PROJECT MANUAL

CHERRY HILL WATER SYSTEM
WATER TREATMENT FACILITY - REBID

FOR

CULPEPER COUNTY, VIRGINIA

BID SET

July 9, 2020

Revised January 30, 2023

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Charlottesville, VA 22911
Phone: 434-984-2700

ENGINEERS
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Section 01200
Instructions to Bidders

1 General: To be valid for consideration, bids must be completed and submitted in accordance with these instructions to bidders.

2 Qualification of Bidders

2.1 The Contractor shall complete Section 01303 – Contractor Qualifications and submit with the bid to be considered a qualified bidder.

2.2 In addition to the experience qualifications listed above, each bidder must be prepared to submit within 5 calendar days of the Owner's request written evidence of his qualifications for the project, including financial data, previous experience, and evidence of authority to conduct business in the jurisdiction where the project is located.

3 Changes/Modifications to Solicitations

3.1 Bid documents, and any and all changes, addendums, amendments, and/or supplements to any Invitation to Bid (IFB), shall be posted on the Culpeper County website on the Purchasing Office's webpage under the tab titled "Current Active Solicitation" found at the following address:

https://web.culpepercounty.gov/rfps

3.2 Any and all changes, addendums, amendments, and/or supplements to the IFB shall be posted no later than the latest time on the last day by which submissions have to be received by the Purchasing Office. Offerors/Bidders are responsible for monitoring the Purchasing Office's webpage for the posting of any changes, addendums, amendments, and/or supplements.

4 Examination of Bid Documents and Site

4.1 Before submitting bids, each bidder must examine bid documents thoroughly; familiarize himself with federal, state and local laws, ordinances, rules, and regulations affecting the work; and correlate his observations with the requirements of the bid documents.

4.2 Bidders are requested and expected to visit the site of the project to alert themselves to local and special conditions, which may be encountered during construction of the project. Failure to make such investigations shall not relieve the successful bidder from performing and completing the work in accordance with the contract documents.

5 Interpretations

5.1 **All questions concerning this project shall be directed in writing to WW Associates, Inc. Jason A. Clark, P.E. is the point of contact. E-Mail:**

jclark@wwassociates.net. No oral interpretations of the bid documents will be made to any bidder. To be given consideration, requests for interpretations must be received in time to allow preparation of written response at least 7 days prior for receipt of bids. Interpretations will be written in the form of written addenda to the bid documents and e-mailed to all parties recorded by WW Associates, Inc. as having received bid documents, prior to scheduled receipt of bids. Only interpretations by formal written addenda will be binding.

6 Bid Submission

6.1 Submit one copy of the bid using forms furnished by WW Associates, Inc. and fill in all blank spaces on the form. Repeat notation "Contractor's Current Virginia License No. _____" on outside of inner envelope containing bid and bid security, and place this envelope within another envelope addressed to:

6.1.1 Culpeper County Procurement Office
155 West Davis Street, Suite 100
Culpeper, VA 22701
Attn: Alan H. Culpeper, CPPO, VCO
IFB No. PW-24-2102
Title: Cherry Hill Water System Water Treatment Facility – REBID

6.2 The inner envelope shall have noted thereon:

6.2.1 "IFB No. PW-24-2102. Title: Cherry Hill Water System Water Treatment Facility – REBID. Contractor's Name and Complete Mailing Address (Return Address).

6.3 Bid security, bidding documents, receipt deadline for bids, and pre-bid conferences shall be as specified herein.

6.3.1 No bidder shall withdraw, modify, or cancel any part of his bid for 90 days following bid opening.

6.3.2 Due to the restricted access, County personnel will provide only one inspection of the project site directly after the completion of the pre-bid conference.

6.4 Late Bids/Proposals and Modifications and Withdrawal of Bids/Proposals

6.4.1 Any bid/modification received at the office designated in the solicitation after the exact time specified for receipt of the bid/proposal/modification is considered a late bid/proposal/modification. The County is not responsible for delays in the delivery of the mail by the U.S. Postal Service, private carriers, or the inter-office mail system.

6.4.2 Late bids/proposals/modifications will be returned to the Bidder unopened, if solicitation number, acceptance date and Bidder return address are shown on the container.

6.4.3 If the County closes its offices due to inclement weather, scheduled bid openings or receipt will be extended to the next business day, same time.

6.4.4 Bids may be modified or withdrawn by appropriate document duly executed (in the manner that a bid must be executed) and delivered to the place where the bids are to be submitted at any time prior to the receipt of bids.

6.5 Errors in Bids/Proposals

6.5.1 When an error is made in extending total prices, the unit bid price will govern. Erasures in bids/proposals must be initialed by the Bidder. Carelessness in quoting prices, or in preparation of bid otherwise, will not relieve the Bidder. Bidders are cautioned to recheck their bids for possible error.

6.5.2 Withdrawal of bids after date for submission: In accordance with Procedure (ii) of Section 11-54(A) of the Code of Virginia, the bidder will have 2 business days after the opening of bids within which to claim in writing any mistake as defined in said section and withdraw his bid, provided such mistake be proved from the Contractor's work papers. Failure to submit Contractor's work papers will be considered as a waiver of any right of withdrawal of bids after the date for submission.

6.6 Bid Security: Bids shall be accompanied by a certified check or an acceptable bid bond in the amount of 5 percent of the base bid.

6.7 All Bid Items must be completed in their entirety; failure by the Contractor to fully complete the bid form will be considered a non-responsive bid.

6.8 Anti-Collusion Statement: Bidders shall complete Section 01301 – Certification of Non-Discrimination and Anti-Collusion and submit with the bid. Failure to sign, notarize, and submit this statement may result in rejection of the bid.

6.9 Proof of Authority to Transact Business in Virginia: Bidders shall complete Section 01304 – Proof of Authority to Transact Business in Virginia and submit with the bid. Failure to sign and submit this statement may result in rejection of the bid.

6.10 Acceptance of Bids/Proposals

6.10.1 Unless otherwise specified, all formal bids/proposals submitted shall be valid for a minimum period of ninety (90) calendar days following the date established for acceptance. At the end of the ninety (90) calendar days, the bid/proposal may be withdrawn at the written request of the Bidder. If the proposal is not withdrawn at that time, it shall remain in effect until an award is made, or the solicitation is canceled.

7 Agreement, insurance certificate, and bonds shall be drawn on forms identical to those bound within this project manual.

7.1 Bonds shall be with a surety company acceptable to the Owner.

7.2 A Performance Bond and a Payment Bond will be required in the amount of 100 percent of the bid.

8 Award of Contract

8.1 The award of the contract will be as specified in Section 01300 – Bid Form.

8.2 Should the responsive bid from the lowest responsible bidder exceed available funds, the Owner may negotiate with the lowest responsible bidder in accordance with Section 2.2-4318 of the Virginia Public Procurement Act to obtain a contract price within available funds.

8.3 The Owner reserves the right to reject any and all bids and waive any and all informalities and the right to disregard all nonconforming or conditional bids or counterproposals.

8.4 Submission of post-bid information shall be in accordance with the contract documents.

9 Bidders must comply with President's Execution Order No. 11246, prohibiting discrimination in employment regarding race, color, creed, sex, or national origin, and Executive Order Nos. 12138 and 11625 regarding utilization of MBE/WBE firms; Certification that they do not or will not maintain or provide for their employees any facilities that are segregated on the basis of race, color, creed, or national origin; and Statement that bidders must comply with the Civil Rights Act of 1964.

End of Section

Contractor _____ Date _____

VA License No. _____

Section 01300
Bid Form

Gentlemen:

The undersigned, having visited and examined the site and having carefully studied the drawings and project manual for the Cherry Hill Water System – Water Treatment Facility - REBID for Culpeper County, Virginia, hereby proposes to furnish all plant, labor, equipment, materials, and services and to perform all operations necessary to execute and complete the work required for the project, in strict accordance with the drawings and technical specifications prepared by WW Associates, Inc., Engineers • Surveyors • Planners, dated July 9, 2020, revised January 30, 2023, together with addenda numbered _____, issued during bidding period and hereby acknowledged, subject to the terms and conditions of the agreement as follows:

Base Bid Item No. 1 is defined as all work associated with the Cherry Hill water treatment facility improvements, except for Base Bid Item No. 2 listed below, complete and in accordance with the Part A drawings and technical specifications, for the sum of:

_____
_____ dollars
($_____).

Base Bid Item No. 2 is defined as all work associated with the Cherry Hill water treatment facility building, complete and in accordance with the Part B drawings and technical specifications, for the sum of: _____
_____ dollars
($_____).

