawings including shaft size, seal plan, coupling, bearings, anchor bolt plan, parts nomenclature, and materials of construction lists.
 - 3. Baseplate drawings with leveling jackscrew details, anchor bolt and sleeve details, and minimum foundation installation and leveling requirements.
 - 4. Power and control wiring diagrams, including terminals and numbers.
 - 5. Anchorage and bracing:
 - a. Seismic attachment assembly drawings: include connection hardware, braces, and anchors or anchor bolts for nonexempt components, equipment, and systems.
 - b. Submitted seismic anchorage drawings and calculations are identified as IBC deferred submittals and will be submitted to and accepted by the Authority Having Jurisdiction prior to installation of component, equipment or distribution system.
 - c. Submit deferred action submittals such as shop drawings with supporting deferred informational submittals such as calculations no less than 4 weeks in advance of installation of component, equipment or distribution system to be anchored to structure.
 - D. Manufacturer's Certificates:
 - 1. Factory finish system: Manufacturer's Certificate of Compliance, in accordance with Section 01 60 00–Product Requirements, that factory finish system is identical to requirements specified herein.
 - 2. Certify that products meet or exceed specified requirements.
 - E. Manufacturer's Installation Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
 - F. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
 - G. Qualifications Statement: Submit qualifications for manufacturer.
- 1.6 CLOSEOUT SUBMITTALS
 - A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.
 - B. Project Record Documents: Record actual locations of mechanical appurtenances.
- 1.7 MAINTENANCE MATERIAL SUBMITTALS
 - A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for spare parts and maintenance materials.

- B. Suggested spare parts list to maintain equipment in service for a period of 1 year and 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

1.8 EXTRA MATERIALS

- A. Furnish:
 - 1. One complete set of bearings
 - 2. One complete set of gaskets and O-ring seals
 - 3. One complete set of shaft sleeves
 - 4. One complete set of keys, dowels, pins, etc
 - 5. One complete mechanical seal
 - 6. One complete set of special tools required to dismantle pump

1.9 QUALITY ASSURANCE

- A. Services of Manufacturer's Representative shall be as stated in Section 01 43 33 – Manufacturers' Field Services and specified herein.

1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 3 years documented experience.
- B. Installer: Company specializing in performing work of this Section with minimum 10 years documented experience.

1.11 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.

1.12 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Indicate field measurements on Shop Drawings.

1.13 WARRANTY

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

PART 2 PRODUCTS

2.1 GENERAL

- A. Vertical turbine pumps shall be submersible turbine pumps driven by a vertical shaft affixed to a pump-mounted motor as indicated in Drawings for the purpose of pumping water as indicated in Drawings.

2.2 Recycled Water (RW) Transfer Pump

- A. Equipment Tag Numbers:

1. P208

- B. Performance and Design Requirements

1. Pump Requirements:

- a. Flow Capacity (Gallons per minute, gpm): 56
- b. Stages: 3
- c. Total Dynamic Head, Feet: 30
- d. Minimum Pump Efficiency, Percentage (%): 56
- e. Minimum Speed, RPM: 1750
- f. Motor Power (horsepower, HP): 3HP, 480V 3 Phase
- g. Discharge Size, inches: 4
- h. Flange Standard/Class: 150#

2. Manufacturer:

- a. Trillium Floway, Model 6LKM
William Swartz
2495 S. Golden State Blvd.
Fresno, CA 93706
(559) 374-8977
William.Swartz@trilliumflow.com
- b. Flowserve, Model 06EJH
Greg Pritchard
DXP Enterprises, Inc.
(925) 922-8995
Gregory.Pritchard@dxpe.com
- c. Approved Equal

- C. Materials of Construction

- 1. Bowl: Cast Iron, ASTM A48 CL30 with epoxy coating and porcelain enamel lining
- 2. Bowl Bearings: Bismuth tin bronze, UNS C89835 or C84400, lubricated by the product being pumped. The bearings are to be located above and below each impeller. The bowls are to be of threaded connection.
- 3. Impeller: Bronze, ASTM B584 C90300, cast in one piece of the enclosed type. The impellers shall be statically and dynamically balanced. The impeller shall be securely fastened to the shaft with 316SS taper split bushings (collets). Impellers shall be adjusted vertically by external means and shall have sufficient axial clearance for reliable service in accordance with the specified operating conditions.
- 4. Suction Bell: The suction bell shall be fitted with a heavy gauge wire woven basket type strainer, of the cast iron or galvanized steel material. The strainer shall have a net inlet equal to at least four times the suction pipe area. The maximum opening shall not be more than 75% of the minimum opening of the water passage through the bowl and impeller. The strainer shall be secured to the suction bell by means of bronze clips and 300 series stainless steel cap screws.

5. Column Pipe: Carbon steel, plate conforming to ASTM A36, and the pipe shall conform to ASTM A53. The column pipe shall be flanged with rabbeted fits to ensure proper alignment. The weight of the column pipe shall be no less than that stated in ANSI/AWWA Specification E103. Flange bolting shall be made of 304SS.
6. Line Shaft: The column line shaft shall be turned and ground and manufactured of 416SS.
7. Line Shaft Bearings: The line shaft bearings shall be Buna-N.
8. Discharge Head: Carbon steel, ASTM A36 steel plate materials, ASTM A53 Grade B body pipe and ASTM A181 flanges, or ASTM A48 CL30. The discharge flange shall have a 150# ANSI raised face with bolt holes straddling the vertical centerline. The discharge elbow transitioning from the vertical column pipe to the horizontal discharge outlet shall be constructed of either a smooth short radius elbow, or a 3 piece mitered elbow to reduce friction losses. A 1/4" NPT pressure gauge connection shall be supplied on the top centerline of the discharge outlet. The top of the discharge head shall be machined to accept a standard NEMA P base, driver and have a diameter equal to the driver base diameter (BD). The head shaft shall be coupled to the top line shaft beneath the motor to facilitate ease of assembly and maintenance. All couplings and other moving or rotating parts shall be covered on all sides by an OSHA approved coupling guard. Coupling guards shall be fabricated from 16 USS gage or thicker galvanized or aluminum-clad steel or from 1/2 inch mesh expanded metal. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard.
9. Mechanical Seal: The discharge head shall be fitted with a mechanical seal. The seal shall be of the cartridge type, sleeve mounted, easily replaceable and have its face continuously flushed with the product being pumped. The seal shall be equivalent to the Chesterton 155.
10. Sole Plate: The pump shall be mounted and supported by a separate steel base plate (sole plate). The soleplate shall be drilled to match the base flange drilling of the discharge head. Abutting surfaces between the soleplate and the discharge head shall be machined to provide 100% surface contact with the discharge head base. The center opening diameter shall be of sufficient size to permit installation and removal of the complete pump assembly. The soleplate shall be permanently anchored and leveled by the installation contractor on the existing Filter Effluent Pump plate.
11. Nameplate: The pump shall be furnished with a stainless steel nameplate securely mounted to the discharge head. At a minimum it shall contain information providing design flow, design TDH, HP, RPM, bowl model number, number of stages, manufacturer serial number, pump type & impeller setting dimension.

2.3 SOURCE QUALITY CONTROL

1. Test all equipment actually furnished.
2. Factory Test Report: Include test data sheets, performance test logs, and as tested pump curve.
3. Functional Test: Perform manufacturer's standard test on equipment. Include vibration test, as follows:
 - Dynamically balance rotating parts of each pump and its driving unit before final assembly.
 - Limits:
 - a) Driving Unit Alone: Less than 80 percent of NEMA MG 1 limits.
4. Complete Rotating Assembly including coupling, drive unit, and motor: Less than 90 percent of limits established in the Hydraulic Institute Standards Performance Test:
 - a. Conduct on each pump at rated speed.

- b. Perform under simulated operating conditions over full range of pump operating parameters.
- c. Test for a continuous 3-hour period without malfunction.
- d. Test Log: Record the following:
 - Total head.
 - Capacity.
 - Horsepower requirements.
 - Flow measured by factory instrumentation and storage volumes.
 - Average distance from suction well water surface to pump discharge centerline for duration of test.
 - Pump discharge pressure converted to feet of liquid pumped and corrected to pump discharge centerline.
 - Calculated velocity head at the discharge flange.
 - Bowl head.
 - Driving motor voltage and amperage measured for each phase.
- 5. Adjust, realign, or modify units and retest in accordance with Hydraulic Institute standards if necessary.
- 6. Hydrostatic Tests: Pump casing(s) tested at 150 percent of shutoff head. Test pressure maintained for not less than 5 minutes.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Prior to installation, protect stored appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, vandalism, etc.
- B. Clean all debris and foreign materials from inside of piping before installing appurtenances.
- C. Clean out debris and foreign material from openings and seats, test operating mechanisms to check functioning, and check nuts and bolts for tightness.
- D. Erect and support appurtenances in respective positions free from distortion and strain during handling and installation.
- E. Inspect material for defects in workmanship and material.
- F. Repair appurtenances and other equipment that do not operate easily or are otherwise defective at no additional cost to the Owner.
- G. Field Testing:
 - 1. Pressure test appurtenances with pipeline pressure testing. .

3.2 FIELD FINISHING

- A. Touch up factory finish as specified in Section 09 90 00—Painting and Coating.

3.3 FIELD QUALITY CONTROL

- A. Functional Tests: Conduct on each pump.
 - 1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
 - 2. Vibration Test:

- a. Test with unit installed and in normal operation, and discharging to connected piping systems at rates between low discharge head and high discharge head conditions specified, shall not develop vibration exceeding 80 percent of limits specified in HI 9.6.4.
- b. If unit exhibits vibration in excess of limits specified, adjust or modify as necessary. Unit that cannot be adjusted or modified to conform as specified shall be replaced.
3. Flow Output: Measured by plant instrumentation and storage volumes.
4. Test for continuous 3-hour period.
5. Test Report Requirements: In accordance with HI 14.6.

B. Performance Test: In accordance with Hydraulic Institute Standards.

3.4 MANUFACTURER'S SERVICES

- A. Manufacturer's Representative: Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:
1. 1 person-day for installation assistance and inspection.
 2. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
 3. 1 person-day for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Engineer.
- B. See Section 01 43 33—Manufacturer's Field Services
- C. Provide in accordance with Section 01 70 00—Execution and Closeout Requirements.

END OF SECTION

SECTION 44 42 57

SUBMERSIBLE TURBINE PUMPS

PART 1 GENERAL

1.1 GENERAL

A. Recycled Water Distribution Pumps.

1.2 REFERENCES

- A. Reference Standards:
1. American Bearing Manufacturers Association (ABMA):
ABMA 9: Load Ratings and Fatigue Life for Ball Bearings
ABMA 11: Load Ratings and Fatigue Life for Roller Bearings
 2. ASTM International (ASTM):
ASTM A36: Standard Specification for Carbon Structural Steel
ASTM A536: Standard Specification for Ductile Iron Castings
ASTM B584: Standard Specification for Copper Alloy Sand Castings for General Applications
 3. Hydraulic Institute (HI):
HI 9.6.4: Rotodynamic Pumps for Vibration Measurements and Allowable Values
HI 14.6: Rotodynamic Pumps for Hydraulic Performance Acceptance Tests
 4. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
IEEE 112: Standard Test Procedure for Polyphase Induction Motors and Generators
 5. National Electrical Manufacturer's Association (NEMA):
NEMA MG 1: Motors and Generators
 6. National Fire Protection Association (NFPA):
NFPA 70: National Electrical Code
 7. Underwriters Laboratories Inc. (UL):
UL 83: Standard for Safety for Thermoplastic-Insulated Wire and Cables
UL 674: Standard for Safety for Electric Motors and Generators for Use in Division I Hazardous (Classified) Locations
UL 2111: Standard for Safety for Overheating Protection for Motors

1.3 DEFINITIONS

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- B. Inverter Duty Motor: Motor meeting applicable requirements of NEMA MG 1, Section IV, Parts 30 and 31
- C. Motor Nameplate Horsepower: That rating after any derating required to allow for extra heating caused by the harmonic content in the voltage applied to the motor by its controller
- D. ODP: Open drip-proof enclosure
- E. TEFC: Totally enclosed, fan-cooled enclosure
- F. TENV: Totally enclosed, nonventilated enclosure

G. WPI: Open weather protected enclosure, Type I

H. WP II : Open weather protected enclosure, Type II

1.4 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meetings.

1.5 SUBMITTALS

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

B. Product Data:

1. Make, model, weight, and horsepower of each equipment assembly
2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction
3. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions.
4. Pump maximum downthrust or upthrust in pounds.
5. Motor data including:
 - a. Descriptive information.
 - b. Nameplate data in accordance with NEMA MG 1.
 - c. Additional Rating Information:
 - 1) Service factor.
 - 2) Locked rotor current.
 - 3) No load current.
 - 4) Adjustable frequency drive motor load classification (for example, variable torque) and minimum allowable motor speed for that load classification.
 - 5) Guaranteed minimum full load efficiency and power factor.
 - d. Enclosure type and mounting (such as, horizontal, vertical).
 - e. Dimensions and total weight.
 - f. Conduit box dimensions and usable volume as defined in NEMA MG 1 and NFPA 70.
 - g. Bearing type.
 - h. Bearing lubrication.
 - i. Bearing life.
 - j. Description, ratings, and wiring diagram of motor thermal protection.
 - k. Motor sound power level in accordance with NEMA MG 1.
 - l. Maximum brake horsepower required by the equipment driven by the motor.
 - m. Description and rating of submersible motor moisture sensing system.
6. Factory Functional and Performance Test Reports: Factory test data for each pump shall be submitted, reviewed, and approved by Engineer prior to shipment of equipment.
7. Anchorage and bracing:
 - a. List of mechanical, and electrical equipment requiring Contractor-designed anchorage and bracing, unless specifically exempted.
 - b. Manufacturers' engineered seismic hardware product data.
 - c. Submittal will be rejected if proposed anchorage method would create an overstressed condition of supporting member. Revise anchorages and strengthening of structural support so there is no overstressed condition.

- d. Anchorage and Bracing Calculations: For attachments, braces, and anchorages, include IBC and Project-specific criteria as noted on General Structural Notes on Drawings, in addition to manufacturer's specific criteria used for design; sealed by a civil or structural engineer registered in the State of California.
 - e. Manufacturer's hardware installation requirements.
- C. Shop Drawings:
 - 1. Detailed structural, mechanical, and electrical drawings showing equipment dimensions, size, and locations of connections and weights of components.
 - 2. Assembly and installation drawings including shaft size, seal plan, coupling, bearings, anchor bolt plan, parts nomenclature, and materials of construction lists.
 - 3. Baseplate drawings with leveling jackscrew details, anchor bolt and sleeve details, and minimum foundation installation and leveling requirements.
 - 4. Power and control wiring diagrams, including terminals and numbers.
 - 5. Anchorage and bracing:
 - a. Seismic attachment assembly drawings: include connection hardware, braces, and anchors or anchor bolts for nonexempt components, equipment, and systems.
 - b. Submitted seismic anchorage drawings and calculations are identified as IBC deferred submittals and will be submitted to and accepted by the Authority Having Jurisdiction prior to installation of component, equipment or distribution system.
 - c. Submit deferred action submittals such as shop drawings with supporting deferred informational submittals such as calculations no less than 4 weeks in advance of installation of component, equipment or distribution system to be anchored to structure.
- D. Manufacturer's Certificates:
 - 1. Factory finish system: Manufacturer's Certificate of Compliance, in accordance with Section 01 60 00—Product Requirements, that factory finish system is identical to requirements specified herein.
 - 2. Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
- G. Qualifications Statement: Submit qualifications for manufacturer.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.
- B. Project Record Documents: Record actual locations of mechanical appurtenances.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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

- B. Suggested spare parts list to maintain equipment in service for a period of 1 year and 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

1.8 EXTRA MATERIALS

- A. Furnish:
 - 1. One complete set of bearings
 - 2. One complete set of gaskets and O-ring seals
 - 3. One complete set of shaft sleeves
 - 4. One complete set of keys, dowels, pins, etc
 - 5. One complete mechanical seal
 - 6. One complete set of special tools required to dismantle pump

1.9 QUALITY ASSURANCE

- A. Services of Manufacturer's Representative shall be as stated in Section 01 40 00 - Quality Requirements and specified herein.

1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 3 years documented experience.
- B. Installer: Company specializing in performing work of this Section with minimum 10 years documented experience.

1.11 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.