Total Base Bid is defined as the sum of Base Bid Item Nos. 1 and 2:_____
_____
_____ dollars ($_____).

Notes:

a) The basis of award for determining the low bidder shall be the Total Base Bid.

b) The Total Base Bid is founded upon furnishing equipment and materials of specified manufacturers.

c) The Contractor is advised to refer to the Lines and Grades paragraph in Section 01400 – General Requirements for bidding instructions on construction stakeout services.

It is understood and agreed that the Owner, in protecting his best interest, reserves the right to:

a) Reject any or all bids.

b) Accept any bid at the base bid price, or any combination of the bid items, whereupon the Contractor shall furnish equipment and materials as specified.

Contractor _____ Date _____

VA License No. _____

We are properly equipped to execute work as defined in the contract documents and so covered by this bid and will enter into agreement for the execution and completion of the work in accordance with the drawings, project manual, and this bid. We further agree that if awarded the contract, we will commence the work on the date stated in the "Notice to Contractor to Proceed," and will prosecute the work and shall be substantially complete as defined in the General Conditions within 330 calendar days, and complete all obligations within 360 calendar days.

The Owner and Contractor recognize that time is of the essence with this agreement and that the Owner will suffer financial loss if the work is not completed within 330 calendar days. They also recognize the delays, expense, and difficulties involved in proving the actual loss suffered by the Owner if the work is not completed on time. Accordingly, instead of requiring any such proof, the Owner and Contractor therefore agree that, as liquidated damages for delay (but not as a penalty), the Contractor shall pay the Owner one thousand five hundred dollars ($1,500.00) for each day that expires after the time specified for substantial completion of this project.

Enclosed herewith is the following security, offered as evidence that the undersigned will enter into agreement for the execution and completion of the work in accordance with the drawings and project manual:

Certified check for the sum of_____

Name of bank_____

Bidder's bond in amount of_____

Bond issued by_____

The undersigned further agrees that in case of failure on his part to execute the said agreement within 10 consecutive calendar days after written notice being given on the award of the contract, the monies payable by the securities accompanying this bid shall be paid to Culpeper County, Virginia as liquidated damages for such failure; otherwise, the securities accompanying this bid shall be returned to the undersigned.

Contractor _____ Date _____

VA License No. _____

This bid is subject to acceptance within a period of 90 days from bid submission date.

Respectfully Submitted,

_____
Contractor

By_____

_____

_____
Address

_____
Telephone

Date_____

Contractor's Current Virginia
License Number _____ Code _____

Section 01301
Certification of Non-Discrimination and Anti-Collusion

By submitting their bids, all bidders certify to Culpeper County, Virginia, that they will conform to the provisions of the Federal Civil Rights Act of 1964, as amended, as well as the Virginia Fair Employment Contracting Act of 1975, as amended, where applicable, the Virginians with Disabilities Act, the Americans with Disabilities Act, and Section 2.2-4311 of the Virginia Public Procurement Act:

In every contract over $10,000, the provisions below apply:

1. During the performance of this contract, the Contractor agrees as follows:

   a. The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, or any other basis prohibited by state law relating to discrimination in employment, except where there is bona fide occupational qualification reasonably necessary to the normal operation of the Contractor. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

   b. The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, will state that such contractor is an equal opportunity employer.

   c. Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.

2. The Contractor will include the provisions of the foregoing Paragraphs a, b, and c in every subcontract or purchase order of over $10,000, so that the provisions will be binding upon each subcontractor or vendor.

I hereby certify that this bid is not the result of, or affected by, any act of collusion with another person engaged in the same line of business, or any act of fraud punishable under the Virginia Governmental Frauds Act.

Certified by:_____ (Corporate Seal)
Signature

Date:_____

Acknowledges before me this_____day of _____, 2024.

_____
Notary Public

My Commission Expires: _____

Section 01303
Contractor Qualifications

"The bidder shall state here what previous municipal type work he has performed similar to that contemplated in this contract, and give references that will afford Culpeper County an opportunity to judge experience and skill of proposed contractor and all subcontractor(s). The Contractor shall list five (5) projects of similar size and dollar value completed within the last five (5) years. If proposing to use subcontractors or joint partners to complete more than 20% of the work by partnership, joint venture, or subcontract means, then provide project experience information as outlined above for all contractors, partners, or subcontractors."

Submittal of this information on other standard forms containing all the information noted below is acceptable.

Failure to provide satisfactory evidence of experience may cause the bid to be rejected.

Location	Dollar Value	Year Completed	Owner/ Engineer	Phone Number	Contact Person	Type of Work Done

End of Section

Section 01304
Proof of Authority to Transact Business in Virginia

Culpeper County, Virginia

Procurement Department
155 West Davis Street, Suite 100
Culpeper, Virginia 22701

PROOF OF AUTHORITY TO TRANSACT BUSINESS IN VIRGINIA
THIS FORM MUST BE SUBMITTED WITH BID/PROPOSAL. FAILURE TO INCLUDE THIS FORM SHALL RESULT IN REJECTION OF BID/PROPOSAL.

Pursuant to Virginia Code § 2.2-4311.2, a bidder/offeror organized or authorized to transact business in the Commonwealth pursuant to Title 13.1 or Title 50 of the Code of Virginia shall include in its bid/proposal the identification number issued to it by the State Corporation Commission (SCC). Any bidder/offeror that is not required to be authorized to transact business in the Commonwealth as a foreign business entity under Title 13.1 or Title 50 of the Code of Virginia or as otherwise required by law shall include in its bid or proposal a statement describing why the offeror is not required to be so authorized. Any bidder/offeror described herein that fails to provide the required information shall not receive an award unless a waiver of this requirement and the administrative policies and procedures established to implement this section is granted by County Administrator.

If this bid/proposal for goods or services is accepted by the County of Culpeper, Virginia, the undersigned agrees that the requirement of the Code of Virginia § 2.2-4311.2 have been met.

Complete the following by checking the appropriate line that applies and providing the requested information.

A.____ Bidder/offeror is a Virginia business entity organized and authorized to transact business in Virginia by the SCC and such bidder's/offeror's Identification Number issued to it by the SCC is _____.

B.____ Bidder/offeror is an out-of-state (foreign) business entity that is authorized to transact business in Virginia by the SCC and such bidder's/offeror's Identification Number issued to it by the SCC is _____.

C.____ Bidder/offeror does not have an Identification Number issued to it by the SCC and such bidder/offeror is not required to be authorized to transact business in Virginia by the SCC for the following reason(s):

Please attach additional sheets of pager if you need to explain why such bidder/offeror is not required to be authorized to transact business in Virginia.

_____ _____
Legal Name of Bidder/Offeror Legal Name of Company

_____
Authorized Signature

_____ Date:_____
Print or Type Name and Title

(Return this Page)

Section 01400
General Requirements

1 General

1.1 Summary of Work

1.1.1 The work covered under this contract comprises the furnishing of all labor, materials, equipment, tools and services and the installation and construction of all items, and the performance of all work necessary to complete the work shown or called for on the drawings and/or this project manual.

1.1.2 All units under this Contract shall be operable, shall be installed as designed, and shall conform to the manufacturer's specifications for the particular application.

1.1.3 Owner Furnished Equipment

1.1.3.1 The equipment specified in Section 11240 – Water Softening Equipment (Owner Furnished) has been pre-purchased by the Owner and will be furnished to the Contractor for installation in this project.

1.1.3.2 For Owner furnished equipment, the Contractor shall receive, off-load, and store as required all equipment and installation materials. This shall include all equipment and materials, regardless of whether purchased by the Owner, the Contractor, or a subcontractor.

1.1.3.3 Withdraw from storage as required and transport all equipment and material to the installation location.

1.1.3.4 The Contractor shall provide all hoisting equipment, lift trucks, rigging materials, operating and travel permits, personnel, etc. necessary to unload, examine, assemble, erect or place at the site all equipment and materials. Insure that all hoisting and rigging is performed by qualified full-time professionals. Do not use any building structure for the rigging and hoisting equipment. Any damages to finishes during installation and storage shall be repaired by the Contractor at no additional cost to the Owner.

1.1.3.5 The Contractor shall unload, store, assemble, and install all Owner furnished equipment. The Contractor shall furnish and install all piping, electrical wiring, conduit, controls, supports, anchor bolts, and equipment and appurtenances required to install and render usably complete the Owner furnished equipment manufacturer/supplier, and these contract documents, at no additional cost to the Owner. The installation of the equipment shall be in accordance with the contract drawings in the space

provided. Equipment startup and training services shall be provided by the equipment manufacturer as specified in the technical sections.

1.1.3.6 All other equipment required by the contract documents shall be furnished and installed by the Contractor, unless otherwise noted.

1.2 Contractor Use of Premises

1.2.1 The Contractor shall assume full responsibility for protection and safekeeping of products stored on or off premises.

1.2.2 The Contractor shall coordinate use of premises with the Owner and Engineer, and remove stored products that interfere with the operations of the Owner or other contractors.

1.2.3 The Contractor shall obtain and pay for all additional storage or work areas needed for operations under this Contract. These areas shall be subject to the same conditions as described for the Owner's property.

1.3 Construction and Scheduling Sequence

1.3.1 All associated water utilities shall remain in full operation during the construction period. Phases of the construction which involve the temporary interruption of essential services and demolition of existing items shall be scheduled in consultation with the Owner or their representatives, shall not be of longer duration than essential to accomplish the purpose for such interruptions, and shall be coordinated to give the Owner the ability to maintain water service. Liaison with the Owner in these matters is a salient feature of this contract.

1.3.2 Provide a written construction schedule and plan which describes in detail each major task and operation which will interfere with any existing system, equipment, or operation. The plan shall describe the sequence and proposed method of accomplishing each task and the proposed schedule for interruptions.

1.3.3 All construction activities shall be performed inside acquired easements and right of ways designated for this project. Laydown areas for this project shall be the Contractor's responsibility. Coordination and scheduling of construction activities with the Owner is a salient feature of this contract.

1.3.4 The Contractor shall make provisions for protecting all asphalt and concrete surfaces. Rubber tired vehicles will be required. Any damage to asphalt or concrete surfaces shall repaired/replaced in kind by the Contractor.

1.3.5 The Contractor shall create a pre-construction video of the entire project area to demonstrate pre-construction conditions. The Contractor shall provide the Owner with a DVD of the pre-construction video as a submittal.

1.3.6 A project entitled "Cherry Hill Water System, Phase I and Phase II Water Line Improvements – Culpeper County, Virginia" is an ongoing construction project to construct new raw and finished water line improvements. Coordination with this referenced project is a salient feature of this Contract. The Contractor shall coordinate final connections, and pressure, leakage, and disinfection testing with the Water Line Contractor to provide a complete and useable water system. Connection points to the water line project are shown on the Contract Drawings. Each Contractor will be responsible for disinfection, pressure, and leakage testing of the water lines indicated in their respective Contracts.

1.3.7 SCADA System

1.3.7.1 The Owner will provide the services of a single instrumentation and controls (IC) Contractor to furnish and install the instrumentation and controls equipment required to connect this project to its existing SCADA system. P&I diagrams included in the contract drawings are provided for the Contractor's convenient reference only.

1.3.7.2 The Contractor shall be responsible for all work and materials, including, but not limited to, providing equipment items specified in Divisions 11 and 13 of this project manual. The Contractor shall install conduit, associated pull boxes, wire (excluding wire terminations), and appurtenances from the Division 11 and 13 equipment to the SCADA system interface provided by the Owner's IC Contractor.

1.4 Work Restrictions

1.4.1 Occupancy: If the Owner elects to operate any of the water line improvements under partial utilization, prior to the project's final acceptance, neither WW Associates, Inc. nor the Contractor shall be held responsible for the safety or well being of those occupants beyond the normal care and practice of the construction industry.

1.4.2 Normal working hours for the Contractor shall be 7:00 A.M. to 4:00 P.M., Monday through Friday, excluding state and federal holidays, unless otherwise approved by the Owner and WW Associates, Inc.

1.5 Contract Modification Procedures

1.5.1 Change Orders: No amount, in part or in whole, of a change order shall be included in a requisition for payment by the Contractor until the change order has been executed and copies of the change order have been distributed to the Owner and Contractor.

1.5.2 Work Orders: A work order is a device which enables the Owner to promptly order changes in the work which may involve changes in cost or

contract time, or both pending preparation and execution of a formal change order.

1.5.3 Request for Change Order Proposal: The Owner may request the Contractor to submit a change order proposal for changes in contract work. The Contractor shall submit the proposal in accordance with contract requirements within 3 days of a request by the Engineer or Owner. The Owner may issue to the Contractor a work order authorizing the required changes for an additional amount not to exceed, or a deduction of not less than the amount shown in the work order. If the Contractor is not in agreement with the amount stipulated in the work order, he shall, within a reasonable time after the issue date of the order, submit to WW Associates, Inc. an equitable proposal and develop with the Owner a mutually acceptable price for the required change in work.

1.5.4 The Contractor may initiate changes by submitting a written notice to the Engineer containing:

1.5.4.1 Description of the proposed changes.

1.5.4.2 Statement of the reason for making the changes.

1.5.4.3 Statement of the effect on the Contract Sum and the Contract Time.

1.5.4.4 Statement of the effect on the Work of separate Contractors.

1.5.4.5 Documentation supporting any change in Contract Sum or Contract Time, as appropriate.

1.6 Payment Procedures

1.6.1 Applications and Certificates for Payment: The form of each application for payment shall be EJCDC Document C-620 entitled, "Application and Certificate for Payment" accompanied by "Continuation Sheet," and "Stored Material Summary." Each application for payment by the Contractor, excluding the first, shall be accompanied by a "Contractor's Affidavit of Payment of Debts and Claims," AIA Document G706, and "Contractor's Affidavit of Release of Liens," AIA Document G706A. Each application shall be submitted on these forms as referenced in Section 01600 – Standard Contract Forms. Payment for stored material delivered but not incorporated in the work will be the invoiced amount only. Submit invoices with application for payment.

1.6.2 Upon recommendation by WW Associates, Inc. of the Contractor's request for partial payment, the Owner shall pay to the Contractor 95 percent of the total amount due and the Owner shall retain 5 percent of the amount due until final completion and acceptance of all work covered by the contract.

1.6.3 Schedule of Values: Submit complete schedule of values at least 10 days prior to first application for payment.

1.7 Project Meetings

1.7.1 Preconstruction conferences with the Contractor will be held after the effective date of the agreement.

1.7.2 Progress Meetings: Each month, the Contractor, Engineer, and the Owner shall hold a progress meeting to review progress to date and to resolve all questions for the upcoming month.

1.8 Progress Schedules: Submit a detailed construction schedule prior to the preconstruction conference. Revise the schedule prior to each progress meeting. Construction schedule shall be in a form that will clearly show the proposed degree of completeness of each aspect of the construction throughout the life of the contract. Bar graphs and/or PERT diagrams are acceptable forms.

1.9 Submittal Procedures

1.9.1 Shop Drawings, Product Data, and Samples: Prior to the preconstruction conference, prepare a submittal schedule satisfactory to WW Associates, Inc. fixing the dates for submission of shop drawings, product data, samples, and the like and update this schedule at each progress meeting to reflect the status of each submittal item.

1.9.1.1 Submit an electronic copy of all shop drawings in Adobe Acrobat PDF format.

1.9.1.2 A PDF electronic file of reviewed shop drawings will be returned to the Contractor.

1.9.1.3 Submit shop drawings, product data, samples, and the like as required by applicable specification sections.

1.9.1.4 Identify each item submitted using applicable specification section number and paragraph reference or drawing reference.

1.9.1.5 Shop drawings shall be approved by the Contractor and those subcontractors whose work is associated with the subject equipment as being in accordance with the contract documents prior to submission.

1.9.1.6 Failure to comply with these requirements will result in the submittal being returned unprocessed.

1.9.2 The Engineer's approval of Contractor's shop drawings will be general and shall not relieve the Contractor from the responsibility for adherence to the Contract, nor shall it relieve him of the responsibility for any errors that may

exist. Where such errors or omissions are discovered later, they shall be made good by the Contractor, irrespective of any approval by the Engineer.

1.9.3 Equipment/Material Shop Drawings for any piece of equipment or item will be reviewed a maximum of one time by the Engineer. Subsequent reviews will be paid for by the General Contractor to the Engineer at the rate of $160.00 per hour and paid to the Engineer by an Owner deduct from the Contractor's monthly pay request. Contractors are cautioned to select equipment that meets the requirements specified in the contract documents and to require their suppliers to provide detailed and accurate information in their submittal packages which can readily be approved.