1.12 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Indicate field measurements on Shop Drawings.

1.13 WARRANTY

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

PART 2 PRODUCTS

2.1 GENERAL

- A. Equipment Tag Numbers:
 - 1. P101, P102
- B. Performance Requirements
 - 1. Pump Requirements:
 - a. Flow Capacity (Gallons per minute, gpm): 250
 - b. Stages: 10
 - c. Total Dynamic Head, Feet: 400
 - d. Minimum Pump Efficiency, Percentage (%): 72
 - e. Minimum Speed, RPM: 1730
 - f. Motor Power (horsepower, HP): 40HP, 480V 3 Phase
 - g. Discharge Head Size, Inches: 4
 - h. Flange Standard/Class: 150#
 - 2. Manufacturer:
 - a. Xylem Goulds, Model VIS-WFTM 9WAHC
Tyson MacDonald
R.F. MacDonald Co.
San Francisco, CA
(209) 595-5523
Tyson.MacDonald@RFMacDonald.com
 - b. Flowserve, Model 06EHL
Greg Pritchard
DXP Enterprises, Inc.
(925) 922-8995
Gregory.Pritchard@dxpe.com
 - c. Approved equal.
- C. Materials of Construction
 - 1. Bowl: The bowls shall be flanged type constructed of close-grained cast iron conform to ASTM A48, Class 30 with glass enamel lining and epoxy coating. They shall be free from sand holes, blowholes, or other faults and must be accurately machined and fit- ted to close tolerances. They shall be capable of withstanding a hydrostatic pressure equal to twice the pressure at rated flow or 1.5 times shut-off head, whichever is greater. The intermediate bowls shall have glass enamel lined waterways for maximum efficiency and wear protection. All intermediate bowls shall be of identical design for interchangeability.
 - 2. Bowl Bearings: All the bowls shall be fitted with sleeve type bearings of bronze alloy C89835. A discharge bowl shall be used to connect bowl assembly to the discharge pipe with bronze material. An extra-long bronze bearing packed with non-soluble grease shall be provided in the top bowl and extended into the discharge bowl The bearing shall have a threaded cast iron cap or plug at the top to protect the bearing from abrasives. The hub of the discharge bowl should be such that the bearing can be easily removed through the top of the hub. A thrust ring shall be above the top impeller to prevent excessive vertical upthrust.
 - 3. Impeller: The impellers shall be constructed from 316 stainless steel. They shall be free from defects and must be accurately cast, machined, balanced, and filed for optimum performance and minimum vibration. Impellers shall be balanced to grade G6.3 of ISO 1940 as minimum. They shall be securely fastened to the bowl shaft with taper locks of C1018.

4. Motor Adapter: The inlet motor adapter shall be of ASTM A536 Gr. 60-40-18 ductile iron and shall contain an extra-long bronze bearing. The inlet area shall have a net open area of at least four times the eye of the impeller and shall be protected with a 304 stainless steel screen. The openings on the screen shall not be more than 75% of the minimum opening of the water passage through the bowl or the impeller. Motor adapter shall be 10 inches.
5. Column Pipe: The column pipe shall be ASTM A53 grade B standard weight carbon steel pipe, in feet lengths and connected by threaded sleeve type steel coupling. The ends of the pipes shall have ANSI B1.20.1 standard tapered pipe threads. Inside diameter of the pipe shall be such that the head losses shall not be over 5 feet per 100 feet of pipe.
6. Line Shaft: The pump shaft shall be of ASTM 582 Type 416 stainless steel. It shall be precision ground and polished with surface finish better than 40 RMS.
7. Shaft Coupling: The shaft coupling shall be of Type 416 stainless steel and be capable of transmitting the total torque and total thrust of the bowl assembly in either direction of rotation.
8. Discharge Bearings: Bearings of Bismuth Bronze alloy, B584 Modified.
9. Submersible Cable: Pump cable shall be sized to limit the voltage drop to no more than 5%. The cable shall have three separate conductors and a ground and shall be included in a single continuous jacketed assembly. The insulation shall be water and oil resistant, and suitable for continuous immersion. The cable should be the length of the discharge pipe plus feet to extend from the surface plate to the electrical controller. The cable should be adequately secured to the discharge pipe by plastic ties, or other non-metallic means, at 10-foot intervals.
10. Discharge Head: Carbon steel, ASTM A36 steel plate materials, ASTM A53 Grade B body pipe and ASTM A181 flanges, or ASTM A48 CL30. The discharge flange shall have a 150# ANSI raised face with bolt holes straddling the vertical centerline.
11. Submersible Motor: The motor shall be a heavy duty canned (or wet wound) type of NEMA design, with outside diameter not to exceed inches. The motor shall be capable of continuous operation underwater at the specified conditions outlined above. A suitable thrust bearing shall be incorporated in the lower end of the motor adequate to receive the entire hydraulic thrust load of the pump unit plus the weight of the rotating parts regardless of the direction of rotation. The motor shall have a 1.15 service factor, and suitable for use on volt, three phase, 60 Hz electric service. The motor leads shall be of sufficient length so that they may be spliced above the bowl assembly and the leads shall be protected by a type 304 stainless steel cable guard held in place with stainless steel banding. As the motor lead exit the top of the cable guard it shall be properly protected to prevent damaging or cutting the lead by the cable guard material.
12. Motor Cooling Shroud: The motor shall be enclosed with a cooling shroud. Carbon steel, ASTM A36 steel plate materials with epoxy lining and coating or Type 304 stainless steel.
13. Sole Plate: The surface plate shall be of fabricated steel. The plate shall incorporate a long radius elbow welded securely to an ANSI Class 150# flange and shall rigidly support the total weight of the motor, bowl assembly, discharge pipe, cable, and column of water. The plate shall have a cable seal of adequate size to accommodate the cable size and well vent and water level indicator.
14. Nameplate: The pump shall be furnished with a stainless steel nameplate securely mounted to the discharge head. At a minimum it shall contain information providing design flow, design TDH, HP, RPM, bowl model number, number of stages, manufacturer serial number, pump type & impeller setting dimension.

2.2 SOURCE QUALITY CONTROL

- A. Test all equipment actually furnished.
- B. Factory Test Report: Include test data sheets, performance test logs, and as tested pump curve.
- C. Functional Test: Perform manufacturer's standard test on equipment. Include vibration test, as follows:
 - 1. Dynamically balance rotating parts of each pump and its driving unit before final assembly.
 - 2. Complete Rotating Assembly including coupling, drive unit, and motor: Less than 90 percent of limits established in the Hydraulic Institute Standards Performance Test:
 - a. Conduct on each pump at rated speed.
 - b. Perform under simulated operating conditions over full range of pump operating parameters.
 - c. Test for a continuous 3-hour period without malfunction.
 - d. Test Log: Record the following:
 - 1) Total head
 - 2) Capacity
 - 3) Horsepower requirements
 - 4) Flow measured by factory instrumentation and storage volumes
 - 5) Average distance from suction well water surface to pump discharge centerline for duration of test
 - 6) Pump discharge pressure converted to feet of liquid pumped and corrected to pump discharge centerline
 - 7) Calculated velocity head at the discharge flange
 - 8) Bowl head
 - 9) Driving motor voltage and amperage measured for each phase
 - e. Adjust, realign, or modify units and retest in accordance with Hydraulic Institute standards if necessary.
 - f. Hydrostatic Tests: Pump casing(s) tested at 150 percent of shutoff head. Test pressure maintained for not less than 5 minutes.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Prior to installation, protect stored appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, vandalism, etc.
- B. Clean all debris and foreign materials from inside of piping before installing appurtenances.
- C. Clean out debris and foreign material from openings and seats, test operating mechanisms to check functioning, and check nuts and bolts for tightness.
- D. Erect and support appurtenances in respective positions free from distortion and strain during handling and installation.
- E. Inspect material for defects in workmanship and material.

- F. Repair appurtenances and other equipment that do not operate easily or are otherwise defective at no additional cost to the Owner.

- G. Field Testing:
 - 1. Pressure test appurtenances with pipeline pressure testing.

3.2 FIELD FINISHING

- A. Touch up factory finish as specified in Section 09 90 00—Painting and Coating.

3.3 FIELD QUALITY CONTROL

- A. Functional Tests: Conduct on each pump.
 - 1. Laser Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
 - 2. Vibration Test:
 - a. Test with unit installed and in normal operation and discharging to connected piping systems at rates between low discharge head and high discharge head conditions specified, shall not develop vibration exceeding 80 percent of limits specified in HI 9.6.4.
 - b. If unit exhibits vibration in excess of specified limits, adjust or modify as necessary. Unit that cannot be adjusted or modified to conform as specified shall be replaced.
 - 3. Flow Output: Measured by plant instrumentation and storage volumes.
 - 4. Test for continuous 3-hour period.
 - 5. Test Report Requirements: In accordance with HI 14.6.
- B. Performance Test: In accordance with Hydraulic Institute Standards.

3.4 MANUFACTURERS' SERVICES

- A. Manufacturer's Representative: Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:
 - 1. 1 person-day for installation assistance and inspection.
 - 2. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper installation.
 - 3. 1 person-day for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Engineer.
- B. See Section 01 43 33—Manufacturer's Field Services

3.5 CONTRACT CLOSEOUT

- A. Provide in accordance with Section 01 70 00—Execution and Closeout Requirements.

END OF SECTION

SECTION 46 33 13

SODIUM HYPOCHLORITE GENERATING EQUIPMENT

PART 1 GENERAL

1.1 DESCRIPTION

- A. An onsite generation system (OSG) shall be furnished to enable onsite production of a 0.65% (6,500 ppm) (± 500) oxidant solution through the electrolysis of brine. The total installed generation capacity of the OSG shall be 25 pounds of free available chlorine per day.
- B. OSG system shall produce mixed oxidant solution for the disinfection of wastewater and recycled water. All components of this system are to be installed in the water processing room of the new chlorine generation building.
- C. The disinfection system shall consist of equipment associated with an onsite generation system. The system shall include, but not be limited to: water preconditioning including cartridge filtration and dual tank water softener, a salt tank/brine generator suitable for storing and dissolving salt, generator controls, AC to DC power conversion and electrolytic cell located in an operator safe powder coated aluminum enclosure, an oxidant solution holding tank, and a disinfectant injection system.
- D. As evidence of oxidant production, the equipment supplier must submit bona fide 3rd party independent testing documentation verifying inactivation of *Cryptosporidium parvum* at least 2 log in excess of what can be accomplished using sodium hypochlorite solution.
1. Onsite generation of sodium hypochlorite is not acceptable as a substitute product.
- E. The equipment supplier shall furnish all components of the OSG as specified herein, including:

Component	Quantity
Onsite Oxidant Generator (OSG)	One (1)
Feed Water Filter	One (1)
Feed Water Softener (dual tank)	One (1)
Feed Water Heater	One (1)
Brine Saturator Tank (Brine Generator)	One (1)
Brine Feed filter (integral to OSG unit)	One (1)
Disinfectant Solution Storage Tank	One (1)
Liquid Barrier Vent System	One (1)
Hydrogen Gas Detection Sensor and Controller	One (1)
Disinfectant Meter Pump System (2 injection points)	One (1)
Microchem Analyzer	One (1)

- F. The equipment supplier shall provide the following services to ensure the safe and efficient operation of the OSG.
1. OSG installation inspection
2. OSG startup and commissioning
3. OSG testing supervision
4. Operator training
- G. The Contractor shall furnish all labor, materials, equipment and appurtenances required to install, test, and place into satisfactory operation the OSG furnished by the equipment supplier

as described in Execution Section. The contractor is responsible with engaging the supplier to ensure a fully operable, safe and code compliant system is installed and coordinated with other elements of the project including but not limited to interconnecting pipework, electrical, drains, vents, communication signals, system/alarm integration, supports, pads and safety equipment. The contractor is responsible for providing the balance of plant for any interconnecting components required that is not supplied by the OSG supplier but required for a fully operable and safe system.

1.2 RELATED SECTIONS

Section 01 33 00:	Submittal Procedures
Section 01 60 00:	Product Requirements
Section 01 91 14:	Equipment Testing and Facility Startup
Section 40 05 00:	General Piping Requirements
Section 40 05 53:	Identification for Process Piping, Water and Wastewater Equipment
Section 40 27 00:	Process Piping
Section 40 80 01:	Process Piping Leakage Testing
Section 40 94 00:	Control Strategy
Section 26 05 00:	Basic Electrical Material Methods

1.3 REFERENCES

- A. Project Drawings: Layout and Section sheets
- B. Project Process and Instrumentation Diagrams
- C. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
 - 1. OSHA safety standards concerning personnel protection against machinery and the handling of dangerous chemicals
 - 2. Instrument Society of America (ISA)
 - 3. ASTM-International (ASTM)
 - 4. Joint Industrial Council (JIC)
 - 5. National Electric Manufacturer's Association (NEMA)
 - 6. National Electrical Code (NEC)
 - 7. Institute of Electrical and Electronic Engineers (IEEE)
 - 8. American Welding Society (AWS)
 - 9. American National Standards Institute (ANSI)
 - 10. Anti-Friction Bearing Manufacturers Association (AFBMA)
 - 11. Standards of American Water Works Association (AWWA)
 - 12. Air Movement & Control Association (AMCA)

1.4 QUALITY ASSURANCE

- A. All OSG components shall be supplied to the Contractor by a single equipment supplier, including standard valving and gauges required for the operation of the system.
- B. The equipment supplier shall have hydrogen handling devices and processes reviewed and endorsed by Hydrogen Safety, LLC.

- C. The equipment supplier shall have at least 10 years experience in furnishing onsite electrolytic oxidant generation systems of similar capacity to the equipment specified herein. As part of their submittal package, the equipment supplier shall submit the following documentation:
1. Evidence that oxidant generators of similar design have been in successful operation
 2. for at least 5 years in at least 10 separate installations—provide location of installation system and years installed.
 3. Current NSF/ANSI Standard 61 Certification (Drinking Water Additives – Health Effects).
 4. Manufacturer must be ISO 9001:2008 certified or higher.
- D. Salt Quality Requirements, containing no organic binders, flow control agents or resin cleaning material, and meeting the following specifications:

Component	Percent Minimum
NaCl (dry)	99.5%
Impurity	Percent Maximum
Calcium (in all forms)	0.01%
Magnesium (in all forms)	0.01%
Manganese	0.00002%
Iron (as Fe)	0.0005%
Insoluble	0.005%
Additives	0.0001%

- E. Prior to shipment, the equipment supplier will provide a factory test.
1. A copy of the test results will be certified and shipped with the equipment.
 2. The Engineer and/or District are allowed to witness testing.
 3. The test will include the following:
 - a. Cell Voltage
 - b. Cell Amperage Range
 - c. Oxidant Solution Flow Rate from Cell
 - d. Free Available Chlorine Measurement of Oxidant Solution
 - e. Temperature Monitoring and Control System
 - f. Standby Switch
 - g. System Operational
 - h. Proper Alarm and Safety Shutdown Function
 - i. Functionality of Menu and Manual Buttons
 - j. Proper Cell Purge Function
 - k. Bill of Materials Verified
 - l. Proper Labeling in Place

1.5 SUBMITTALS

- A. The equipment supplier shall submit, in accordance with Section 01 33 00—Submittal Procedures, complete shop drawings to establish compliance with this section. Submittals shall include the following and all other information requested in other paragraphs of this specification section for approval.
1. Manufacturer's literature and specifications, including a complete description in sufficient detail to permit comparison with the technical specifications.
 2. Onsite Generator Manufacturer Certification for ISO 9001
 3. Onsite Generator NSF/ANSI 61 Certification
 4. Certified testing results from factory testing of unit
 5. Evidence that oxidant generators of similar design have been in successful operation for

- at least 5 years in at least 10 separate installations—provide location of installation system and years installed.
6. Bill of Materials, including as a minimum the following data for each component:
 - a. Manufacturer
 - b. Model number
 - c. Quantity provided
 - d. Description
 - e. Capacity
 7. Dimensional drawings (including anchor bolt layout) for each component of the OSG
 8. Piping and instrumentation diagrams (P&IDs) showing location of all instruments, valves and auxiliary equipment, and process loop descriptions showing and describing the operation and control of the OSG
 9. Motor Data: For each motor furnish a certified motor data sheet for the actual motor
 10. A list of any and all parameters, ratings or other characteristics where the proposed OSG deviates from the requirements set forth in these Specifications.
 11. An electronic or scanned copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with “No changes required” or provide a statement that no changes are required.
 - a. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.
 - b. An electronic or scanned copy of this Specification section with addenda and all referenced Specification sections with addenda, with each paragraph check-marked to indicate Specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
 - 1) If deviations and clarifications from the Specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
 - 2) Failure to include a copy of the marked-up Specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up Specifications and justifications are submitted in a complete package.
- B. The equipment supplier shall submit electrical/instrumentation submittals including:
1. Complete electrical and instrumentation diagrams in sufficient detail to allow installation of the OSG system components
- C. The following information shall be required.
1. Recommended spare parts list for all equipment associated with the OSG system
- D. The equipment supplier shall submit five (5) copies of complete instructions manuals with detailed operation and maintenance data for each component of the OSG. One (1) digital copy of the manual shall also be provided. The instructions manual shall include.
1. Safety precautions
 2. Safety data sheets for all chemicals associated with the system
 3. Protective equipment and clothing
 4. Cell warranty conditions
 5. Technical data, including detailed descriptions of OSG operation, and each component
 6. Installation data, procedures, and recommendations
 7. Operation instructions, including startup and shutdown procedures and sequence

8. Service and maintenance data, including all information and instructions required by plant personnel to keep equipment properly cleaned, lubricated, and adjusted so that it functions economically throughout its full design life
9. Illustrations
10. Spare parts list
11. Name, address, and phone number of manufacturer and manufacturer's local service representative

E. Manufacturer's Certificate

1. Manufacturer shall provide signed certification by the field technician that the onsite generation system has been installed in accordance with the equipment manufacturer's guidelines and that the complete system has been verified to be fully operable within tolerances contained within this Specification.