1.10 Quality Control

1.10.1 Testing Laboratory Services: The Contractor will employ and pay for the services of an independent testing laboratory to perform testing specified to be done by an independent testing laboratory, unless specifically stated otherwise in other sections of the specifications. Employment of the laboratory shall in no way relieve the Contractor's obligations to perform the work of the contract.

1.11 Temporary Utilities

1.11.1 Temporary Electricity: The Contractor shall make all necessary arrangements for obtaining temporary electric power for construction purposes. No separate payment for electric power for construction purposes or testing other than the payment included in the contract lump sum or unit prices will be allowed.

1.11.2 Temporary Water: The Contractor may use the Owner's potable water during construction free of charge. The Contractor must provide an appropriate air gap to prevent cross contamination in the Owner's water system. Coordinate and schedule potable water usage with Owner personnel prior to construction activities.

1.11.3 Temporary Sanitary Facilities: The Contractor shall provide and maintain in a neat and sanitary condition such accommodations for the use of his employees as will comply with laws and regulations.

1.12 Temporary Controls

1.12.1 Construction Cleaning: The Contractor shall clean daily all areas under construction to ensure minimum interference with roads, streets, sidewalks, and access of adjacent property owners.

1.12.2 Erosion and Sediment Control: These controls shall be in coordination with the appropriate drawings and any requirements of the local authority.

1.12.3 Dust Control: Contractor shall ensure that dust is held to a minimum throughout the length of the project through the application of moisture where applicable.

1.13 Vehicular Access and Parking

1.13.1 Parking and Laydown Areas: The location of Contractor parking and laydown areas shall be as agreed upon by the Owner and the Engineer. Provide gravel in the laydown area and comply with the latest edition of the Virginia Erosion and Sediment Control Handbook. Parking and laydown areas shall be restored to original condition at the end of construction.

1.13.2 Maintenance and Access Roads

1.13.2.1 All maintenance and access roads used by the Contractor shall be surfaced with 6 inches of VDOT No. 21A coarse aggregate. This work shall be progressively performed prior to use of any unsurfaced areas by the Contractor where construction will cause muddy and erodible conditions.

1.13.2.2 The Contractor shall maintain and supplement coarse aggregate and perform routine maintenance as required for all maintenance and access roads during construction. The Contractor shall develop suitable subgrade and provide 6 inches of VDOT No. 21A coarse aggregate as finished road course at the end of construction at no additional cost to the Owner.

1.13.2.3 The Contractor shall develop suitable subgrade and replace damaged asphalt pavement in kind for the access road to the Finished Water Storage Tank/cell tower site.

1.14 E-Mail Address: The Contractor shall provide an e-mail address to allow the Owner and the Engineer to correspond with the Contractor's project manager during the construction period.

1.15 Product Requirements

1.15.1 Quality of Material and Equipment Incorporated into the Work:

1.15.1.1 Design, fabricate and assemble in accordance with the best engineering and shop practices.

1.15.1.2 Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.

1.15.1.3 Two or more items of the same kind shall be identical, by the same manufacturer.

1.15.1.4 Products shall be suitable for services conditions.

1.15.1.5 Equipment capacities, sizes, and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.

1.15.2 Except as specifically indicated or specified, materials and equipment removed from the existing structure shall not be used in the completed work.

1.15.3 For material and equipment specifically indicated or specified to be reused in the work:

1.15.3.1 Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed work.

1.15.3.2 Arrange for transportation, storage, and handling of products, which require off-site storage, restoration, or renovation. Pay all costs for such work.

1.15.4 Manufacturer's Instructions

1.15.4.1 When contract documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to WW Associates, Inc.

1.15.4.2 Maintain one set of complete instructions at the job site during installation and until completion.

1.15.4.3 Handle, install, connect, clean, condition, and adjust products in accordance with such instructions and in conformity with specified requirements.

1.15.5 Transportation and Handling of Materials

1.15.5.1 Arrange deliveries of products in accordance with construction schedules. Coordinate to avoid conflict with work and conditions at the site.

1.15.5.2 Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

1.15.5.3 Immediately on delivery, inspect shipments to assure compliance with requirements of contract documents and approved submittals, and that products are properly protected and undamaged.

1.15.6 Storage and Protection

1.15.6.1 Store products in accordance with manufacturer's instructions, with seals and labels intact and legible.

1.15.6.2 Store products subject to damage by the elements in weathertight enclosures.

1.15.6.3 Maintain temperature and humidity within the ranges required by manufacturer's instructions.

1.15.6.4 Exterior Storage

1.15.6.4.1 Store fabricated products above the ground, on blocking or skids; prevent soiling or staining; cover products, which are subject to deterioration with impervious sheet coverings; and provide adequate ventilation to avoid condensation.

1.15.6.4.2 Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

1.15.6.4.3 Protection after Installation: Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove when no longer needed.

1.16 Lines and Grades

1.16.1 The Contractor shall use a land surveyor currently licensed in the Commonwealth of Virginia to establish all controls and perform all construction stakeout necessary to determine the location, elevation, and construct all structures, pavements, roads, piping, buildings, and other improvements associated with this project. This stakeout will be in accordance with the dimensions and elevations shown on the contract drawings.

1.17 Starting of Systems

1.17.1 The Contractor shall initially start up and place all equipment installed by the Contractor into successful operation according to manufacturers' written instructions and as instructed by manufacturers' representatives.

1.17.2 Provide all materials, labor, tools, equipment and expendables required.

1.17.3 Coordinate schedule for start-up of various equipment and systems. Notify the Engineer at least seven days prior to start-up of each item. The Owner's operator and the Engineer will be present during start-up.

1.17.4 When required in individual Specification Sections, the manufacturer shall provide an authorized representative to be present at the site to inspect, check, and approve equipment or system installation, and to supervise placing equipment or system into operation.

1.17.5 Submit a written report that each equipment item or system has been properly installed and is functioning correctly.

1.17.6 General activities include the following:

1.17.6.1 Cleaning.

1.17.6.2 Removing temporary protective coverings.

1.17.6.3 Flushing and replacing greases and lubricants, where required by manufacturer.

1.17.6.4 Lubrication.

1.17.6.5 Check shaft and coupling alignments and reset where needed.

1.17.6.6 Check and set motor, pump and other equipment, rotation, safety interlocks, and belt tensions.

1.17.6.7 Check and correct, if necessary, leveling plates, grout, bearing plates, anchor bolts, fasteners, and alignment of piping which may put stress on equipment connected to it.

1.17.6.8 Test all equipment and systems at normal operating conditions and through the normal operating range.

1.17.6.9 Make all adjustments and balances required

1.17.7 Minimum Start-Up Procedures

1.17.7.1 Motors: Measure amperage of each motor and compare to nameplate value. Correct conditions which produce excessive current flow, and which exist due to equipment malfunction.

1.17.7.2 Pumps: Check glands and seals for cleanliness and adjustment before operating pump. Inspect shaft sleeves for scoring. Inspect mechanical faces, chambers, and seal rings, and replace, if defective. Verify that piping system is free of debris before circulating liquid through pump. Pump startup shall be performed in accordance with the manufacturer's written recommendations under the supervision of the manufacturer's representatives, and as specified in the technical specifications of this document.

1.17.7.3 Valves: Inspect all valves, clean bonnets and stems. Inspect packing glands to assure no leakage, and tighten or replace as necessary. Verify that control valve seats are free from foreign material and are properly positioned for service.

1.17.7.4 Pipe Joints: Inspect all joints for leakage, and tighten, remake, or replace as necessary.

1.17.7.5 Pipe Supports: Inspect all piping supports to assure adequate restraint to prevent displacement, vibration, or failure of piping and fittings, while allowing for expansion and contraction. Modify and adjust as necessary.

1.17.7.6 Electrical Circuits: Check each electrical control circuit to assure operation complies with specifications and requirements to provide desired performance.

1.17.7.7 Instruments: Test, adjust, and calibrate as required.

1.18 Demonstration and Instructions

1.18.1 Prior to final inspection, demonstrate operation of each system to the Engineer and the Owner.

1.18.2 Instruct the Owner's personnel in operation, adjustment, and maintenance of equipment and systems, using the operation and maintenance manuals as a basis for instruction. Review the contents of all manuals with the Owner's personnel in detail to explain all aspects of operation and maintenance.