F. Contractor shall submit shop drawings for layout and details.

1.6 WARRANTY

- A. Manufacturer shall warrant the onsite generator enclosure for a period of two (2) years from the date of original manufacture.
- B. Manufacturer shall warrant electrolytic cell for the period of five (5) years from startup.
 1. The cell warranty covers the complete cell not just electrodes.
- C. Manufacturer shall warrant other items in the project specification for one (1) year from ship confirmation or with the original equipment manufacturer's warranty, whichever occurs first.

PART 2 PRODUCTS

2.1 ONSITE GENERATOR

A. Requirements

1. The electrolytic cell is required to have the capability to automatically reverse polarity in a self-cleaning cycle in order to decrease the frequency of manually acid washing the cell.
2. OSG shall produce an oxidant solution of 0.65% (6,500 ppm) (± 500) through the electrolysis of brine.
3. The oxidant generator shall have a capacity of 25 pounds of equivalent chlorine per day using a single cell/module.
4. Oxidant generator capacity shall be capable of being increased up to 100 pounds of equivalent chlorine per day using a single cell composed of multiple modules.
5. Each oxidant generator shall consume a maximum of:
 - a. 3.00 pounds of salt per pound of equivalent chlorine
 - b. 3.00 kWh AC per pound of equivalent chlorine
6. Oxidant generator operating voltage shall be 240VAC, 1 phase, with AC to DC converters.
7. Oxidant generator shall receive a process stream of saturated brine.
 - a. The dilution of the concentrated brine will take place on each of the OSG skids by using an internal variable speed brine pump.
 - b. Conductivity probes shall not be allowed.
 - c. Manual controlled brine feed to electrolytic cell shall not be allowed.

8. Each generator shall receive a processed stream of dilution soft water.
 - a. The soft water feed shall be monitored using a pressure sensor and a flow meter.
 - b. Water flow shall be automatically controlled by the generator PLC by means of integrated pulse width modulated control valve for each electrolytic cell.
 - c. Flow sensing shall be performed using a high-speed counting functionality with an accuracy within $\pm 15\%$.
 - d. Manual controlled soft dilution water feed to electrolytic cell shall not be allowed.
 9. All electrolytic cell modules shall be plumbed and operated in a parallel flow arrangement. Electrolytic cells and/or modules installed in series shall not be allowed.
 10. Recirculation of water and brine through individual and/or multiple cells shall not be allowed.
 11. The oxidant generator shall operate at constant capacity, and automatically start and stop based on the low and high level signals from the oxidant storage tank.
 12. All OSG functions performed by the controls platform shall use PID loops where applicable.
 13. The oxidant generator enclosure shall include all valves, piping and instrumentation necessary to dilute saturated brine before it enters the electrolytic cell(s).
 14. At a minimum, the oxidant generator shall have the following safety features:
 - a. Rupture disk fail with burst sensor
 - b. Cell high temperature
 - c. Cell low level flow
 - d. Power supply low voltage
 - e. Power supply low and high current
 - f. Automatic current regulation
 - g. Pressure switch at the inlet to the cell
 - h. Flow switch on the inlet side of the pressure relief valve
 15. The hydrogen handling devices and processes shall be reviewed and endorsed by Hydrogen Safety, LLC.
 16. No system requiring dilution air blowers will be accepted.
- B. Enclosure
1. Shall be wall mounted.
 2. Dimensions of each generator:
 - a. Width of 36 inches
 - b. Depth of 17.4 inches
 - c. Height of 66.5 inches
- C. Integral Brine Filter
1. 5-micron nominal rating
 2. 10 inches long
- D. Integral Electrolytic Cell(s)
1. The electrolytic cell casing shall be constructed of high-quality CPVC material, which has superior chemical and temperature compatibilities with oxidants. The electrolytic cell shall be mounted so that it prevents pure horizontal or vertical flow through it in order to maximize the use of the electrode available active surface. The electrolytic cell shall be mounted for clear and easy access. No pure vertically oriented cells shall be allowed.
 2. Cell construction shall be rectangular to minimize gas head space inside of the cell, and modular allowing electrodes to be removed as a modular assembly. Any necessary joining of cell materials shall be by solvent welding or mechanical compression. Thermal welding will not be allowed.

3. The electrodes shall be titanium and the anodes, coated with a mixed metal oxide catalytic coating for electrical efficiency and maximum longevity. The electrodes shall be solid flat plate and shall be constructed in a bipolar configuration to facilitate current distribution and minimize voltage drop through the electrodes.
 4. The electrolytic cell shall be of modular design with a total of one (1) inlet and one
 5. (1) outlet regardless if the electrolytic cell is composed of a single module or multiple modules. Multiple cells design will not be allowed.
 6. The electrolytic cell shall automatically self-clean by reverse polarity and acid washing should not be a task required for routine maintenance. High fluid velocity and/or gas lifting are not adequate means to claim a self-cleaning electrolytic cell.
- E. Integral Power Supply
1. The power supply shall be air cooled and shall function to provide constant current to the cell within the specified voltage ranges.
- F. Integral Control System
1. Each generator shall be controlled using an Allen Bradley MicroLogix 1400 PLC to maintain consistent cell and system operation.
 2. The user interface shall be an Allen Bradley panel view plus 600 with a 6 inch (minimum) color touch screen.
 3. Control system shall be integrated into oxidant generator enclosure.
 4. External control panel shall not be allowed to control a single generator.
 5. At a minimum, the OSG shall have the following alarms and status:
 - a. Master Switch Off—Status
 - b. Low Water Flow—Alarm
 - c. Power Supply Thermal Switch—Status
 - d. Inlet Water Pressure Low—Alarm
 - e. Oxidant Tank Level Low—Status
 - f. Oxidant Tank Level High—Status
 - g. High Oxidant Temperature—Alarm
 - h. High Power Supply Temperature—Alarm
 - i. Low Cell Current—Alarm
 - j. High Cell Current—Alarm
 - k. Low Cell Voltage—Alarm
 - l. Very High Cell Current—Alarm
 - m. Low Brine Pump Voltage—Alarm
 - n. Low Feed Water Temperature—Alarm
 - o. High Feed Water Temperature—Alarm
 - p. High Oxidant Shutdown Temperature—Alarm
 - q. Integral Overall System Controls/Monitoring
 - r. Brine Tank Level Low—Status
 - s. Brine Tank Level High—Status
- 1) Connection to site SCADA systems shall be provided through Ethernet port with Ethernet/IP, DNP3 over IP, and Modbus TCP/IP protocol support, as well as web server capabilities.
 - a) Shall also have serial capabilities using DF1/DH485/Modbus RTU/DNP3/ASCII protocol support
 - 2) Control system shall have, but not be limited to, the following digital I/O:
 - a) Inputs
 - i. Disinfectant Solution Storage Tank Level
 - ii. Hydrogen Monitor
 - iii. Hardness Monitor
 - b) Outputs

- i. Dry contact water boost pump relay
- ii. Dry contact brine boost pump relay
- iii. Dry contact alarm output relay

G. All components mounted on the oxidant generator shall be pre-plumbed and pre-wired.

H. Manufacturer

1. The oxidant generator shall be a ClorTec25-V-SC as supplied by De Nora Water Technologies/MIOX, Albuquerque, New Mexico,
2. Microchlor, or approved equal capable of producing a chlorine oxidant solution, meeting the specifications herein, and fitting the entire system within the physical space constraints of the Chlorine Generation Building factoring in all required access and safety clearances.

2.2 FEED WATER FILTER

- A. One (1) wall-mounted cartridge type filter polypropylene (poaque) housing holding a 10-inch cartridge, mounting bracket cap and support bracket.
1. Pentek Products Filter Housing or approved equal
- B. One (1) micro filter filter cartridge shall be 5-micron, 9.75" cartridge length, disposable cartridge.
1. Vorex filter Cartridges or approved equal
- C. Two (2) pressure gauges shall measure pressure drop across filter.
- D. Two (2) PVC isolation valves shall be provided.
- E. NSF/ANSI Standard 42

2.3 FEED WATER SOFTENER

- A. Water for use in generating the oxidant will be softened using one (1) set of twin tank ion exchange water softeners with a hydraulically-driven, flow-controlled switchover valve. When the ion exchange capacity of one (1) resin tank is nearly exhausted, the softener control mechanism will automatically divert flow to the alternate tank while initiating a brine backwashing of the first tank for regeneration of the ion exchange resin. Minimum efficiency will be 3,181 grains exchange per pound of salt.
- B. Capacity the softeners shall be appropriate for continuous use with water of the following quality:
1. Water Pressure (min to max): 15 to 125 psi
 2. Water Temperature (min to max): 35 to 120 °F
 3. Water pH (min to max): 5 to 10
 4. Water Hardness: 66 gpg (max)
 5. Chlorine Residual: 2 mg/L (max)
- C. Connections associated with each water softener will include 1½-inch inlet/outlet pipe fittings, a ¾-inch high-density polyethylene tube with in-line check valve for feeding brine to regenerate the water softener, a ½-inch high-density polyethylene tube for draining backwash waste.
- D. The water softener will be a highly efficient, regeneration design as manufactured by Kinetico Corporation. The regeneration process and frequency will be accomplished by the water supply hydraulic pressure, no electric power required. Regeneration shall be based on total

volume of water flow since the last regeneration cycle rather than on a fixed time interval.

- E. Each softener shall use brine from the saturator tank for the regeneration cycle. The regeneration waste shall be disposed to a sanitary drain.
- F. Softener system shall be complete with the following items:
 - Wrapped polyethylene Softener Tanks
 - Mechanical control valve
 - PVC isolation Valves
 - One (1) Check Valve
- G. The water softener shall be a CP208s as supplied by Kinetico or approved equal.

2.4 FEED WATER HEATER

- A. One (1) industrial grade instantaneous electric water heater unit shall be furnished and wall mounted as indicated on the Drawings to heat soft water entering the water/brine flow panel to above 50 °F.
- B. The entire unit shall be packaged ready for plumbing and electrical service connections and shall bear the cULus listing mark certifying the entire unit to UL499, UL EPH Sanitation listed to ANSI/NSF Standard 5 and CSA C22.2 No. 64-M91.
- C. The tankless heater shall be designed to operate at 240 volts, 1 phase, 60 Hz. The heater will draw 33 amps only when operating at full power. The immersion heating elements shall be high-quality incoloy sheathed and sized to obtain the rated capacity. Each element is to be operated using zero cross over solid state controls. The heating elements shall be fully modulated from 0-100% to provide precise temperature control through the full range of flows. A hi-limit thermostat with automatic reset shall be factory installed to disconnect each heating element in the event of an over-temperature condition. An electronic digital display temperature controller shall be user adjustable in 1° increments in either °F or °C and shall display flow rate, outlet temperature, inlet temperature, and provide error indication. A turbine-type flow meter shall be factory installed to provide precise temperature control for water flows as low as 0.2 gpm up to a maximum flow of 8 gpm. Heaters that require greater than 0.2 gpm flow for actuation or restrict flow shall not be acceptable.
- D. The heating chamber shall be all sil-brazed copper and bronze construction. A plastic heating chamber shall not be acceptable. Water heater heating chamber shall be rated for a maximum allowable working pressure of 150 psi. The heating chamber and all electrical controls shall be completely enclosed in a heavy gauge Type 304 stainless steel case.
- E. Heater unit shall be properly sized for the soft water flow required by the electrolyzer train.
- F. Connections
 - 1. Inlet/outlet: ¾ Press-fit
- G. Dimensions
 - 1. Width: 16-3/16 inches
 - 2. Depth: 3-9/16 inches
 - 3. Height : 17 inches
- H. Heater shall have the capacity to heat:

1. Flow: 0.36 gpm
2. Temperature (from): 40 °F
3. Temperature (to): 65 °F
4. Heater Temperature Delta: 25 °F

I. Electrical Requirements

1. 8 kW, 240 VAC, 1 Phase, 60 Hz

J. Water Heater shall be Hubbell Electric Heater Co Model TX008-2RS or approved equal.

2.5 BRINE SATURATOR TANK

- A. The OSG equipment supplier shall furnish one (1) salt storage brine making system in accordance with the Drawings and the following specifications.
1. Dimensions
 - a. 52 inches inner diameter
 - b. 63 inches height with lid
 2. Designed to be refilled manually by hand using 50 lb salt bag.
- B. The brine vessel shall be capable of storing approximately 4,500 pounds of dry salt, depending on what salt is used.
- C. The brine vessel shall be capable of storing approximately 500 gallons of liquid storage.
- D. The brine generator shall be constructed of linear polyethylene (LPE).
- E. The brine maker shall be installed indoors. Brine vessel shall include removable top and water level control system.
- F. The brine maker shall be circular construction with a round cover that fits the complete diameter of the top of the brine generator, includes a drain fitted with a ½-inch PVC ball valve.
- G. Softened feed water shall enter through a bulkhead fitting at the top side of the tank, through a ¾-inch PVC ball valve and an ell fitting. Inside shall be a ¾-inch connection PVC piston float valve and a spray ring to distribute feed water around the inside circumference of the tank. The float valve shall have 0.5-inch orifice and 12-inch stainless steel rod with a 6-inch diameter float at the end.
- H. Brine discharge at the bottom of the brine generator shall be through a slotted PVC pipe
- I. collection manifold with a ¾-inch PVC ball valve on the exterior of the tank.
- J. A ¾-inch overflow port shall be incorporated into the upper sidewall of tank and the overflow shall be plumbed to the sanitary drainage.
- K. A quartz rock bed shall be installed in the bottom of the tank over the brine collection manifold.
1. The quartz rock bed shall be two-layer with the bottom layer consisting of:
 - a. The top layer shall consist of ¼-inch quartz rocks 5 inches deep.
 - b. The bottom layer shall consist of ½-inch quartz rocks 7 inches deep.
 - c. The quartz rock shall be installed, by the Contractor, at the site.
- L. Tank shall be complete with:
- a. One (1) mechanical float assembly for level control
 - b. One (1) set of inlet and discharge manual PVC isolation valves

- c. One (1) Brine Guard (bottom PVC slotted discharge pipe)

2.6 BRINE FEED FILTER (INTEGRAL TO THE OSG UNIT)

- A. One (1) cartridge type filter housing holding a 10-inch cartridge.
1. Pentek Products Filter Housing or approved equal
- B. One (1) filter cartridge shall be 5-micron, disposable cartridge.