1.19 Acceptance for Operation

1.19.1 As soon as the unit, equipment, or system has been properly prepared for operation and it is necessary to be placed into service, bring it on-line; then make an on-line performance test by operating it under approximately normal conditions for a period of 5 consecutive days to demonstrate that all materials and components are in proper working order and free from defects. During this time, the Owner will receive specified instruction on the unit or system by qualified personnel, and be furnished all appropriate operation and maintenance manuals. In event of failure to demonstrate successful performance on the first or any subsequent attempt, make all alternations, adjustments, repairs, and replacements that may be needed; and, if it becomes necessary to shut down the unit or system, or any portion thereof before the on-line test is satisfactorily completed, provide all appropriate measures to resume operations without the unit or system. When the unit or system is again ready for operation, bring it on-line and start a new on-line test. This procedure shall be repeated as often as necessary until the unit or system shall have operated continuously to the satisfaction of the Owner, for a test period duration of 5 consecutive days. The Owner will furnish all operating personnel (other than vendor's or subcontractor's service engineers) needed to operate equipment during the on-line test period; however, said personnel will perform their duties under the Contractor's direction and supervision. Until performance tests are completed and units and systems are accepted by the Owner for operation, the Contractor shall be fully responsible for supervising their operation.

1.19.2 When the on-line test has been completed, the Owner will notify the Contractor to this effect in writing and will then take over the unit or system for purpose of operation. Neither this notice nor the act of taking over any item for operation shall relieve the Contractor from his obligations to complete the facility or perform any other obligations or responsibilities, which extend beyond the completion of the on-line tests.

1.19.3 The Contractor shall maintain full responsibility for the maintenance of all units and systems placed on-line until they have been determined substantially complete. No warranties shall begin prior to the date of substantial completion.

1.19.4 Acceptance Requirements: All equipment shall pass the specified performance testing prior to substantial completion certifications. Partial acceptance of equipment will not be allowed.

1.20 Cleaning

1.20.1 Periodically clean premises of accumulated construction debris.

1.20.2 Prior to final completion, thoroughly remove from premises any debris remaining from construction activities, and properly dispose. Leave premises in a clean, neat, orderly and safe condition.

1.21 Contract Closeout Procedures

1.21.1 Punch List: Correct All Punch List Items.

1.21.2 Operations and Maintenance Data: Obtain, assemble, and submit to WW Associates, Inc. a manual in PDF format containing comprehensive operating and maintenance instructions and parts lists. The manual shall be self-contained and include information for efficient servicing of equipment supplied and installed under the contract.

1.21.2.1 Operating instructions shall explain maintenance procedures, methods of checking the systems for safe and normal operation, and recommended procedure for safely stopping and starting the equipment and systems.

1.21.2.2 These requirements shall be fulfilled before any guarantee periods become effective so as to limit the possibility of claims arising from the absence of pertinent information.

1.21.3 Guarantees, Warranties, and Bonds: Submit all required guarantees, warranties and bonds.

1.21.4 Project Record Documents

1.21.4.1 Provide an as-built survey by a Virginia licensed land surveyor. As-built survey shall be provided in AutoCAD, Version 21. Provide one complete set of drawings and project manual recording all changes to work to indicate actual installation. Changes shall be in AutoCAD, Version 21. These changes shall include, but are not limited to, the following:

1.21.4.1.1 Size, depth or position of foundations.

1.21.4.1.2 Exact location and elevation of all underground utility services.

1.21.4.1.3 Changes in general construction, mechanical, or electrical work above or below ground.

1.21.4.2 These records are a specific contract requirement, and final payment will not be made until these drawings and project manual have been submitted in an acceptable form.

1.21.5 Spare parts and maintenance materials required by these contract documents shall be delivered to the Owner as directed by the Owner.

1.21.6 List of Manufacturers and Suppliers: At the conclusion of the project, the Contractor shall furnish WW Associates, Inc. with a complete list of subcontractors, manufacturers, and suppliers who participated in the construction or who furnished materials or equipment. The address of each firm shall be included, together with types of materials or work performed.

1.21.7 Affidavit of Payment of Debts and Claims

1.21.8 Affidavit of Release of Liens

End of Section

Section 01500
Supplementary Conditions

1 Supplements

1.1 These supplementary conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC Document C-700, 2013 edition, and other provisions of the contract documents to the extent indicated. All provisions, which are not so amended or supplemented, remain in full force and effect.

2 Definitions

2.1 The terms used in these supplementary conditions that are defined in the Standard General Conditions of the Construction Contract (EJCDC Document C-700, 2013 edition) have the meanings assigned to them in the general conditions.

3 Copies of Documents: Modify Article 2.02 as follows: For construction purposes, the Contractor will be issued, free of charge, the following:

One (1) compact disc containing the "Issued for Construction" project manual and the project drawings in Adobe Acrobat (PDF) format

4 Physical Conditions: Explorations and Reports. Add the following to Article 4, Paragraph 4.02.A.

"Subsurface exploration by Soils Engineer, Underhill Engineering, LLC, Charlottesville, Virginia, has been performed, and the soil reports, dated December 12, 2019, and February 4, 2022, are appended to this project manual for convenient reference only and will not be part of the contract documents.

Soil reports were obtained by WW Associates, Inc. in design and are available for the Contractor's information, but are not a warranty of subsurface conditions. The Contractor shall be responsible for his own interpretation for construction purposes.

Prior to bidding, the Contractor may make subsurface investigations."

5 Bonds

5.1 Add the following to Article 6, Paragraph 6.01.

"The Contractor shall secure and provide all bonds called for in the General Conditions and Instructions to Bidders. All bonds shall be written by sureties or insurance companies licensed to do business in the Commonwealth of Virginia."

6 Insurance

6.1 The Contractor shall purchase and maintain the insurance, required by Article 6 of the General Conditions, in at least the following amounts: (A sample Certificate of Insurance is attached for use as a template by your agent.)

6.1.1 Workers Compensation: Statutory

6.1.2 Employer's Liability

6.1.2.1 Each Accident:	$100,000
6.1.2.2 Disease, Each Employee:	$100,000
6.1.2.3 Disease, Policy Limit:	$500,000

6.1.3 General Liability

6.1.3.1 Each Occurrence:	$1,000,000
6.1.3.2 Personal and Advertising Injury:	$1,000,000
6.1.3.3 Products Completed Operations Aggregate:	$2,000,000
6.1.3.4 General Aggregate:	$2,000,000

6.1.4 Excess or Umbrella Liability

6.1.4.1 Each Occurrence:	$10,000,000
6.1.4.2 General Aggregate:	$10,000,000

6.1.5 Automotive Liability

6.1.5.1 Combined Single Limit (Each Accident):	$1,000,000

6.1.6 Builder's Risk: Coverage Equal to Contract Amount

6.2 Contractor's workers compensation insurance as required by Federal, State, and Municipal laws for the protection of all Contractors' employees working on or in connection with the project, including broad form all states and voluntary compensation coverages and employers' liability coverage.

6.3 Contractor's general liability insurance shall include the following coverages:

6.3.1 Premises and Operations

6.3.2 Explosion

6.3.3 Collapse and Underground

6.3.4 Products Completed Operations

6.3.5 Contractual Liability

6.3.6 Personal and Advertising Injury

6.4 The Automobile Liability Insurance shall include coverage for owned, non-owned, and hired autos.

6.5 All insurance shall be written by insurance companies licensed to do business in the Commonwealth of Virginia.

6.6 Culpeper County and WW Associates, Inc. shall be listed as additional insureds on all policies except workers compensation.

6.7 A waiver of subrogation shall apply in favor of Culpeper County and WW Associates, Inc. on all policies as permitted by law.

6.8 Certificate Holder:

Culpeper County
Department of Environmental Services
118 West Davis Street, Suite 101
Culpeper, VA 22701

7 Contractor's Responsibilities

7.1 Labor, Materials, and Equipment: Add the following to Paragraph 6.03:

"All material incorporated in the work of this contract shall be free of asbestos and other hazardous materials."

7.2 Laws and Regulations:

7.2.1 Add the following to Subparagraph 6.09.D.:

"The Contractor shall be licensed in the Commonwealth of Virginia in accordance with Title 54.1, Chapter 11, Code of Virginia (1950) as amended."

7.2.2 Add the following to Subparagraph 6.09.E.:

"The Contractor shall comply with the provisions set forth in Section 2.2-4311.1 of the Code of Virginia and shall not during the performance of the contract knowingly employ an unauthorized alien as defined in the Federal Immigration Reform and Control Act of 1986."