2.7 DISINFECTANT SOLUTION STORAGE TANK

- A. The equipment supplier shall furnish one (1) solution storage tank in accordance with the Drawings and the following specifications.
- B. Each oxidant tank shall be 1500 gallons, closed top, rotationally-molded, vertical, cross-linked high density polyethylene one-piece seamless construction, cylindrical in cross-section and vertical with flat bottom. Tank shall be adequately vented. Where indicated, tank shall be provided with ancillary mechanical fittings, accessories, and flexible connectors.
- C. Tanks molded in cross-linked polyethylene shall be Schulink XL 350 or equivalent.
- D. No fillers shall be added to the resin.
- E. Tank dimensions:
1. 64-inch diameter
2. 121-inch overall height
- F. Design Requirements:
1. The minimum required wall thickness of the cylindrical straight shell at any fluid level shall be determined by the following equation, but shall not be less than 3/16-inch thick. The tolerance apply to these dimensions:

$$T = \frac{P \times O.D.}{2 SD} = \frac{0.433 \times S.G. \times H \times O.D.}{2.SD}$$

Where:

T = Wall thickness, inches
SD = Hydrostatic design stress, psi
P = Pressure (0.433 x S.G. x H), psi
S.G. = Specific gravity of fluid
O.D. = Outside Diameter, inches
H = Height, feet

2. The hydrostatic design shall be determined by multiplying the hydrostatic design basis (determined by ASTM D2837 using rotationally molded samples) by a service (design) factor selected for the application. The standard product line of tanks is engineered using a maximum hydrostatic design stress, 600-psi for cross linked and 550 psi for conventional.
3. The vessels shall be designed and molded with a uniform wall thickness equal to or greater than the minimum thickness requirement per the Barlow Formula shown in this specification.
4. Top head shall be integrally molded (one piece) with the cylinder shell. The minimum thickness of the top head shall be 3/16-inch.

5. Tank shall be designed with top mounting flats to enhance fixture assemblies.
 6. The bottom head of a tank shall be integrally molded (one piece) with the cylinder shell. The minimum thickness for a fully supported flat bottom head shall be 3/16-inch. All parting lines shall be located within the top 1/3 of the vertical sidewall.
 7. Vents will be provided as agreed, to prevent pressure or vacuum from damaging the tank when filling or draining. Vents shall be sized to maintain atmospheric pressure under normal filling and discharge operations. Some applications or service conditions may require larger vents.
 8. All piping shall be supported independently of the tank. Flexible expansion joints are required to allow the tank to expand and contract when filling and draining.
 9. The finished tank wall, so far as is commercially practical, shall be free of visual defects (such as, foreign inclusions, air-bubbles, and pinholes) that may impair the serviceability of the vessel.
 10. The inner surface shall be smooth and free of cracks, crazing or pits. Waviness is a characteristic of the molding process for large tanks and is acceptable, provided the surface is smooth and free of cracks.
 11. Each tank shall be marked with a quality and routing control number. This number will be used to trace the vessel and shall be common to all required documentation.
 12. Product identification label with installation and use instructions will be applied to each tank.
- G. Where indicated, tanks shall be provided with ancillary mechanical fittings and accessories.
- H. The solution storage tank shall be installed indoors.
- I. Included tank accessories shall be:
1. One (1) Dual Tank GF Signet 8900 with pressure sensor
 2. One (1) 1-inch CPVC inlet port
 3. One (1) 1-inch PVC outlet port
 4. One (1) 1-inch PVC overflow connection
 5. One (1) 1-inch PVC top vent port
 6. One (1) 1-inch flexible hose for outlet piping
 7. One (1) Hydrogen Vent Liquid Barrier System
 8. Two (2) 1" True Union Ball Valve for Outlet and Drain, PVC/Viton
 9. One (1) port required for level sensor cable entry (size to be coordinated with level switch fittings).
- J. Oxidants will flow into the solution storage tank through fittings and into an internal tank mounted liquid barrier vent drop tube.
- K. The tank shall have a 2-inch vent, at the highest point of each tank, to be vented to the exterior of the building.
- L. Combining vents (tank and oxidant transfer line) is strictly prohibited.
- M. The tank shall be part of the Denora System, or approved equal.
- 2.8 DISINFECTANT SOLUTION STORAGE TANK AND BRINE TANK LEVEL FLOAT SWITCH
- A. The oxidant tank and brine tank shall use a single, dual floats switch to indicate liquid high and low levels in the tanks.

- B. The sensor shall have two (2) floats that have temperature ratings of 0°F to 180 °F and a maximum pressure rating of 15 psi at 70 °F.
- C. The sensor mounting shall be installed vertically in the tank and all materials in contact with the oxidant solution shall be CPVC.
- D. The high level float shall be installed at 6.3 feet above the tank base elevation to maintain a freeboard of 1.0 foot.
- E. The low-level float shall be installed at 3.7 feet above the tank base elevation. The low level shall maintain a storage volume of 2 days of average oxidant demand (approximately 320 gallons).
- F. The switch shall be pilot duty rated and shall be supplied with 20VA power from the onsite generator.
- G. High- and low-level signals shall be transmitted from the switch to the onboard PLC in the oxidant generator, which will use these levels to determine operation.
- H. The equipment shall be:
 - 1. Gems Sensor of Plainville, CT. Model: LS-800-1-CPVC-SPST-20VA-SPCL-2
 - 2. Or approved equal
- I. Warranty:
 - 1. The float switch shall be warranted against defective workmanship or materials for a period of two (2) years from date of shipment.
- J. Tag Numbers: LS101, LS102

2.9 LIQUID BARRIER SYSTEM

- A. The equipment supplier shall provide a liquid barrier system. No systems requiring dilution air blowers will be accepted.
- B. Onsite-generated solution will flow into the oxidant product tank through fittings and into an internal tank mounted liquid barrier vent drop tube that extends to within 1 inch of the bottom of the tank.
 - 1. The drop tube diameter shall be 4 inches in order to ensure that the bubble rise velocity is significantly greater than the liquid flow velocity, thereby ensuring that hydrogen is force vented to the top of the drop tube and out of the hydrogen vent plumbing.
 - 2. The hydrogen vent plumbing will be connected to a tee fitting immediately on the exterior of the oxidant product tank extending upward and plumbed to exterior of the facility.
 - 3. The proposed system shall be submitted for approval by the Engineer.
 - 4. The proposed handling devices and processes shall be reviewed and endorsed by Hydrogen Safety, LLC.

2.10 HYDROGEN GAS DETECTION

- A. The equipment supplier shall supply one (1) complete hydrogen gas detector and the Contractor shall mount the hydrogen gas detector at the highest point in the room above the generator assembly and above the oxidant storage tank.
- B. Sensor

1. Enclosure
 - a. Surface-mounting cast aluminum explosion proof enclosure with screw-on cover.
 2. Hydrogen Sensor
 - a. Catalytic combustion sensor with molecular sieve
 - b. Range: 0-100% LEL.
 - 1) 4mA at 0% LEL
 - 2) 20mA at 100 % LEL
 - 3) Linear output
 - c. Encapsulated in stainless steel and aluminum enclosure
 - d. Sensor shall be special formulation that will only respond to hydrogen gas. Sensor will not respond to any other flammable gases and vapors.
 3. Wiring
 - a. Internal field wiring terminal block, capable of receiving 14 AWG wire. Terminal block is for sensor lead wire (4 terminal, pre-wired to sensor from factory) connection to controller. Cable length to be 20 ft minimum
 - b. Wiring from sensor assembly to controller should be shielded, provided by contractor.
 4. Input Power
 - a. Operates from controller supplied DC power, approximately 11-30 VDC. Current draw is approximately 200 mA.
 5. Calibration
 - a. Onsite calibration shall be accomplished through use of zero (combustible-free air) and span (known concentration of hydrogen gas in air) gases.
 - b. The sensor shall be a Model# 61-1001RK-04 supplied by RKI Instruments Inc. or approved equal.
 6. Hydrogen gas vents shall be provided by the contractor as shown on drawings and as required.
- C. Controller
1. The Controller shall be type wall-mounting single-channel controller for combustible gas, toxic gas, or oxygen detection. The controller shall be configurable using internal controls, no hardware change or jumper selection required.
 2. Enclosure
 - a. Wall mounting gray fiberglass NEMA-4X enclosure with hinged cover
 - b. Wiring access through two (2) conduit hubs mounted to bottom of enclosure
 3. Display
 - a. Backlit LCD display with adjustable contrast control for variation in ambient lighting
 4. Signal Input
 - a. Capable of either direct input from RKI sensors or 4-20 mA signal input from remote transmitter, two (2) or three (3) wire format
 5. Audible Alarm
 - a. An audible alarm device shall be attached to bottom of enclosure, rated at 94 db.
 - b. The audible alarm shall be capable of being silenced or reset using external sealed pushbutton switch, coded for low and high gas alarms (pulsing tone) or malfunction (steady tone).
 6. Visual Indicator
 - a. Three (3) color coded LEDs shall be visible on the front of the controller enclosure.
 - b. LED
 - 1) First LED, Fail condition
 - 2) Second LED, Alarm 1 low alarm condition
 - 3) Third LED, Alarm 2 condition high alarm condition
 7. Wiring
 - a. Field wiring terminal blocks top access type capable of receiving 14 AWG wire.
 - b. Separate terminal blocks for AC power, relay outputs, sensor or transmitter input and

controller wiring connections.

8. Input Power
 - a. Two (2) options:
 - 1) 115VAC or 230VAC
 - 2) 24VDC
 - b. If 24VDC is selected, this connection provides trickle charge to back-up battery (optional) while AC power is connected, and automatically switches to back-up power if AC power is lost. If backup battery option is used, the unit will display a warning message on the display in the event of low battery voltage condition, and the Fail LED will be illuminated.
9. Controls External
 - a. Sealed pushbutton switch for alarm silence or reset
10. Control Internal
 - a. Shall have relay for low, high, and fail alarm condition.
 - b. All contacts shall be Form C, rated 10A-250VAC resistive.
 - c. All relay outputs (except fail) shall be programmable using internal pushbuttons for normally de-energized or normally energized (fail-safe) operation, and latching or self-resetting.
 - d. Fail relay shall be normally energized (fail-safe) and self-resetting only.
11. Analog Outputs
 - a. Shall have 4-20 mA output (500 ohms impedance maximum per channel), corresponding linearly to 0-100% full scale.
12. Transmitter Output
 - a. Shall be 24VDC, 350 mA maximum, for two (2) or three (3) wire connection.
13. Min/Max Readings
 - a. The minimum and maximum values shall be stored automatically, and can be displayed as required through use of the reset button, which is also used to reset the min/max readings.
14. Calibration
 - a. The calibration mode shall be entered through use of the programming buttons.
 - b. Access to the calibration program shall be protected through use of a coded sequence of button operation to enter the calibration program.
 - c. Automatic exit shall be provided from the calibration menu to prevent the unit from inadvertently being left in the calibration mode.
 - d. The calibration mode shall accommodate and automatically recognize and distinguish between direct connected sensors and remote amplifier (4-20 mA) type transmitters. If direct connect sensor is used, a fresh air adjust capability shall be included.
 - e. The unit shall allow selection of calibration gas concentration during the calibration sequence.
 - f. A provision for aborting the calibration and retaining old calibration data shall be provided
15. Channel Setup and Configuration
 - a. Channel setup and configuration mode shall be entered through use of the programming buttons.
 - b. Access to the channel setup and configuration program shall be protected through use of a coded sequence of button operation to enter the channel setup and configuration program.
 - c. Automatic exit shall be provided from the channel setup and configuration mode to prevent the unit from inadvertently being left in the channel setup and configuration mode.
 - d. The setup and configuration mode shall allow the user to enable and disable the channel for maintenance or service purposes, and to configure settings for alarm levels and activation type (increasing or decreasing), alarm time delay, relay logic (latching/non-latching, normally energized/normally de-energized), noise filter selection,

and zero suppression selection.

16. The controller shall be a Beacon 110 supplied by RKI Instruments Inc. or approved equal.

2.11 DISINFECTANT METERING PUMP SYSTEM

A. Minimum Requirements:

Pump Tag No.	Skid #1 – P106	Skid #2 – P105 & P108
Pump Qty	One (1)	Two (2)
Product Pumped	0.65% Oxidant	0.65% Oxidant
Skid Mounting Type	Floor	Dual Discharge Wall Mount
Product Required Flow Rate, gph (max)	71	7.2 per pump
System Discharge Pressure, psig (max)	100	102
Liquid End Material	PVDF	PVDF
Speed Control	4-20 mA	4-20 mA
Remote Pause (Dry Contact)	Standard	Standard
Diaphragm Failure Indication	Local Only	Local Only
Power	120VAC - 1ph - 60 Hz	120 VAC – 1ph –60 Hz

B. Each skid is complete with the skid assembly containing chemical pumps, all necessary piping, valves, fittings, supports, electrical controls, and accessories as specified herein. The skid piping design shall minimize the use of glued joints in the system.

C. Manufacturer:

1. ProMinent, via Sean Coholan at MISCOwater

925-200-7453, 3825 Hopyard Rd #195, Pleasanton, CA 94588

2. or approved equal

D. Each skid shall have one (1) inlet manifold connection.

E. For single pump skid, skid shall have one (1) outlet connection

F. For dual pump skid, skid shall have two (2) outlet connections—one (1) per pump.

G. The metering pump skid shall contain the following items:

1. Floor skid:

- One (1) non-metallic skid with built in containment area
- One (1) backpressure valve
- One (1) main inlet strainer
- One (1) pressure gauge with gauge isolator
- One (1) pressure relief valve
- One (1) pulsation dampener
- One (1) calibration column
- One (1) NEMA 4X junction box

2. Wall Panel skid:

- One (1) Non-metallic skid panel
- Two (2) backpressure valve—one (1) for each pump
- One (1) main inlet strainer

- d. Two (2) pressure gauges with gauge isolators. One (1) for each pump
 - e. Two (2) pressure relief valves—one (1) for each pump
 - f. Two (2) pulsation dampeners—one (1) for each pump
 - g. One (1) calibration column
 - h. One (1) NEMA 4X junction box
- H. All components of the chemical metering system shall be contained within the skid.
- I. The floor skid design shall incorporate spill containment capability. The skid bottom shall be designed to slope towards a common drain point. Pedestals shall be provided to elevate the metering pumps above the skid base. The pedestals shall be fastened to the skid base. The skid shall be constructed with fork lift cut-outs for offloading and/or installation at the job site.
- J. The solution metering pumps shall be suitable to operate 24 hours per day.
- K. Pump Description
- a. Pump rated per Table in 2.11A, with VFDs and the following ancillaries.
 - b. Clear discharge piping shall include a pressure relief valve to protect pump and piping components from overpressure conditions.
 - c. Discharge piping shall include a pulsation dampener sized for adequate handling of the dynamic loads and rated pressure of the fluid stream.
 - d. Pump drive motors shall be TEFC for mill and chem duty with epoxy coatings for corrosion resistance. Motors shall incorporate shaft seals. Variable speed motors shall be premium efficiency for operation at low speeds.
 - e. For pumps without an internal pressure relief mechanism, the discharge plumbing shall incorporate a pressure relief valve rated and factory adjusted to a relief pressure set at the maximum discharge pressure rating of the pump.
 - f. A back-pressure valve shall also be incorporated in the discharge plumbing in order to prevent oxidant flow through the pump via gravity suction.
 - g. A calibration column and appropriate valving shall be installed on the skid in order to verify pumping rate of the pump.
 - h. The pump can be operated manually or automatically. Automatic operation requires a 4-20 mA signal provided by an external SCADA system or chlorine analyzer.
 - i. The following ancillaries supplied as loose components shall be supplied and incorporated:
 - o One (1) Calibration column.
 - o Six (6) Ball Valves.
 - o One (1) Y-Strainer.
 - o One (1) pressure gauge with PVC guard.

2.12 Microchem Analyzer

- A. One (1) Microchem Analyzer.

2.13 SPARE PARTS AND SPECIAL TOOLS

- A. Included in the proposal, the equipment supplier shall furnish spare parts required to ensure adequate operation of the OSG system. Spare parts shall include as a minimum.
- 1. One (1) brine proportion pump
 - 2. Six (6), 5-micron filter brine cartridges
 - 3. One (1) set assorted fuses
 - 4. One (1) acid wash kit
 - 5. Plus one (1) lot of assorted items recommended by manufacturer

- B. The equipment supplier shall furnish all special tools required for the proper installation, operation, and maintenance of any component of the OSG.
- C. The equipment supplier shall furnish the following recommended spare parts for the disinfectant pumping system:
 - 1. Spare parts shall include all parts required for one (1) year of normal maintenance of all components of the disinfectant metering system. All parts shall be in one (1) box labeled with the pump ID Information.
 - 2. Maintenance kits shall include, but not be limited to, diaphragm, check valve seats, gaskets and o-rings.
 - 3. One shelf spare for each unique model of injection pump shall be provided.