7.3 Prohibition of Employment Discrimination

7.3.1 During the performance of this contract, the Contractor agrees as follows:

7.3.1.1 The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, or other basis prohibited by state law relating to discrimination in employment, except where there is a bona fide occupational qualification reasonably necessary to the normal operation of the Contractor. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

7.3.1.2 The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, will state that such contractor is an equal opportunity employer.

7.3.1.3 Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.

7.3.2 The Contractor will include the provisions of the foregoing paragraphs in every subcontract or purchase order of over $10,000, so that the provisions will be binding upon each subcontractor or vendor.

7.4 Permits: The Contractor shall obtain all required permits for this project at no additional cost to the Owner. The Contractor shall pay any associated fees for required permits. Required permits shall include, but not be limited to, the following:

7.4.1 Culpeper County Business Registration: Submit a Business Registration Form to the Commissioner of the Revenue. Telephone: (540) 727-3443.

7.4.2 Culpeper County Building Permit: The Contractor shall apply for and obtain the building permit. Comply with all County requirements and provide all required Special Inspections for building construction. Contact the County Building Department for additional information. Telephone: (540) 727-3405.

7.4.3 Culpeper County Land Disturbance Permit: Contact the County Erosion and Sediment Control Administrator for additional information. Telephone: (540) 727-3404.

7.4.4 Virginia Department of Transportation Land Use Permit. Comply with all VDOT requirements and obtain any required permits for work in VDOT rights-of-way. Costs associated with VDOT permits shall be paid for by the Contractor.

7.5 OSHA Requirements: The Contractor shall be responsible for all safety at the job site and shall comply with OSHA Regulations for all work associated with this project.

ACORD®

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME:
PLEASE SEND THIS SAMPLE CERTIFICATE TO YOUR AGENT	PHONE (A/C, No, Ext): FAX (A/C, No):
	E-MAIL ADDRESS:
	PRODUCER CUSTOMER ID #:

INSURED	INSURER(S) AFFORDING COVERAGE	NAIC #
	INSURER A :	
	INSURER B :	
	INSURER C :	
	INSURER D :	
	INSURER E :	
	INSURER F :	

COVERAGES **CERTIFICATE NUMBER:** **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
	GENERAL LIABILITY						EACH OCCURRENCE	$ 1,000,000
	[X] COMMERCIAL GENERAL LIABILITY	[Y]	[Y]				DAMAGE TO RENTED PREMISES (Ea occurrence)	$
	[ ] CLAIMS-MADE [X] OCCUR						MED EXP (Any one person)	$
	[X] Primary Coverage						PERSONAL & ADV INJURY	$ 1,000,000
	[X] Contractual Liability & XCU						GENERAL AGGREGATE	$ 2,000,000
	GEN'L AGGREGATE LIMIT APPLIES PER:						PRODUCTS - COMP/OP AGG	$ 2,000,000
	[X] POLICY [ ] PRO-JECT [ ] LOC							$
	AUTOMOBILE LIABILITY						COMBINED SINGLE LIMIT (Ea accident)	$ 1,000,000
	[ ] ANY AUTO	[Y]	[Y]				BODILY INJURY (Per person)	$
	[X] ALL OWNED AUTOS						BODILY INJURY (Per accident)	$
	[ ] SCHEDULED AUTOS						PROPERTY DAMAGE (Per accident)	$
	[X] HIRED AUTOS							$
	[X] NON-OWNED AUTOS							$
	[ ]							
or	[X] **UMBRELLA LIAB** [X] OCCUR						EACH OCCURRENCE	$ 10,000,000
	[X] **EXCESS LIAB** [ ] CLAIMS-MADE	[Y]	[Y]				AGGREGATE	$ 10,000,000
	[ ] DEDUCTIBLE							$
	[ ] RETENTION $							$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y / N						[X] WC STATU-TORY LIMITS [ ] OTH-ER	
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? [ ]	N / A	[Y]				E.L. EACH ACCIDENT	$ 100,000
	(Mandatory in NH) If yes, describe under SPECIAL PROVISIONS below						E.L. DISEASE - EA EMPLOYEE	$ 100,000
							E.L. DISEASE - POLICY LIMIT	$ 500,000
	Builder's Risk	[Y]	[Y]				Coverage Equal to Contract Amount	

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

Place owner's name and name of project here. (Owner's Name) and WW Associates, Inc. are listed as an additional insured on all policies except workers compensation. A waiver of subrogation shall apply in favor of (Owner's Name) and WW Associates, Inc. on all policies as permitted by law.

CERTIFICATE HOLDER	CANCELLATION
Defined in Supplementary Conditions	**SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.**
	AUTHORIZED REPRESENTATIVE

End of Section

Section 01600
Standard Contract Forms

The following Engineers Joint Contract Documents Committee (EJCDC) and American Institute of Architects (AIA) documents will be incorporated in this project manual. All forms shall be utilized in accordance with applicable EJCDC and AIA regulations and modified as needed for this particular project:

Agreement

Completed EJCDC Document C-520 (2013) "Suggested Form of Agreement Between Owner and Contractor for Construction Contract", will be a part of this contract.

Performance Bond, and Payment Bond

Completed EJCDC Document C-610, (2013) and EJCDC Document C-615 (2013), will be a part of this contract.

Supplemental Attachment for Accord Certificate of Insurance

Completed AIA Document G715, (1991), will be a part of this contract.

Application and Certificate for Payment and Continuation Sheet

Completed EJCDC Document C-620, (2013), will be a part of this contract.

Affidavit of Payment of Debts and Claims, and Affidavit of Release of Liens

Completed AIA Documents G706 and G706A (1994), will be part of this contract.

Standard General Conditions of the Construction Contract

EJCDC Document C-700 (2013) "Standard General Conditions of the Construction Contract", modified as needed, will be a part of this contract.

EJCDC documents are available from the EJCDC online store at www.ejcdc.com.

AIA documents are available at www.AIA.org.

End of Section

Section 02200
Earthwork

1 GENERAL

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

1.1.1 American Society for Testing and Materials (ASTM)

1.1.1.1 ASTM C 136: Sieve analysis of fine and coarse aggregates.

1.1.1.2 ASTM D 698: Moisture-density relations of soils and soil-aggregate mixtures using 5.5-pound rammer and 12-inch drop.

1.1.1.3 ASTM D 1140: Amount of material in soils finer than the No. 200 sieve.

1.1.1.4 ASTM D 1556: Density of soil in place by the sand-cone method.

1.1.1.5 ASTM D 2487: Classification of soils for engineering purposes.

1.1.1.6 ASTM D 4318: Liquid limit, plastic limit, and plasticity index of soils.

1.1.1.7 ASTM D 6938: In-place density and water content of soil and soil-aggregate by nuclear methods (shallow depth).

1.2 Definitions

1.2.1 Hard Materials: Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of “rock” but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.2 Rock: Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding ½ cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.3 Cohesive Materials: Materials ASTM D 2487 classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

1.2.4 Cohesionless Materials: Materials ASTM D 2487 classified as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have plasticity index of zero.

1.3 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.3.1 Two copies of field test reports for fill and backfill tests, select materials tests, and density tests.

1.4 Delivery, Storage, and Handling: Perform in a manner to prevent contamination or segregation of materials.

1.5 Criteria for Bidding

1.5.1 Base bids on the elevations as indicated.

1.5.2 The Contractor shall comply with the requirements specified herein, as well as the geotechnical recommendations presented in Appendices A and B of this project manual.

1.5.3 All earthwork excavation shall be unclassified, regardless of material encountered. All earthwork excavation shall be performed to the indicated elevations at no additional cost to the Owner.

1.5.4 Material character is generally indicated by the boring logs presented in Appendices A and B of this project manual. The soils reports (Appendices A and B) are available for the Contractor's information, but will not be part of the contract documents. When there is a conflict between the soils reports, the drawings, and the project manual, the project manual shall take precedence.

1.5.5 Groundwater elevations indicated by the boring logs were those existing at the time subsurface investigations were made and do not necessarily represent groundwater elevation at the time of construction.

1.5.6 Blasting will not be permitted on this project.

1.5.7 Remove material in an approved manner, and provide excavation support structures as required in accordance with the U.S. Army Corps of Engineers "Safety and Health Requirements Manual," EM-385-1-1, Sections 25 A through E.

1.5.8 The Contractor shall retain the services of a geotechnical firm to certify the subgrade condition prior to installation of building and tank foundations. This evaluation shall include laboratory evaluations for foundation validation. The geotechnical firm shall perform all services at the direction of WW Associates, Inc.

1.6 Provide barricades, coverings, or other types of protection necessary to prevent damage to existing improvements not indicated to be removed, and improvements on adjoining properties.

1.6.1 Restore all improvements damaged by this work to their original condition, and acceptable to the Owner or other parties or authorities having jurisdiction, unless indicated otherwise.

1.7 Protect existing trees and other vegetation indicated to remain in place against cutting, breaking, or skinning of roots; skinning and bruising of bark; smothering of trees by stockpiling construction materials or excavated materials within drip line; excess foot or vehicular traffic; or parking of vehicles within drip line. Provide temporary fences, barricades, or guards as required to protect trees and vegetation to be left standing.

1.8 Burning of site clearing debris will not be allowed.

1.9 Utility Location: The Contractor shall provide the services of a pipe utility location firm to use nondestructive, air vacuum excavation methods to pothole existing underground utilities within the limits of disturbance on this project to avoid utility conflicts. Pothole excavations shall be performed every 50 linear feet along pipe lines, and at additional locations where requested by WW Associates, Inc. Resolution of utility conflicts is the responsibility of the Contractor at no additional cost to the Owner. Utilities shall be marked by the pipe utility location firm prior to construction.

2 PRODUCTS

2.1 Soil Materials: Free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen deleterious or objectionable materials. The maximum particle diameter shall be one-half the lift thickness at the specified location. The maximum particle diameter for pipe backfill material located less than 1-foot above the pipe crown shall be 1-inch.

2.1.1 Common Fill: Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.2 Backfill and Fill Material: ASTM D 2487, Classification GW, GP, GM, GC, SW, SP, SM, SC, ML with a maximum ASTM D 4318 liquid limit of 35, maximum ASTM D 4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D 1140, No. 200 sieve.

2.1.3 Topsoil: Provide as specified in Section 02936 – Seeding.

2.1.4 Select Material: ASTM D 2487, Classification GW, GP, SW, SP with a maximum of 10 percent by weight passing ASTM D 1140, No. 200 sieve.

2.1.5 Pipe Bedding Material: VDOT No. 57 coarse aggregate.

2.1.6 Aggregate Fill: VDOT No. 57 coarse aggregate.

2.1.7 Riprap: Class A1 dry riprap as defined in the Virginia Department of Transportation (VDOT) Road and Bridge Specifications, Section 414, "Riprap."

2.2 Borrow: Obtain borrow materials required in excess of those furnished from excavations from sources off the Owner's property. Provide and submit soil classification testing to ensure borrow materials meet the requirements of this specification.

2.3 Geotextile Fabric

2.3.1 Geotextile fabric shall be protected from mud, dirt, dust, sunlight, and debris during transport and storage. Material shall be inert to commonly encountered chemicals; resistant to mildew, rot, insects, and rodents; and biologically and thermally stable. Geotextile fabric for subsurface installation shall not be exposed to direct sunlight for more than 24 hours during installation.

2.3.2 Geotextile fabric beneath access roads shall be woven polypropylene and shall have the following properties as a minimum:

Physical Property	Specification	Test Method
Apparent Opening Size	Equal to or greater than No. 40 sieve	ASTM D 4751
Grab Tensile Strength	315 pounds	ASTM D 4632
Grab Tensile Elongation	10%	ASTM D 4632
Mullen Burst Strength	650 psi	ASTM D 3786
Trapezoidal Tear Strength	120 pounds	ASTM D 4533
Puncture Strength	145 pounds minimum	ASTM D 4833

UV Resistance after 500 hours	70%	ASTM D 4355
Permittivity	0.05 sec^{-1}	ASTM D 4491

2.3.2.1 Acceptable products are Mirafi 600X as manufactured by Mirafi Construction Products, 365 South Holland Drive, Pendergrass, Georgia, 30567, Telephone: (706) 693-2226, or approved equal by Synthetic Industries, or Amoco Fabrics and Fibers Company.

2.3.3 Geotextile fabric for riprap bedding material shall be woven polypropylene and shall have the following properties as a minimum:

Physical Property	Specification	Test Method
Apparent Opening Size	Equal to or greater than No. 50 sieve	ASTM D 4751
Grab Tensile Strength Warp/Fill	350 pounds/250 pounds	ASTM D 4632
Puncture Strength	140 pounds minimum	ASTM D 4833

2.3.3.1 Acceptable products are Erosion 1 as manufactured by Synthetic Industries, 4019 Industry Drive, Chattanooga, Tennessee 37416, Telephone: (615) 899-0444, and Amoco 1199 as manufactured by Amoco Fabrics and Fibers Company, 260 The Bluffs, Austell, Georgia 30168, Telephone: (770) 944-4569.

3 EXECUTION

3.1 Land Disturbance and Construction Limit Criteria for Utility Construction

3.1.1 General Requirements Applying to all Areas

3.1.1.1 The Contractor shall plan construction to minimize disturbance to properties adjacent to the proposed utilities. The Contractor shall flag the proposed limits of construction and mark all proposed trees to be cut for review and approval by the Engineer prior to any clearing being performed.

3.1.1.2 The Engineer reserves the right to limit the width of land to be disturbed and to designate on the drawings or in the field certain areas or items within this width to be protected from damage.

3.1.1.3 The Contractor shall be responsible for damages to area or items designated by the Engineer to be protected. Repairs to, replacement of, or reparations for areas or items damaged shall be

made to the satisfaction of the Engineer before acceptance of the completed project.

3.1.1.4 Unless otherwise noted on the contract drawings, all trees cut shall be removed from this project. Brush, laps, roots, and stumps from trees shall also be removed from the site.

3.1.1.5 All buildings or structures located along the line shall be protected by the Contractor. Hand trenching, shoring, or other methods may be required.

3.1.1.6 Any fences disturbed by the Contractor shall be repaired with new materials to a condition equal to or better than their original condition or to the satisfaction of the Engineer. Provide new fencing where indicated on the drawings.

3.1.1.7 The Contractor shall obtain written permission from property owners for use of any access points other than ones located within right-of-ways. Written permission shall contain conditions for use and restoration agreements between property owner and Contractor.

3.1.1.8 All areas disturbed shall be restored to a condition equal to or better than their original condition and shall be graded to drain.

3.1.1.9 The Contractor shall replace or repair all damaged or destroyed property corners.

3.1.1.10 All trees located beyond 10 feet of the utility centerline shall be protected unless the Contractor obtains written authorization from the Engineer to remove them. The Engineer reserves the right to designate other trees located closer to the centerline for protection where possible.

3.1.1.11 All shrubs, hedge, or other ornamental plantings located along the line shall be protected or moved and replanted by the Contractor.

3.1.1.12 The Contractor shall grub only brush, roots, and stumps of removed trees. Damage to lawns shall be kept to an absolute minimum necessary for construction.

3.1.1.13 Topsoil shall be removed from trench line to a depth of 6 inches and stockpiled for use in final restoration. Topsoil shall be replaced to the same depth.

3.1.1.14 Excavated rock shall be removed from the site unless otherwise ordered by the Engineer.

3.1.1.15 Restoration and fine grading shall follow within 1 week from the time an area is disturbed or within 500 feet from the immediate work site, whichever occurs first. Seeding shall follow as specified in Section 02936 – Seeding.

3.1.2 Construction Limits

3.1.2.1 The Contractor shall not disturb any areas outside the construction limits indicated on the drawings without express written permission from the Engineer. Construction limits are defined as the limits of clearing.

3.1.2.2 No clear-cutting of timber shall be permitted within the construction limits. The Contractor shall make select cutting of trees, taking the smallest trees first, that are mandatory for the construction of the utility line. The Engineer's decision shall be final on determination of which trees are to be cut.

3.2 Remove debris from the site in such a manner as to prevent spillage. Keep pavement and areas adjacent to site clean and free from mud, dirt, and debris at all times.

3.3 Surface Preparation

3.3.1 Stripping: Strip existing topsoil, when present, to a depth of 6 inches without contamination by subsoil material. Stockpile topsoil separately from other excavated material and locate convenient to finish grading area.

3.3.2 Unsuitable Material: Remove unsuitable soil materials, waste material, vegetation, debris, decayed vegetable matter, sod, and mulch from the construction site. Dispose of the unsuitable material off the Owner's property in accordance with all federal, state, and local regulations.

3.4 Protections

3.4.1 Protection Systems: Provide shoring, bracing, and sheeting as required in accordance with the U.S. Army Corps of Engineers "Safety and Health Requirements Manual," EM-385-1-1, Sections 25 A through E.