PART 3 EXECUTION

3.1 SHIPPING AND EQUIPMENT DELIVERY

- A. All equipment and materials shall be inspected against approved shop drawings at time of delivery. Equipment and materials damaged or not meeting requirements of the approved shop drawings shall be immediately returned to the equipment supplier for replacement or repair.
- B. The Contractor shall handle and store the equipment and materials in accordance with Section 01 60 00–Product Requirements, and in a dry location, protected from the elements according to the manufacturer's instructions.

3.2 INSTALLATION

- A. The Contractor shall furnish all labor, materials, equipment and appurtenances required to install, test, and place into satisfactory operation the OSG furnished by the equipment supplier including, but not limited to:
 - 1. Mechanical installation of OSG components, interconnecting piping, piping supports, fittings, valves and appurtenances.
 - 2. Reference Process and Instrumentation and Plan and Section drawings for pipe sizes and equipment configuration, and the following:
 - a. Piping from source water to the water softeners is ¾-inch Schedule 80 PVC
 - b. Piping from the water softener to the generator is ¾-inch Schedule 80 PVC
 - c. Piping from the salt tank/brine maker to the generators is ½-inch Schedule 80 PVC
 - d. Piping manifold from the generator discharge to the solution tank(s) is 2-inch Schedule 80 CPVC
 - e. Minimum tank through-wall from manifold is 2-inch Schedule 80 CPVC
 - f. Minimum drop tube diameter is 4 inches
 - g. Piping from the disinfectant solution tank is 2-inch Schedule 80 PVC
 - h. Piping from the disinfectant feed pump is ½-inch Schedule 80 PVC for normal flows and ¾-inch Schedule 80 PVC for peak flow
 - i. Schedule 80 CPVC Hydrogen venting, (2-inch diameter) exiting highest point of the solution tank to the outside of facility
 - j. Schedule 80 CPVC vent piping, 2-inch diameter, from the inlet of the liquid barrier vent down-tube in the solution tank to the outside of the facility
 - k. Connection to building sewer piping to service water softener backwash and brine tank overflow and OSG drain lines and other drain connections shown on contract drawings.
 - 3. Electrical installation of OSG components, circuit breakers, raceways, fittings, conduits, wires and cables, panel boards, metering devices, grounding systems, surge protection.

4. Minimum feed water supply: 0.36 gpm at a minimum pressure of 25 psig to the onsite generator; provide feed pressure booster pumps if required
5. Electrical supply – Dedicated 240 volt, single phase, 30 amps service for the onsite generator
6. The enclosure building must provide a building ambient air temperature between 45 °F and 110 °F.

B. The Contractor to provide all piping, valves, and seismic D supports for a complete and functional system whether specified or not.

3.3 COMMISSIONING AND START-UP

- A. The equipment supplier shall provide a factory trained representative to be retained for a period of not less than 2 days over 1 trip to inspect equipment installation, piping and wiring to ensure proper installation of each component in accordance with approved submittals.
- B. Contractor shall make at its own cost any modifications required to meet equipment supplier installation recommendations.
- C. A written statement certifying that the equipment has been properly installed and interconnected shall be provided by the equipment supplier.
- D. The equipment supplier shall coordinate commissioning of the system and verify that each component of the OSG is ready for operation. OSG commissioning shall include testing and calibration of each component of the system. A written statement certifying that the OSG has been commissioned and is ready for operation shall be provided.
- E. The equipment supplier shall coordinate initial OSG start-up to ensure operating procedures are followed in accordance with approved submittal's instructions manuals.

3.4 PERFORMANCE TEST

- A. In order to determine compliance of the OSG with the performance requirements set forth in this specification, the following test will be performed at commissioning.
- B. Necessary pre-requisites for the performance test are:
 1. System must be running and stabilized before the test period starts.
 - a. Water pressure to OSG greater than 25 psi
 2. Incoming water temperature is higher than 50 °F, and lower than 80 °F
 3. Incoming water hardness after water softeners is less than 17 mg/L
- C. Two (2) performance parameters shall be measured:
 1. Oxidant Solution Concentration
 - a. Oxidant solution samples shall be taken at the outlet of the oxidant generator.
 - b. One sample shall be taken.
 - c. Samples shall be analyzed for available chlorine concentration in accordance with *Standard Methods* Method 4500-Cl G. DPD Colorimetric Method as adapted by Bradford (2010) for concentrated neat solutions to use the Hach Company Method 8201 Chlorine, Free by the DPD Method.
 - d. The test shall be deemed successful if the average chlorine concentration is between 0.55 and 0.75% (5,500 to 7,500 g/L).
 2. Generation Capacity
 - a. The generating capacity of the unit shall be calculated by multiplying the system flow rate (gph) with the free available chlorine concentration times 0.0002 using a 15

second graduated cylinder flow measurement.

- b. The generator capacity shall be reported in equivalent pounds per day.
 - c. The test shall be deemed successful if the generator capacity is greater than 15 pounds per day.
- D. Once both performance tests are successful, the Contractor shall issue a final acceptance letter to the equipment supplier.

3.5 TRAINING

- A. Site Technical Training
- 1. The equipment supplier shall provide operator training at the site for a period no less than one (1) eight (8) hour day. Training shall include operation, maintenance, and troubleshooting for each component of the OSG.

END OF SECTION

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SECTION 46 33 14

COAGULANT DOSING SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION

- A. The polymer dilution and feed system shall be capable of effectively activating and fully blending with water a homogenous polymer solution ranging from 0.1% to 1% concentration of emulsion polymers with active contents up to 75%.

B. RELATED SECTIONS

Section 01 33 00:	Submittal Procedures
Section 01 60 00:	Product Requirements
Section 26 05 00:	Basic Electrical Material Methods
Section 40 94 00:	Control Strategy
Section 01 43 33:	Manufacturer's Field Services

1.2 REFERENCES

- A. Project Drawings: Layout and Section sheets
- B. Project Process and Instrumentation Diagrams
- C. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
1. OSHA safety standards concerning personnel protection against machinery and the handling of dangerous chemicals
 2. Instrument Society of America (ISA)
 3. ASTM-International (ASTM)
 4. Joint Industrial Council (JIC)
 5. National Electric Manufacturer's Association (NEMA)
 6. National Electrical Code (NEC)
 7. Institute of Electrical and Electronic Engineers (IEEE)
 8. American Welding Society (AWS)
 9. American National Standards Institute (ANSI)
 10. Anti-Friction Bearing Manufacturers Association (AFBMA)
 11. Standards of American Water Works Association (AWWA)
 12. Air Movement & Control Association (AMCA)

1.3 QUALITY ASSURANCE

- A. Prior to shipment the system shall be inspected for quality of construction verifying all fasteners and fittings are tight, all wires are secure and connections whisker-free.
- B. The complete system shall be fully factory tested prior to shipment. Testing shall include: setting and verification of all instrumentation and sensors per the design requirements of the application; pressure testing all plumbing systems for a minimum of one hour at 100 psi. If leaks are found they shall be fixed and a new test shall be conducted for one hour at 100 psi until the plumbing system is verified to be leak free; verification of system design flow rates,

and; complete functional simulation of operation.

- C. Factory Authorized Testing: The owner shall be notified two weeks prior to testing and be allowed to witness testing, if desired.

1.4 SUBMITTALS

- A. Product Data:
1. Submit data completely describing product, including detailed scope of supply, detailed bill of materials and annotated specification sheets of all components.
- B. Shop Drawings:
1. Submit detailed specifications and shop drawings with both shaded isometric and orthogonal views of the proposed system, including dimensions and weights.
 2. Submit wiring, control schematics, and control logic diagrams for all electrical and control components furnished.
- C. Provide detailed Operations and Maintenance Manuals including storage, installation start-up and operating instructions. Provide safety precautions and warnings of all hazards operating equipment.

1.5 WARRANTY

- A. The system shall be covered by a one (1) year limited warranty against defects in materials and workmanship. The mixing chamber shall be warranted for the life of the system against failure for plugging for any reason. The warranty shall exclude failure due to over pressure or freezing.

PART 2 PRODUCTS

2.1 Liquid Polymer Blending System

A. PERFORMANCE CRITERIA

1. Polymer Type: Emulsion
2. Polymer Activity (percent active): 30 to 75
3. Solution Concentration Range: 0.1% to 2% based on neat polymer
4. Solution Concentration Design Point: 0.5% based on neat polymer

Neat Polymer Flow Range (GPH)	Dilution Water Range (GPH)
0.1 – 2	30 – 300

Manufacturer: VeloDyne - Velocity Dynamics of Louisville model VM-2P-300-RpX-1-A-2, CO or approved equal.

2.2 Identification

- A. Provide a name plate securely affixed to the unit providing Manufacturer with phone number, model number, and serial number.

2.3 Materials

- A. The following material requirements will be strictly adhered to:
1. System skid: 304 stainless steel
 2. Hardware: Type 18-8 stainless steel

3. Inlet and Outlet fittings: 304 stainless steel
4. Piping & pipe fittings: schedule 80 PVC
5. Tubing and tube fittings: polyethylene, polypropylene, stainless steel and Viton
6. Water solenoid valve: brass
7. Pressure gauges: stainless steel, liquid filled
8. Pressure switches: NEMA 4, brass connection
9. Flow meter: acrylic, stainless steel, PVC and or polypropylene
10. Water control valve: stainless steel with stainless steel seat
11. Mixing chamber body / flanges: stainless steel
12. Mixing chamber cover / chamber: clear polycarbonate
13. Mixing Chamber Discharge: stainless steel
14. Impeller: 304 stainless steel
15. Impeller shaft seal: Viton, stainless steel, ceramic, carbon
16. Mixing chamber pressure relief valve: brass, stainless steel or PVC
17. Metering pump wetted parts: stainless steel & Viton
18. Metering Pump Shaft Seals: Viton, stainless steel ceramic, carbon
19. Control enclosure: 316 stainless steel.

2.4 Equipment

A. Polymer Activation & Blending Chamber :

1. These specifications are based on a multi-stage, multi-zone, Hydro-Mechanical polymer activation & blending technology. Alternate technologies will only be considered if proven to provide an equal level of performance, versatility, reliability and quality, otherwise the following technology will be provided without exception. Polymer mixing chamber shall be veloblend VM series or approved equal.
2. In order to provide control and versatility to optimize the performance of the wide range of polymers available and to optimize system reliability, a multi-stage Hydro-Mechanical polymer blending technology shall be provided with both a non-mechanical and mechanical mixing stage:
 - a. Non-Mechanical Stage: To optimize reliability, the device shall be capable of activating and blending polymer based on plant water pressure alone at 30 psid or greater. Polymer shall be injected directly into a water jet by means of an injection quill positioned such that the non-mechanical mixing energy is no way diminished prior to polymer and water contact. The non-mechanical zone shall be designed such that the velocity of the mixing energy-producing water jet is maintained or increases as flow decreases.
 - b. Hydro-Mechanical mixing Stage: In order to provide optimal polymer performance under all operating conditions and to provide total control over mixing energy, in addition to the non-mechanical mixing stage the device shall be capable of producing its mixing energy independent of plant water pressure through a variable intensity, controllable stainless steel hydro-mechanical mixer. The mixing impeller shall be fully controllable and capable of inducing ultra high, non-damaging mixing energy at all flow rates. This shall be accomplished by controlling mixing intensity and preventing over exposure to, or damaging recirculation through the impeller. The polymer mixing impeller shall be designed to produce both axial and radial flow to optimize mixing effectiveness and to effectively inducing high, non-damaging mixing energy over the systems full flow range.
 - c. Mixers that rely solely on plant water pressure and or flow for mixing energy will not be acceptable. Mixers where performance is affected by flow rate and therefore retention time resulting in under or over exposure to mixing energy, or

which rely on constant speed impellers or that rely on close tolerances for blending shall not be acceptable.

3. In order to prevent polymer build-up, the mixing chamber shall maintain high velocity in the entire chamber - at no time shall there be low velocity within any portion of the mixing chamber.
4. The mixing impeller shall be controlled by an SCR motor controller and driven by a wash-down duty motor. The motor shall be mounted horizontally or above the mixing chamber. Motors mounted under the mixing chamber where seal failure or leaks can damage the motor shall not be acceptable. Motor shall be ½ HP, 90 VDC, 1750 RPM, wash-down duty.
5. The mixer drive shaft shall be sealed by a mechanical seal which shall have an integrally mounted and factory plumbed seal flush. A drain port behind the seal shall be provided in the mixing chamber to drain the polymer solution in case of a seal failure. The seal shall be easily accessible for replacement. Systems with holes in the mixing impeller to "pull" polymer away from the seal shall not be acceptable or used, as this feature fails to prevent polymer from coating the shaft seal face. All bearings shall be external from the mixing chamber. Internal bearings shall not be acceptable.
6. Both mechanical and non-mechanical mixing zones shall be clear polycarbonate to view the mixing action and blending effectiveness. Acrylic chambers prone to becoming brittle over time and cracking, or opaque pipe shall not be acceptable to meet this requirement. The clear cover shall have a stainless steel reinforced gusseted flange with a stainless steel discharge connection in order to handle maximum operating pressures.
7. The mixing chamber shall have a maximum rated pressure of 100 psi. Provide a pressure relief on the mixing chamber factory set at 75 psi.
8. Provide a neat polymer check valve specifically designed to isolate neat polymer from dilution water. The valve shall be designed with an open, unobstructed path to the valve seat. To minimize check valve plugging due to normally occurring polymer agglomerations, the minimum open area up to and including the valve seat shall be 3/16" without exception. The valve body shall be constructed of Teflon with Viton seals. The valve poppet and spring shall be stainless steel. The spring shall be outside of the polymer flow path to prevent build-up and plugging. The locking pin used to hold the valve in place shall be attached to the mixing chamber with a lanyard. The valve shall be readily accessible for cleaning and shall not require tools for removal, cleaning or replacement. Conventional check valves, valves that rely on ball seals, and or check valves that are installed inside the mixing chamber, or which require mixing chamber disassembly for servicing will not be accepted.

B. Dilution Water Assembly:

1. The dilution water flow rate shall be monitored by a paddle type flow meter having the range as specified under paragraph 1.02 above. Unions or flanges shall be provided on the flow meter to allow easy removal for cleaning.
2. The unit shall have an electric solenoid valve for on/off control of total dilution water flow.
3. The unit shall have a linear actuated variable rate control valve to automatically proportion water flow to polymer flow for polymer / water ratio control. Valves that diminish mixing energy in the non-mechanical stage shall not be used.
4. Dilution water inlet pressure transducer.
5. Provide a 2-1/2" stainless steel liquid filled pressure gauge to monitor dilution water inlet pressure (0-160 psi).

C. Progressive Cavity Neat Polymer Metering Pump

1. The unit shall have one (1) neat polymer metering pump(s) integrally mounted on the systems skid. The metering pump(s) shall have a range as specified. The pump shall be a positive displacement, progressive cavity type constructed of stainless steel and Viton. The shaft seal shall be a lip seal type riding on a ceramic sleeve. Mechanical

- seals shall not be used. A ½ HP, 1750 RPM, 90 VDC wash-down duty motor with gear reducer shall drive the pump. A gear reducer shall be provided to produce a maximum pump shaft speed of not more than 545 RPM. The motor shall be controlled by an SCR motor controller located in the system control panel.
2. Provide a calibration column with two full port PVC ball valves having Viton o-rings. The column shall be calibrated for a one minute draw-down at maximum pump rate and read in GPH and milliliters. The calibration column shall be rigidly mounted to the systems frame with a minimum of two heavy duty brackets. Mounting the calibration to the neat polymer inlet piping shall not be acceptable. Provide a breather plug in the top of the calibration column designed to allow adequate displacement of air during calibration while preventing water or other foreign material from entering the calibration column.
 3. Neat Polymer Metering Pump Assemble shall be PVC FNPT union style polymer inlet.
 4. Plumbing: Schedule 80 PVC
 5. Metering pump calibration assembly with isolation valves shall be 250 ml.
 6. Provide a thermal type loss of polymer flow sensor.
- D. Solution Discharge Assembly:
1. Provide stainless steel FNPT solution discharge connection.
 2. Provide a 0-160 psi solution discharge pressure gauge (stainless steel, liquid filled) to monitor system discharge pressure.
 3. Provide schedule 80 PVC plumbing.
- E. Controls:
1. A control panel integral to the systems frame shall be provided. The enclosure shall be rated NEMA 4X and constructed of FRP. The control panel shall consist of all controllers, digital displays, potentiometers, switches, lights, relays, and other control devices required for a complete operable system. The control panel and all components shall be industrial duty. All skid mounted electrical components interconnected to the control panel shall terminate at numbered and labeled terminal blocks. The terminal blocks shall be sized for 14 ga. wire. Wires shall be neatly run through wire race-way and numbered with shrink tubing type labels. Adhesive labels shall not be used. The control panel shall be positioned such that there are no obstructions in front of the control panel per related NFPA requirements. Control.
 2. Power: 120 VAC, 1Ph, 60/50 Hz. with a 10' power cord and receptacle.
 3. A circuit breaker on the main control circuit and on each motor shall be provided as manufactured by Allen Bradley or equal. Fuses shall not be used for circuit protection.
 4. The controller shall be PLC based with a minimum 5.7" TFT touch screen. Systems that rely on microprocessors and or alphanumeric displays shall not be considered.
 5. Operator Interface – 5.7" Minimum TFT touch screen with the following features as a minimum:
 - a. LOCAL / REMOTE start/stop mode select:
 - 1) LOCAL start/stop mode: System shall run based on operator input from touch panel start/stop push-button.
 - 2) REMOTE start/stop mode: System shall start and stop according to the state of remote dry contacts (closed = run, open = stopped).
 - b. MANUAL / PACED POLY RATIO operational mode select.
 - 1) MANUAL mode: The desired water flow is set manually using increase/decrease push-buttons on touch panel. The desired polymer flow is set manually using increase/decrease push-buttons on touch panel. Solution concentration defined by water and polymer settings.
 - a) MANUAL mode run screen features:
 - (1) Water control increase/decrease push-buttons.
 - (2) Water flow rate (GPH) display.
 - (3) Polymer control increase/decrease push-buttons

- (4) Polymer flow rate (GPH) display.
 - (5) Solution concentration (% poly) display.
 - (6) Total solution flow rate (GPH)
 - b) PACED POLY RATIO mode:
 - (1) Water flow adjusts automatically to maintain operator desired solution concentration.
 - (2) Polymer flow paced by remote 4-20mA (supplied by others).
 - (3) Desired solution concentration adjusted manually using increase/decrease push-buttons on touch panel.
 - (4) PACED POLY RATIO mode run screen features:
 - (a) Water flow rate (GPH) display.
 - (b) Remote pacing signal level (mA)
 - (c) Polymer flow rate (GPH) display.
 - (d) Solution conc. Control increase/decrease push-buttons.
 - (e) Desired solution concentration (% poly) display.
 - (f) Actual solution concentration (% poly) display.
 - (g) Plant flow in MGD
 - (h) Desired polymer dosage in PPM. The polymer system PLC will calculate required polymer feed rate based on plant flow and desired dosage in PPM as set by the operator.
 - c) Stand-By mode:
 - (1) In Stand-By mode, the operator will select the plant flow where polymer dosing starts and where the polymer dosing stops if the plant flow drops below that point.
- c. Automatic Mixing Energy Control
 - 1) The system shall be capable of monitoring mixing intensity and automatically varying mixing energy to maintain constant mixing energy over the full flow range of the system. Systems without this feature will not be acceptable.
- d. Help Screens:
 - 1) For each mode of operation
- e. Alarm screen features:
 - 1) Indication of alarm
 - 2) Description of recommended corrective action
 - 3) Reset
 - 4) Alarm history
 - 5) Set-up screen features:
 - 6) Semi-auto pump calibration
 - 7) System flush settings
 - 8) Auxiliary alarm user programming mode
- 6. Discrete Selector Switch & System Indicator:
 - a. Main Power ON /OFF Switch
 - b. Main Power ON indicator
- 7. Inputs (signals by others):
 - a. Remote Start / Stop (discrete dry contact)
 - b. Pacing Signal Based on Process Flow (4-20mA)
- 8. Outputs:
 - a. System Running (discrete dry contact)
 - b. Remote Mode (discrete dry contact)
 - c. Common Alarm (discrete dry contact)
 - d. Polymer Pump Rate (4-20mA)
- 9. Special Functions/Features:
 - a. Proportional control of water to polymer flow (ratio control)

- b. Programmable auto flush – keeps water control valve open for programmable amount of time when unit is shut-off.
 - c. Polymer pump rate input for calibration.
- F. System Skid:
 - 1. The system's frame shall be of rugged 304 stainless steel construction. No mild steel shall be used. All piping shall be rigidly supported.
 - 2. Under no circumstance shall the pump suction exceed 5" from the bottom of the skid for progressive cavity pumps.
 - 3. The skid shall have an integral stainless steel drip pan located under the neat polymer metering pump. Provide one dozen absorbent pads designed for oil and sized to fit within the drip pan.
 - 4. Skid to be anchored by Contractor in accordance with Drawings and manufacturer's recommendations.
- G. Accessories:
 - 1. 55 Gallon Drum Accessories:
 - a. Provide a drum suction pipe constructed of clear PVC with a PVC tee at top and a polymer check valve on the bottom. The suction pipe shall include a 2" bung connection with compression fitting to allow suction pipe height adjustment in the drum.
 - b. Provide one (1) polymer drum cradle / dispenser designed to transport up to 55-gallon drums and position the drum in a horizontal position when in service to drain entire contents. Provide Quick Release Wall Mount Brackets to anchor the drum cradle which can be unclipped when the drum needs to be moved, material to match drum cradle material. Provide a polymer drum suction assembly. The assembly shall include quick disconnect cam-lock fittings, a 1" full port ball valve, and 10 feet of 1" braided PVC hose.
 - c. Manufacturer: DAYTON, Milwaukee, or approved equal.

2.5 SPARE PARTS AND SPECIAL TOOLS

- A. One (1) progressive cavity pump stator
- B. One (1) progressive cavity pump shaft seal
- C. One (1) banding clamp tool for replacement of the progressive cavity metering pump pin joint banding clamps.
- D. Provide one (1) neat polymer check valve, complete

PART 3 EXECUTION

3.1 SHIPPING AND EQUIPMENT DELIVERY

- A. All equipment and materials shall be inspected against approved shop drawings at time of delivery. Equipment and materials damaged or not meeting requirements of the approved shop drawings shall be immediately returned to the equipment supplier for replacement or repair.
- B. The Contractor shall handle and store the equipment and materials in accordance with Section 01 60 00–Product Requirements, and in a dry location, protected from the elements according to the manufacturer's instructions.

3.2 INSTALLATION

- A. The Contractor shall furnish all labor, materials, equipment and appurtenances required to install, test, and place into satisfactory operation.

3.3 COMMISSIONING AND START-UP

- A. The equipment supplier shall provide a factory trained representative to be retained for a period of not less than 2 days over 1 trip to inspect equipment installation, piping and wiring to ensure proper installation of each component in accordance with approved submittals.

3.4 FIELD SERVICES

- A. Provide the services of a qualified field service technician to inspect and certify the installation, start-up the equipment, trouble shoot any problems that may arise and providing complete and thorough training of operator personnel.
- B. Field services shall consist of one (1) eight (8) hour day, exclusive of travel time.

END OF SECTION

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SECTION 46 33 44

PERISTALTIC METERING PUMPS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Peristaltic metering pumps and accessories
- B. Related Requirements:
 - 1. Section 01 10 00: Summary of Work
 - 2. Section 01 30 00: Administrative Requirements
 - 3. Section 01 33 00: Submittal Procedures
 - 4. Section 01 60 00: Product Requirements
 - 5. Section 01 70 00: Execution and Closeout Requirements
 - 6. Section 26 05 00: Basic Electrical Material Methods
 - 7. Section 40 05 53: Identification for Process Piping, Water, and Wastewater Equipment
 - 8. Section 40 27 00: Process Piping
 - 9. Section 40 92 13: Mechanical Appurtenances

1.2 REFERENCE STANDARDS

- A. U.S. General Services Administration:
 - 1. ZZ-R-765: Commercial Item Description: Rubber, Silicone

1.3 COORDINATION

- A. Section 01 30 00—Administrative Requirements: Requirements for coordination
- B. Coordinate Work of this section with plant operations.

1.4 SEQUENCING

- A. Section 01 10 00—Summary of Work: Requirements for sequencing
- B. Sequence Work to prevent interference with plant operations.

1.5 SUBMITTALS

- A. Section 01 33 00—Submittal Procedures: Requirements for submittals
- B. Product Data:
 - 1. Submit pump performance characteristics.
 - 2. Submit electrical characteristics and connection requirements.
 - 3. Submit manufacturer model number, dimensions, service sizes, and finishes.

1.6 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.

- C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.

1.7 QUALITY ASSURANCE

- A. Ensure that materials of construction on pump liquid end are compatible with chemicals listed at the end of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00–Product Requirements: Requirements for transporting, handling, storing, and protecting products
- B. Inspection: Accept pumps on site in manufacturer's original packaging and inspect for damage.
- C. Storage:
 - 1. Store products in areas protected from weather, moisture, or possible damage.
 - 2. Do not store products directly on ground.

- 1.9 Handle products to prevent damage to interior or exterior surfaces.

PART 2 PRODUCTS

2.1 PERISTALTIC-TYPE METERING PUMPS

- A. Manufacturers:
 - 1. Blue-White Industries
 - 2. Substitutions: Section 01 60 00–Product Requirements
- B. Description:
 - 1. Capable of self-priming at the maximum rated pressure of up to 125 psi
 - 2. Capable of running dry without damage
 - 3. Capable of continuous duty
 - 4. Pump rollers capable of operating in either direction at the maximum rated pump pressure
 - 5. Pump rollers capable of operating in either direction without output variation
 - 6. Suction lift: 30 feet of water
 - 7. Pump warranted by the manufacturer for a period of five (5) years, including chemical damage to the pump head and roller assembly for a period of two years
- C. Pump Head:
 - 1. Tube failure detection sensors shall be wholly located in the pump head. Tube failure detection system shall not trigger with water contact. Float type switches shall not be used. Process fluid waste ports or leak drains shall not be provided.
 - 2. Squeeze rollers with encapsulated ball bearings shall be directly coupled to a one (1)-piece thermoplastic rotor. Four (4) polymeric rollers shall be provided; two (2) squeeze rollers for tubing compression shall be located 180 degrees apart and two
 - 3. (2) guide rollers that do not compress the tubing shall be located 180 degrees apart. The roller diameters and occlusion gap shall be factory set to provide the optimum tubing compression; field adjustment shall not be required. Spring loaded or hinged rollers shall not be used.
 - 4. Rotor assembly shall be installed on a D-shaped, chrome plated motor shaft and removable without tools.

5. For tubing installation and removal, rotor assembly shall be rotated by the motor drive at 6 rpm maximum when the pump head cover is removed. Hand cranking of the rotor assembly shall not be required.
 6. Pump head and tubing compression surface shall be corrosion resistant Valox thermoplastic.
 7. The pump head cover shall be clear, polycarbonate thermoplastic with an integral ball bearing fitted to support the overhung load on the motor shaft. Cover shall include an imbedded magnetic safety interlock which will limit the motor rotation speed to 6 rpm when removed.
 8. Cover shall be positively secured to the pump head using thumb screws. Tools shall not be required to remove the pump head cover.
- D. Pump Tube Assembly:
1. To ensure pump performance and accuracy, only tubing provided by the manufacturer is acceptable.
 2. Pump tube shall be assembled to connection fittings of PVDF material.
 3. Connection fittings shall be permanently attached to the tubing at the factory. To prevent tubing misalignment and ensure accuracy, fittings shall insert into keyed slots located in the pump head and secured in place by the pump head cover.
 4. Tube sizes and connections shall be measured in inches.
 5. Connection fittings shall be quick disconnect.
- E. Drive System:
1. Shall be factory installed and totally enclosed in a NEMA 4X, (IP66) wash-down enclosure. Capable of operating on any input power from 110VAC to 240VAC, 50/60 Hz single phase supply without user configuration or selection switches.
 2. Motor
 - a. Reversible, brushless DC gear motor rated for continuous duty.
 - b. Motor shall include overload protection.
 - c. The maximum gear motor rpm shall be 125 rpm.
 3. Enclosure
 - a. Pressure cast aluminum with acidic liquid iron phosphate three (3)-stage clean and coat pretreatment and exterior grade corrosion resistant polyester polyurethane powder coat
 - b. Rated NEMA 4X (IP66)
 - c. Provided with 316SS floor/shelf level mounting brackets and hardware. A wiring compartment shall be provided for connection of input/output signal wires and alarm output loads to un-pluggable type terminal block connectors. Terminal board shall be positively secured to the rear of the pump housing by two polymeric screws and fully enclosed by the wiring compartment cover. The terminal board shall not be disturbed by the removal of the wiring compartment cover. Ribbon cables shall not be used in the wiring compartment. Conduit hubs, liquid-tight connectors, connector through holes and tapped holes shall be sized in U.S. inches.
- F. Capacity:
1. Discharge Capacity: as specified in pump schedule attached to this section
 2. Discharge Pressure: as specified in pump schedule attached to this section
 3. Process Fluid Viscosity: as specified in pump schedule attached to this section
- G. Electrical Characteristics:
1. $\frac{1}{8}$ HP or $\frac{1}{4}$ HP as specified in pump schedule attached to this section.
 2. Voltage: 115 V, single phase, 60 Hz.
- H. Control Circuitry.
1. Control circuitry shall be integral to the pump and capable of adjusting the pump motor speed from 0.5 % to 100.00% in 0.1% increments at minimum.

2. The pump output shall be capable of being placed in manual control using the front control panel touchpad. While in manual control, the pump motor speed shall be adjustable from 1.0% to 100.00% in 0.1% increments at minimum using the front control panel touchpad.
3. The pump output shall be capable of being remotely controlled using 4-20mA analog input. The input resolution shall be 0.01 of input value and capable of adjusting the pump motor speed from 0% to 100.0% motor speed in 0.1% increments. Four (4) values shall be user configurable to define the low and high points on the output slope; a low input value, the required pump percentage of motor speed at the low input value, a high input value, the required pump percentage of motor speed at the high input value.
4. The pump output shall be capable of being remotely control using TTL/Cmos digital high speed pulse type input and an AC sine wave type pulse input in the range of 0 to 1,000 Hz. The frequency resolution shall be 1 Hz and capable of adjusting the pump motor speed from 0% to 100.0% motor speed in 0.1% increments. Four (4) values shall be user configurable to define the low and high points on the output slope; a low input value, the required pump percentage of motor speed at the low input value, a high input value, the required pump percentage of motor speed at the high input value.
5. The pump output shall be capable of being placed in remote pulse triggered batch input control using the front control panel touchpad. While in remote control using pulse triggered batch input, the pump shall accept a TTL/Cmos digital pulse type input or a contact closure type pulse input in the range of 1 to 9,999 pulses per
6. batch. The batch time shall be adjustable from 1 to 999.9 seconds or minutes. The pump motor speed during the batch shall be adjustable from 0% to 100.0% motor speed in 0.1% increments.
7. Provide a 9-button minimum front panel user touchpad control for stop/start, configuration menu access and navigation, operating mode selection, auto priming, display options selection, tube life data, and reverse direction.
8. Provide a multi-color VGA graphic LCD display for menu-driven configuration settings, pump output value, service alerts, tube failure detection (TFD) system and flow verification system (FVS) alarms status, remote input signal values, tubing life timer value. Display color shall be green when indicating normal operation, blue when in stand-by, and red to indicate an alarm condition exists.
9. Provide a back-lit LCD display for menu configuration settings, current pump operating mode, pump output volume, tube timer hour counter, tube failure detection (TFD) system and flow verification system (FVS) alarms status, motor direction and remote input signal values.
10. The pump output volume display shall be programmable to indicate the volume in ml/min, L/hr, Oz/min or gal/hr units of measure.
11. Provide for remote stop/start pump via 6-30 VDC powered loop or non-powered contact closure loop.
12. Provide a 4-20 mA output signal which is scalable and proportional to pump output volume.
13. At minimum, provide a contact closure alarm output rated at 3A-250 VAC (3A-30 VDC) that will energize when the TFD (Tube Failure Detection) or FVS (Flow Verification system) is triggered.
14. For non-self priming pumps, provide an auto-prime function that will run the pump at 100% motor speed for 60 seconds maximum when the "prime" button is pressed.
15. Provide a flow verification system (FVS) with programmable alarm delay time from 1-255 seconds. FVS system shall monitor the FVS flow sensor while pump is running only. System shall not monitor pump while not running.

2.2 ACCESSORIES

- A. Pump Tubing:
 1. Material:
 - a. Flex-A-Prene

- b. Or approved for flow temperature, flow rate, and chemical compatibility.
 2. Size: manufacturer recommended for flow range specified in Attachment A of this section
 3. Pressure Rating: As specified in Attachment A of this section
 4. Connections: Quick disconnect
 - B. Suction Tubing:
 1. Material:
 - a. Clear PVC as recommended by equipment manufacturer for service conditions including: suction lift, flow temperature, and flow rate.
 - b. Or approved for flow temperature, flow rate, and chemical compatibility.
 2. Size and Wall Thickness: ID not less than the pump tubing ID for the connected pump.
 3. Connections: Compatible with selected quick disconnect fitting and suction strainer fitting. Contractor responsible for any fittings necessary to make for a complete system that is chemically compatible with the fluid transferred.
 - C. Discharge Tubing:
 1. Material:
 - a. Braided PVC of same interior diameter of equipment tubing. Material as recommended by equipment manufacturer for service conditions including discharge pressure, flow temperature, and flow rate. Pressure rating according to pipe schedule.
 - b. Or approved for flow temperature, flow rate, and chemical compatibility
 2. Size and Wall Thickness: ID not less than the pump tubing ID for the connected pump
 3. Connections: Compatible with selected Quick Disconnect fitting and connections to downstream components or piping. Contractor responsible for any fittings (couplers, reducers, etc.) necessary to make for a complete system that is chemically compatible with the fluid transferred.
 - D. Suction Strainer:
 1. Specified in Section 40 92 13–Mechanical Appurtenances.
 - E. Quick Disconnect Valves:
 1. ½-inch hose barb with FKM O-rings and type 316 stainless steel hose clamps
 - F. Plastic wall-mounted shelf for each pump:
 1. HDPE shelf material 1-inch thick
 - a. Shelf dimensions to accommodate electrical and tubing connections and to protect equipment and connections from inadvertent damage
 2. Stainless steel wall brackets:
 - a. B-Line B3068-3 or Equal

PART 3 EXECUTION

3.1 INSTALLATION

- A. Mount pump shelf to wall with stainless-steel bolts.
- B. Fasten pump to mounting shelf with stainless-steel bolts.
- C. Install power and control and wiring as specified and indicated in drawings.
- D. Flush tubing with clean water.

3.2 FIELD QUALITY CONTROL

- A. Section 01 70 00—Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing
- B. Pre-operational Check: Before operating system or components, vent air from system to ensure water in pump.
- C. Startup and Performance Testing:
 - 1. Test metering pump flow rate by measuring time to fill or by draining calibration column with potable water.
 - 2. Operate each chemical feed system on clear water for continuous period of four (4) hours.
 - 3. Hydrostatically test system piping for leaks at maximum rated pressure.
- D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this section for not less than one (1) day 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 that equipment has been properly installed and is ready for startup and testing.

3.3 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.
- C. Demonstrate system control functions and alarms.

3.4 ATTACHMENTS

- A. Chemical Feed Pump Schedule:
 - 1. PE Chlorine Analyzer Sample Pump SAM201:
 - a. Manufacturer: Blue-White or approved equal
 - b. Model: M-324-QNKL
 - c. Pump Tubing: Flex-A-Prene NKL
 - d. Location: Filter Backwash Control Building
 - e. Pump Type: Peristaltic
 - f. Fluid: Chlorinated Water
 - g. Flow Conditions: Average 10.6 gph; Peak 13.2 gph; Min 7.9 gph
 - h. Suction Lift: 15 feet
 - i. Discharge Pressure: Maximum 14.5 psi
 - j. Motor Size: ¼ HP
 - k. Voltage/Phase: 115V/single-phase

END OF SECTION

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SECTION 46 33 44-01

PUMP DATA SHEET

Tag Number: SAM201

Pump Name: RW Chlorine Analyzer Sample Pump

Manufacturer and Model Number: Blue-White M-324-QNKL

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): Chlorinated Water

Pumping Temperature (Fahrenheit): Normal: 55 Max: Min:

Liquid pH: 6.5-8

Abrasive (Y/N): N Possible Scale Buildup (Y/N):

Suction Pressure (psig):

Minimum 0.5 Suction Lift

(ft): 15

Altitude (ft): 20 Area

Classification:

Location (indoor/outdoor): Indoor

PERFORMANCE REQUIREMENTS

Capacity (US gph): Maximum: 13.2 Average: 10.6 Minimum: 7.9

Maximum Discharge Pressure (psig): 14.5

Relief Valve Setting (psig/as recommended): As recommended

Back Pressure Valve Setting (psig/as recommended): As recommended

Max. Rotation Rate (rpm): Mfr. (1) 130 Mfr. (2)

DESIGN AND MATERIALS

Pump Type: Single Diaphragm (Y/N): Y

Wet End Material: PVDF fittings

Check Valve Material: Included with Chemical Injector

Configuration (Single/Double):

Single

Hose Material: Flex-a-Prene

Calibration Column: Quantity: One Volume:

 Material: Capacity:

Diaphragm Actuation Type: Mechanical N/A Hydraulic Stroke Position Adjustment: Not app

TESTING

Pump Tests: Factory Functional (Y/N): Y Factory Performance (Y/N): Y

Field Functional (Y/N): Y Field Performance

(Y/N): Y Motor Test:

Short Commercial (Y/N): Y Other:

END OF SECTION

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SECTION 46 33 45

AIRLIFT PUMPS

PART 1 GENERAL

1.1 REFERENCES

- A. Reference Standards:
 - 1. ASTM International (ASTM):
 - a. ASTM A36: Standard Specification for Carbon Structural Steel
 - b. ASTM A536: Standard Specification for Ductile Iron Casings
 - c. ASTM B584: Standard Specification for Copper Alloy Sand Castings for General Applications

1.2 PRE-INSTALLATION MEETING

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 - 1. Complete catalog information, descriptive literature, specifications, and identification of materials of construction. Submit descriptive literature including materials of construction, principle dimensions, weights, and other critical details.
 - 2. Shop drawings shall be complete with all dimensions, anchor locations, openings required in structures, details of connecting piping and the size and location of any clearances necessary for manufacturer provided components.
 - 3. Provide brochures, cutsheets and informational materials for all mechanical and electrical components. Provide wiring diagrams for electrical equipment, if applicable.
 - 4. Provide manufacturer's recommended procedures for jobsite storage of equipment, handling and erection.
- C. Shop Drawings:
 - 1. Detailed structural and mechanical drawings showing equipment dimensions, size, and locations of connections and weights of components.
 - 2. Assembly and installation drawings including anchor bolt plan, parts nomenclature, and materials of construction lists.
 - 3. Baseplate drawings with leveling jackscrew details, anchor bolt and sleeve details, and minimum foundation installation and leveling requirements.
 - 4. Anchorage and bracing:
 - a. Seismic attachment assembly drawings: include connection hardware, braces, and anchors or anchor bolts for nonexempt components, equipment, and systems.
 - b. Submitted seismic anchorage drawings and calculations are identified as IBC deferred submittals and will be submitted to and accepted by the Engineer prior to installation of component, equipment or distribution system.
 - c. Submit deferred action submittals such as shop drawings with supporting deferred informational submittals such as calculations no less than 4 weeks in advance of installation of component, equipment or distribution system to be anchored to structure.
- D. Manufacturer's Certificates:

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1. Factory finish system: Manufacturer's Certificate of Compliance, in accordance with Section 01 60 00—Product Requirements, that factory finish system is identical to requirements specified herein.
 2. Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
- G. Qualifications Statement: Submit qualifications for manufacturer.
- H. Operation and Maintenance Manuals:
1. Prior to delivery of equipment, and updated as required during installation of the equipment, the manufacturer shall furnish complete and detailed Installation, Operation and Maintenance (IOM) manuals which shall include the following information:
 - a. Name, address and phone number of nearest competent service organization who can supply parts and service. If this is not the manufacturer's own service department, then furnish letters confirming that the named organization has been factory authorized to represent the manufacturer of the equipment furnished.
 - b. Complete descriptive literature and drawings of all material furnished. This is to include "as built" diagrams of all equipment, "as built" erection drawings providing up-to-date information on the actual construction of the equipment furnished and any field modifications made during installation, start-up and testing.
 - c. Installation, operation and maintenance brochures from the original manufacturers of all mechanical components such as couplings, solenoids, air hoses, valves, etc., incorporated into the completed installation.
 - d. The Halmi Nozzle supplier, if applicable, shall provide, in submittal form, a head versus rate of flow curve and tabulation. Test data shall be provided supporting the accuracy statement of the manufacturer. All test data must be the result of independent laboratory testing on the Halmi Nozzle.
 - e. Recommended spare parts list.
 - f. Guide to "trouble shooting".
 - g. All required assembly, installation, alignment, and adjustment instructions.
 - h. Operating instructions, as required.
 - i. All required maintenance instructions including schedules of routine maintenance and lubrication checks.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.
- B. Project Record Documents: Record actual locations of mechanical appurtenances.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for spare parts and maintenance materials.
- B. Suggested spare parts list to maintain equipment in service for a period of 1 year and 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

1.6 QUALITY ASSURANCE

- A. Services of Manufacturer's Representative shall be as stated in Section 01 40 00 - Quality Requirements and specified herein.
- B. The airlift pump equipment covered by this section is intended to be standard equipment with proven reliability by a reputable Manufacturer having experience in the design and production of equipment specified in this section. 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 in accordance with the Manufacturer's recommendations.
- C. Equipment supplied shall be of completely new materials, fabricated, assembled, erected and placed into proper operating condition in full conformity with approved drawings, specification, engineering design, instructions, and recommendations of the equipment manufacturer.
- D. The contract documents provide details of complete equipment installation for the purpose specified. It shall be the responsibility of the contractor to coordinate all the details required for a complete operating system such as available airflow and pressure, protective coatings, and electrical requirements, as well as provide all work needed to properly install, adjust, and place in operation a complete working system. The MANUFACTURER shall provide drawings with dimensions, elevations required to ensure new mechanisms will fit existing basins. The contractor shall provide dimensions/elevations needed by manufacturer.

1.7 QUALIFICATIONS

- A. The equipment furnished under this section shall be built by an established manufacturer of wastewater process equipment with at least twenty-five (25) years of successful experience building sludge collecting or conveying equipment with at least fifty (50) installations which may be inspected by the Engineer. The equipment manufacturer must have ISO 9001:2015 Certification for design, manufacture, supply, install, service and commissioning of wastewater and water treatment plants, associated equipment and systems.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

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- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. The manufacturer shall provide equipment free of defects in material and workmanship and include a warranty on the equipment for a period of one (1) year from start-up, or eighteen (18) months from delivery, whichever occurs first.

PART 2 PRODUCTS

2.1 GENERAL

- A. A. Equipment Tag Numbers:
 - 1. 1. P109
- B. Manufacturer shall provide airlift pumps in accordance with the following Table 2.1-A:

TABLE 2.1-A

Pump Tag(s)	Application	Qty	Eductor Tube Size	Air Injection Line Size	Pump Flow Rate (gpm)	Headbox Required	Flow Metering	Operation
P109	RAS	1	8"	1-1/2"	500	Yes	No	Automatic

- C. Pump Performance Requirements:
 - 1. Flow: 500 gpm.
 - 2. Total Dynamic Head: 5 feet.
 - 3. Air Pressure required: 6 psi.
 - 4. Air Flow Required: 60 scfm.
 - 5. Minimum depth requirement: 12 inches above aeration basin diffusers.
- D. Airlift Piping:
 - 1. The airlift pump suction and discharge piping shall be as shown in the Drawings.
 - 2. Airlift discharge piping or nozzles shall be oriented in directions as shown in the Drawings.
- E. Solenoid Valves:
 - 1. Solenoid valves shall be constructed with high quality brass housings rated for the pressure ratings and sizes for each application, providing long service life and low internal leakage. Valves shall be rated for up to 212 F temperatures and operate on 115V AC power.
 - 2. Solenoid bodies shall have female NPT threaded ports for connection to air supply lines and installation by the Contractor.
 - 3. Solenoid valves shall be shipped loose for field location and installation by the Contractor.
- F. Plug Valve: Manually operated plug valves shall be cast iron manufactured by Dezurik, Bray, or approved equal.
- G. Each airlift pump shall be fabricated of hot dipped galvanized steel and comprise of a complete assembly including column, energy dissipating headbox, air flex line, discharge nozzle and removable Type 304 stainless steel air injection stinger pipe.
- H. Each airlift pump shall be furnished with a properly sized stainless steel air injection stinger pipe which shall be center mounted for even distribution of the air flow across the eductor pipe cross sectional area. Airlift pumps which utilize exterior fed suction tubes or ring-type air

injectors are not acceptable. The air injection point shall be located by the manufacturer at the proper submergence for optimum pumping efficiency and reliable performance.

- I. The eductor tube for each unit shall be the diameter as shown on the plans, fabricated from minimum Schedule 10 pipe. Each eductor tube shall be supplied with a 150# ANSI flange, equivalent plate flange, or coupling arrangement as shown on the plans for attachment to the suction piping.
- J. The air injection line shall be the same size as the air supply line to the airlift pump, shown in Table 2.01-A. The equipment manufacturer shall furnish a fabricated support bracket as required for supply lines or flexible air supply line.
- K. All anchors and fasteners required to install and secure the airlift pump shall be included and shall be Type 304 stainless steel. All cast in place or drill-in anchorage, including nuts and washers shall be of AISI Type 304 stainless steel. The minimum size of any anchors shall be 1/2" diameter.
- L. Stainless Steel Fabrication: All load bearing weldments supplied shall be minimum 3/16-inch thick. All welding techniques and sizes shall conform to the latest AWS Standards and shall be performed by qualified welders. All welds shall be minimum 3/16" fillets and shall be the full length of all mating surfaces. All weld cleaning shall be done with grinding disks, sanding disks or polishing pads specifically designed for use on stainless steel that will leave no carbon residue or be spot passivated after fabrication. All welding shall be performed in accordance with the latest edition of AWS D1.6 Structural Welding Code – Stainless Steel.
- M. Local control panel to be provided with the Mixed Liquor Recycle Airlift Pump and coordinated with Division 26 electrical panels.
- N. Manufacturer:
 - 1. Ovivo.
 - Peter Lorenz
 - (414) 731-9475
 - Peter.Lorenz@ovivowater.com
 - Ovivo USA, LLC
 - 2300 Greenhill Drive #100
 - Round Rock, TX 78664
 - a. Area Representative
 - Coombs-Hopkins
 - Brian Villacorte
 - brian@chcwater.com
 - 2. Approved equal.

2.2 SOURCE QUALITY CONTROL

- 1. Test all equipment actually furnished.
- 2. Factory Test Report: Include test data sheets, performance test logs, and as tested pump curve.
- 3. Functional Test: Perform manufacturer's standard test on equipment.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Prior to installation, protect stored appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, vandalism, etc.

- B. Clean all debris and foreign materials from inside of piping before installing appurtenances.
- C. Clean out debris and foreign material from openings and seats, test operating mechanisms to check functioning, and check nuts and bolts for tightness.
- D. Erect and support appurtenances in respective positions free from distortion and strain during handling and installation.
- E. Inspect material for defects in workmanship and material.
- F. Repair appurtenances and other equipment that do not operate easily or are otherwise defective at no additional cost to the Owner.
- G. Field Testing:
 - 1. Pressure test appurtenances with pipeline pressure testing per Section 40 80 01.
- H. The installation and any testing shall be checked and approved by a factory representative before acceptance.

3.2 FIELD FINISHING

- A. Touch up factory finish as specified in Section 09 90 00—Painting and Coating.

3.3 FIELD QUALITY CONTROL

- A. Functional Tests: Conduct on each pump.
 - 1. Laser Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
 - 2. Vibration Test:
 - a. Test with unit installed and in normal operation, and discharging to connected piping systems at rates between low discharge head and high discharge head conditions specified, shall not develop vibration exceeding 80 percent of limits specified in HI 9.6.4.
 - b. If unit exhibits vibration in excess of specified limits, adjust or modify as necessary. Unit that cannot be adjusted or modified to conform as specified shall be replaced.
 - 3. Flow Output: Measured by plant instrumentation and storage volumes.
 - 4. Test for continuous 3-hour period.
 - 5. Test Report Requirements: In accordance with HI 14.6.
- B. Performance Test: In accordance with Hydraulic Institute Standards.

3.4 MANUFACTURER'S SERVICES

- A. See Section 01 43 33—Manufacturer's Field Services

3.5 CONTRACT CLOSEOUT

- A. Provide in accordance with Section 01 70 00—Execution and Closeout Requirements.

END OF SECTION

SECTION 46 41 23

SUBMERSIBLE MIXERS

PART 1 GENERAL

1.1 PRE-INSTALLATION MEETING

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
1. Complete catalog information, descriptive literature, specifications, and identification of materials of construction. Submit descriptive literature including materials of construction, principle dimensions, weights, and other critical details.
 2. Provide brochures, cutsheets and informational materials for all mechanical components.
 3. Provide manufacturer's recommended procedures for jobsite storage of equipment, handling and erection.
- C. Shop Drawings:
1. Detailed structural and mechanical drawings showing equipment dimensions, size, and locations of connections and weights of components.
 2. Assembly and installation drawings including anchor bolt plan, parts nomenclature, and materials of construction lists.
- D. Manufacturer's Certificates:
1. Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
- G. Qualifications Statement: Submit qualifications for manufacturer.
- H. Operation and Maintenance Manuals:
1. Prior to delivery of equipment, and updated as required during installation of the equipment, the manufacturer shall furnish complete and detailed Installation, Operation and Maintenance (IOM) manuals which shall include the following information:
 - a. Name, address and phone number of nearest competent service organization who can supply parts and service. If this is not the manufacturer's own service department, then furnish letters confirming that the named organization has been factory authorized to represent the manufacturer of the equipment furnished.
 - b. Complete descriptive literature and drawings of all material furnished. This is to include "as built" diagrams of all equipment, "as built" erection drawings providing up-to-date information on the actual construction of the equipment furnished and any field modifications made during installation, start-up and testing.
 - c. Installation, operation and maintenance brochures from the original manufacturers of all mechanical components such as couplings, solenoids, air hoses, valves, etc., incorporated into the completed installation.

- d. Recommended spare parts list.
- e. Guide to "trouble shooting".
- f. All required assembly, installation, alignment, and adjustment instructions.
- g. Operating instructions, as required.
- h. All required maintenance instructions including schedules of routine maintenance and lubrication checks.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.
- B. Project Record Documents: Record actual locations of mechanical appurtenances.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for spare parts and maintenance materials.
- B. Suggested spare parts list to maintain equipment in service for a period of 1 year and 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

1.5 QUALITY ASSURANCE

- A. Services of Manufacturer's Representative shall be as stated in Section 01 40 00 - Quality Requirements and specified herein.
- B. The submersible air mixer equipment covered by this section is intended to be standard equipment with proven reliability by a reputable Manufacturer having experience in the design and production of equipment specified in this section. 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 in accordance with the Manufacturer's recommendations.
- C. Equipment supplied shall be of completely new materials, fabricated, assembled, erected and placed into proper operating condition in full conformity with approved drawings, specification, engineering design, instructions, and recommendations of the equipment manufacturer.
- D. The contract documents provide details of complete equipment installation for the purpose specified. It shall be the responsibility of the contractor to coordinate all the details required for a complete operating system such as available airflow and pressure, protective coatings, and electrical requirements, as well as provide all work needed to properly install, adjust, and place in operation a complete working system. The manufacturer shall provide drawings with dimensions, elevations required to ensure new mechanisms will fit existing basins. The contractor shall provide dimensions/elevations needed by manufacturer.

1.6 QUALIFICATIONS

- A. The equipment furnished under this section shall be built by an established manufacturer of wastewater process equipment with at least twenty-five (25) years of successful experience building air-powered mixing equipment with at least fifty (50) installations which may be inspected by the Engineer.

1.7 DELIVERY, STORAGE, AND HANDLING

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- 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 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. 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 provide equipment free of defects in material and workmanship and include a warranty on the equipment for a period of two (2) years from start-up.

PART 2 PRODUCTS

2.1 AIR MIXER

- A. Air powered circulation equipment with a durable clog-free design and no moving parts for low maintenance. The air mixer shall be comprised of a housing, lifting eyebolts, air supply connection points, intake plate, air diffusers, intake legs and an intake plate.
- B. Configuration: Floating.
- C. Confirm with manufacturer need for intake plate with hole in center for improved performance.
- D. Materials: made of Type 316 stainless steel. EPDM and PVC air hose and polypropylene air hose fittings.
- E. Deployment depth: 10-11 feet below water surface.
- F. Accessories:
 - 1. 2-inch air hose.
 - 2. Air hose connection kit.
 - 3. Four (4) black poly float balls and Type 316 stainless steel connecting chains, stop bolts and quick links.
 - 4. Retrieval Type 316 stainless steel chain of sufficient length to install as shown on Drawings.
- G. Manufacturer:
 - 1. IXOM Watercare, GridBee AP8000 Mixer.
Brian Villacorta
(925) 989-6041

brian@chcwater.com

brian@chcwater.com

2. Approved equal.

2.2 SOURCE QUALITY CONTROL

1. Test all equipment actually furnished.
2. Factory Test Report: Include test data sheets, performance test logs, and as tested pump curve.
3. Functional Test: Perform manufacturer's standard test on equipment.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Prior to assembly and installation, protect stored appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, vandalism, etc.
- B. Inspect material for defects in workmanship and material.
- C. Assemble air mixer in accordance with manufacturer's written installation instructions.
- D. Erect and support appurtenances in respective positions free from distortion and strain during handling and installation.
- E. Install anchors as shown on Drawings. Connect air hoses to air piping with appropriate fittings.
- F. Deploy air mixer with floats to appropriate depth and secure in place with chain or cable.
- G. Repair appurtenances and other equipment that do not operate easily or are otherwise defective at no additional cost to the Owner.
- H. Field Testing:
 1. Pressure test appurtenances with pipeline pressure testing per Section 40 80 01.
- I. The installation and any testing shall be checked and approved by a factory representative before acceptance.

3.2 FIELD QUALITY CONTROL

- A. Functional Tests: Conduct on each mixer.
 1. Flow Output: Measured by plant instrumentation and blower system.
 2. Test for continuous 4-hour period.
 3. Test Report Requirements: In accordance with manufacturer's requirements.

3.3 MANUFACTURER'S SERVICES

- A. See Section 01 43 33–Manufacturer's Field Services

3.4 CONTRACT CLOSEOUT

- A. Provide in accordance with Section 01 70 00–Execution and Closeout Requirements.

END OF SECTION

SECTION 46 43 21

BAFFLES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Geomembrane Baffle Curtains
 - 2. Fiber Reinforced Plastic Baffle Panels
- B. Related Requirements:
 - 1. Section 01 30 00: Administrative Requirements
 - 2. Section 01 33 00: Submittal Procedures
 - 3. Section 01 40 00: Quality Requirements
 - 4. Section 01 60 00: Product Requirements
 - 5. Section 01 70 00: Execution and Closeout Requirements

1.2 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic

1.3 REFERENCE STANDARDS

- A. ASTM-International (ASTM):
 - 1. ASTM D471: Standard Test Method for Rubber Property-Effect of Liquids
 - 2. ASTM D751: Standard Test Methods for Coated Fabrics
 - 3. ASTM D1204: Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheet or Film at Elevated Temperature
 - 4. ASTM D2136: Standard Test Method for Coated Fabrics - Low-Temperature Bend Test
- B. Military Standard (MIL):
 - 1. MIL-STD 3010C-2065: Puncture Resistance
 - 2. MIL-T 43211: Tent, Radome, Air Support, Nike Hercules System, Single Wall, 27 Feet
- C. Federal Test Method Standard (FTMS):
 - 1. FTMS 191A-5306: Abrasion Resistance of Cloth; Rotary Platform, Double-Head (Taber) Method

1.4 PREINSTALLATION MEETINGS

- A. Section 01 30 00-Administrative Requirements: Requirements for preinstallation meeting

1.5 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 installation and anchoring requirements, fasteners, detailed installation drawings,

and other details.

- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 1. Certify that installation is completed according to manufacturer's instructions.
- E. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Manufacturer Reports: Indicate that equipment has been installed according to manufacturer's instructions.
- I. Qualifications Statement:
 - 1. Submit qualifications for manufacturer.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00—Execution and Closeout Requirements: Requirements for closeout procedures
- B. Project Record Documents: Record actual locations of installed components.
- C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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

1.8 QUALITY ASSURANCE

- A. Perform Work according to Mendocino Community Service District standards.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 20 years of documented experience in the fabrication of geomembrane products and must have manufactured a minimum of 50 structurally supported baffle systems.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00—Product Requirements: Requirements for transporting, handling, storing, and protecting products
- B. Inspection: Accept materials onsite and inspect for damage.
- C. Store materials according to manufacturer's instructions.

1.11 EXISTING CONDITIONS

- A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

1. Section 01 70 00—Execution and Closeout Requirements: Requirements for warranties.
2. Furnish two-year manufacturer's warranty for workmanship and materials.

PART 2 PRODUCTS

2.1 GEOMEMBRANE BAFFLE CURTAINS

A. Description:

1. The tank baffles described in this specification shall be custom manufactured factory prefabricated hydraulic barrier curtains designed to improve flow characteristics in the existing chlorine contact basin as shown on Drawings. The manufacturer shall utilize virgin quality elastomeric geomembrane materials and factory dielectric and thermal seaming processes throughout. The tank baffle support hardware shall be manufactured in prefabricated kits to minimize field cutting and drilling. The tank baffles shall be designed for ease of installation in an existing concrete tank.

B. Scope:

1. Furnish and install Tank Baffles with appurtenances necessary to complete work as directed in the project specifications and drawings.
2. Each Tank Baffle shall include factory fabricated geomembrane panel(s) and related hardware required to complete the installation.

C. Performance and Design Criteria:

1. Baffle Curtain Material: The tank baffle curtains shall be fabricated from polyester reinforced geomembrane material 50 Mil XR®-5 9146Any proposed substitution must be approved by the Engineer.

a. Material Properties:

Physical Properties	Test Method	Value
Base – Type	ASTM D-751	Polyester
Fabric - Weight (oz./sq. yd.)	ASTM D-751	11
Thickness (mils. Min)	ASTM D-751	50
Finished Coated Weight (oz./sq. yd.)	ASTM D-751	46±2
Tear Strength (lbs. min.)	ASTM D-751 Trapezoid Tear	90 x 90
Breaking Yield Strength (lbs. min.)	ASTM D-751, Grab Tensile	850 x 900
Strip Tensile (lbs. min.)	ASTM D-751, Cut Strip Method	400 x 400
Adhesion (lbs./in. min.)	ASTM D-751, Adhesion Para. b	40/2

Physical Properties	Test Method	Value
Hydrostatic Resistance (psi min.)	ASTM D-751, Method A, Proc. 1	800
Puncture Resistance (lbs. min.)	FED-STD 101C Method 2031	350
Dead Load (lbs. min.)	Mil-T-43211 GL Room Temperature Para. 4.4.4, 4 hours 160°F	210 105
Bonded Seam Strength (lbs. min.)	ASTM D-751, Seam strength As Modified By NSF 54	550
Cold Crack (° F)	ASTM D-2136, 1/8" mandrel 4 hrs	Pass -30
Weathering Resistance (hours min.)	Carbon-Arc Atlas Weather-o-meter. No appreciable changes or stiffening or cracking of coating	8,000
Dimensional Stability (max % change)	ASTM D-1204, 212°F, 1 hour, each direction	0.5
Water Absorption (kg/m2)	ASTM D-471, 7 days	@ 70°F 0.025 @ 212°F 0.14
Abrasion Resistance	Taber Method, Method 5306, Fed. Std. 191a, 11-18 wheel, 110g load (Cycles before fabric exposure) (Max. weight loss/100 cycles, in mg)	2000 50

- b. Nylon reinforced materials will not be acceptable. The nylon reinforcing fabric will absorb water through the exposed scrim causing swelling and material delamination.
 - c. Baffle Hems—The baffle manufacturer shall provide a top support pipe hem and 3" wide two-ply perimeter hems for anchoring purposes.
 - d. Equalization Ports – For baffles other than the flow-under type, 10-in. radius semi-circle reinforced cutout equalization ports shall be incorporated at the bottom of the baffle to alleviate differential head pressure on the baffle walls during filling of the reservoir. Fill rate of the reservoir should be limited to 300 GPM, or the size of the equalization port will need to be adjusted to one square foot of flow- through area per 300 GPM of fill flow.
2. Baffle Support and Anchoring Hardware:
 - a. The baffle curtain(s) shall be supported in the tank with a Type 316 stainless steel

structural support pipe combined with stainless steel structural support fittings that shall attach to the tank structure.

- 1) Structural support pipes shall be minimum 2-1/2-in. diameter Schedule 80, Type 316 stainless steel.
- 2) Structural support fittings shall be fabricated from stainless steel.
 - a) Structural support fittings shall be designed to allow installation of structural support pipes without field welding or threading.
 - b) Structural support fittings shall be mounted to the tank walls and floor with minimum 5/8-in. diameter by 4-3/4-in. long, Type 316 stainless steel expansion anchor bolts.
 - c) Structural support fittings shall be engineered to withstand peak hydraulic loads and forces present in the tank during operational conditions as specified on Drawings.
 - i. The bottom and side hems of the baffle curtain shall be attached to the tank structure by clamping the baffle curtain material between 316 stainless steel batten strips and the concrete structure and secured with 316 stainless steel expansion anchor bolts.
 - i) The Type 316 stainless steel batten strips shall have a minimum cross section of 1/4-in. by 2-in. with 1/2-in. diameter holes minimum 12-in. on center.
 - ii) The Type 316 stainless steel expansion anchor bolts shall be minimum 3/8-in. diameter by 3-3/4-in. long installed minimum 12-in. on center.
 - b. All hardware shall be supplied in ready to install kit form. Structural support pipes shall be supplied with one end of the pipe pre-cut and pre-drilled to minimize field cutting and drilling. Field welding of stainless steel support hardware shall not be required.
 - c. All anchoring and support hardware shall be Type 316 stainless steel.

D. Manufacturers:

1. Environetics, Inc., Model: DIRECTOR II™ series
Lockport, IL
Phone: 815-838-8331
2. Approved equal.

2.2 FRP BAFFLE PANELS

- A. Description: The tank baffles described in this Specification shall be custom manufactured factory prefabricated hydraulic barrier panels designed to improve flow characteristics in the new chlorine contact basin as shown on Drawings. The manufacturer shall use virgin quality fiber reinforced plastic materials throughout. The tank baffle support hardware shall be manufactured in prefabricated kits to minimize field cutting and drilling. The tank baffles shall be designed for ease of installation in a new concrete tank.
- B. Scope:
 1. Furnish and install tank baffles with appurtenances necessary to complete work as directed in the project specifications and drawings.
 2. Each tank baffle shall include factory fabricated FRP panels and related hardware required to complete the installation.
- C. Performance and Design Criteria:
 1. FRP baffles shall be perforated as shown on Drawings to allow fluid flow through the panel. Variations in panel design must be approved by Engineer; submit detailed design drawings to engineer for prior approval.
- D. Materials:

1. Hardware: All hardware is to be Type 316 stainless steel.
2. FRP Panels:
 - a. FRP shall not adsorb water or other liquids.
 - b. FRP shall not warp from exposure to moisture or complete submersion.
 - c. FRP shall withstand corrosion from exposure to chlorinated wastewater.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00–Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Certificate of Compliance: When fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The installation contractor shall install the tank baffle(s) in the position(s) shown on the project drawings.
- B. The tank baffle(s) shall be installed in accordance with the manufacturer's drawings, instructions, and recommendations.
- C. The contractor shall verify all baffle dimensions prior to fabrication.
- D. The manufacturer shall, upon request, provide the services of a qualified onsite installation technician to ensure proper installation of the baffle system.

3.2 FIELD QUALITY CONTROL

- A. Section 01 40 00–Quality Requirements: Requirements for inspecting and testing
- B. Wet Startup: Run equipment with wastewater in basins and verify proper operation.

END OF SECTION