3.4.2 Site Drainage: Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.4.2.1 Surface Drainage: Completely drain the construction site during periods of construction to keep soil materials sufficiently dry. Provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove

unsuitable material and provide new soil material as specified in this section at no additional cost to the Owner.

3.4.2.2 Subsurface Drainage: Consider site surface and subsurface conditions, available soil, and hydrological data. Remove water by benching, sump pumping, deep well pumping, or other methods to prevent softening of surfaces exposed by excavation. Use filters on dewatering devices to prevent removal of fines from soil. Provide erosion control at the outlet of piping to prevent erosion. Operate dewatering system continuously until construction work below existing water levels is complete.

3.4.3 Underground Utilities: Location of existing utilities indicated on the drawings is approximate. The Contractor shall physically verify the location and elevation of the existing utilities, whether indicated or not, prior to starting construction. The Contractor shall contact Miss Utility and respective utility owners for exact locations prior to any excavation near utilities.

3.4.4 Machinery and Equipment: Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged at no additional cost to the Owner.

3.4.5 Flotation: The Contractor shall take all necessary precautions to prevent the flotation of new piping and structures during installation and the period before the new piping and associated structures are backfilled and placed in service.

3.5 Excavation

3.5.1 Excavate to the elevations and dimensions indicated and as specified in this section. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. When soil not meeting the requirements specified in this section is encountered during excavation, remove the unsuitable soil material and replace with select material as specified in this section. Removal and disposal of unsuitable soil material and placement and compaction of select material shall be performed at no additional cost to the Owner.

3.5.2 Keep excavations free from water. Excavate soil disturbed or weakened by the Contractor's operations, and soils softened or made unsuitable for subsequent construction due to exposure to weather. Refill with select material and compact to 95% of ASTM D 698 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with select material and compact to 95% of ASTM D 698 maximum density. Side slopes when allowed shall be protected with 6-mil polyethylene sheeting.

3.5.3 Pipe Trenches: Excavate to the dimensions indicated and as specified herein. Trenches in public roadways shall be excavated in accordance with the latest edition of the VDOT Road and Bridge Specifications. Where rock is encountered, excavate and remove rock to a minimum depth of 6 inches below the pipe invert. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement.

3.5.4 Unsuitable Subgrade Soil Materials: Subgrades which are determined to be unsuitable for bearing new equipment, structures, or piping, shall have the unsuitable subgrade soil materials removed and disposed of, and replaced with select material at no additional cost to the Owner.

3.6 Filling and Backfilling: Fill and backfill to elevations and dimensions indicated. Compact each lift before placing overlaying lift.

3.6.1 Common Fill Placement: Provide for general site. Place in 6-inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Provide a smooth finish surface by blading, rolling with a smooth roller, or both.

3.6.2 Backfill and Fill Material Placement: Place in 6-inch lifts. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structures. Place backfill and fill materials to 5 feet outside of structures.

3.6.3 Select Material Placement: Provide under all structures and concrete slabs. Select materials shall be provided from approved borrow areas. In addition, provide stone where indicated on the drawings. Place in 6-inch lifts. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structures.

3.6.4 Trench Backfilling: Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact initial backfill and backfill materials in 6-inch lifts to the top of the trench. Trenches in public roadways shall be backfilled and compacted in accordance with the latest edition of the VDOT Road and Bridge Specifications.

3.6.5 Bedding Requirements: Except as specified otherwise in the individual piping sections, provide bedding for buried piping as specified herein. Piping shall be bedded in VDOT No. 57 coarse aggregate to a depth of ¼ the outside pipe diameter (minimum depth of 4 inches) beneath the pipe invert. Where rock is encountered, provide a minimum bedding depth of 6 inches beneath the pipe invert.

3.7 Compaction: Expressed as a percentage of maximum density. Determine in-place density of the existing subgrade; if required density exists, no compaction of the existing subgrade will be required.

3.7.1 General Site: Compact underneath areas designated for vegetation and areas outside the 10-foot line of structures to 90% of ASTM D 698.

3.7.2 Structures and Concrete Slabs: Compact top 12 inches of subgrade to 98% of ASTM D 698. Compact fill, backfill, and select materials to 98% of ASTM D 698.

3.7.3 Pipe Trenches: Compact fill, backfill, and select materials placed in pipe trenches to 95% of ASTM D 698.

3.7.4 Adjacent Areas: Compact areas within 10 feet of structures to 95% of ASTM D 698.

3.7.5 Paved Areas: Compact top 12 inches of subgrade to 100% of ASTM D 698. Compact fill, backfill, and select materials to 100% of ASTM D 698. In addition to the specified compaction requirements, fill and backfill materials shall be compacted to develop a California Bearing Ratio (CBR) of 10.

3.8 Finish Operations

3.8.1 Grading: Finish grades as indicated within one-tenth of 1 foot. Grade areas to drain water away from structures. For existing grades that will remain but which were disturbed by the Contractor's operations, grade as directed.

3.8.2 Seeding: Provide as specified in Section 02936 – Seeding.

3.8.3 Protection of Surfaces: Comply with all local requirements and the latest edition of the Virginia Erosion and Sediment Control Handbook to control erosion and sedimentation. Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.8.3.1 No more than 100 feet of trench shall be open at any one time. Close and backfill pipe trench at the end of each day.

3.8.3.2 During pipe installation activities, the Contractor shall provide seeding and mulch restoration to ensure no more than 10,000 square feet of disturbed area remains unrestored at any given time.

3.8.3.3 Install silt fence on downhill side of pipe trenches and at other locations to prevent sediment from entering drainageways.

3.8.3.4 Apply permanent or temporary soil stabilization to denuded areas within 15 days after final grade is reached on any portion of the site. In addition, apply soil stabilization within 15 days to denuded areas which may not be at final grade but will remain dormant (undisturbed) for longer than 60 days. Soil stabilization practices include vegetative establishment, mulching, and the early application of gravel base on areas to be paved.

3.8.3.5 Install straw bale dam or silt fence around soil stockpiles and excavations.

3.8.3.6 Take all applicable erosion and siltation control measures prior to grading.

3.8.3.7 Protect and maintain storm sewer and culvert inlets with silt traps.

3.8.3.8 Inspect all erosion and sediment control devices at the close of each work day and after each rainstorm. Make necessary repairs or clean up immediately to maintain effectiveness of the device.

3.8.3.9 Where consistent with job safety requirements, easement conditions, and construction methods, place all excavated material on the uphill side of the trench. When the soil is placed on the downhill side of the trench, divert maximum drainage toward the trench.

3.8.3.10 Repair after cleanup: Upon completion of construction work and after spoils and debris have been removed, regrade any areas disturbed by the operations.

3.8.3.11 Water discharged from dewatering activities shall not be discharged directly to any stream or body of water. Comply with Specification 3.26, "Dewatering Structure," of the latest edition of the Virginia Erosion and Sediment Control Handbook.

3.9 Riprap: Riprap shall be installed in accordance with the latest edition of the VDOT Road and Bridge Specifications, Section 414, "Riprap." Geotextile fabric shall be placed under all riprap.

3.10 Geotextile Fabric: Geotextile fabric shall be installed in accordance with the latest edition of the Virginia Erosion and Sediment Control Handbook and the manufacturer's written recommendations.

3.11 Disposition of Surplus Material: Waste unsuitable soil materials off the Owner's property as directed by the Owner and WW Associates in accordance with federal, state, and local regulations.

3.12 Field Quality Control: The Contractor shall employ an independent testing firm to provide all soil testing required for this project.

3.12.1 Sampling: Take the number and size of samples required to perform the following tests.

3.12.2 Testing: Perform one of each of the required tests for each material used. Provide additional tests for each source change and as requested by WW Associates.

3.12.2.1 Fill and Backfill: Test fill and backfill material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 423 for liquid limit and ASTM D 424 for plastic limits; ASTM D 698 for moisture density relations, as applicable.

3.12.2.2 Select Material: Test select material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 698 for moisture density relations, as applicable.

3.12.2.3 Density Tests: Test soil density in accordance with ASTM D 1556, or ASTM D 6938. When ASTM D 6938 density tests are used, verify density test results by performing an ASTM D 1556 density test at a location already ASTM D 6938 tested as specified herein. Perform an ASTM D 1556 density test at the start of the project, and for every 10 ASTM D 6938 density tests thereafter. Test each lift at randomly selected locations every 500 square feet of existing grade in fills for structures and concrete slabs, every 500 square feet for other fill areas, every 1,000 square feet of subgrade in cut, and every 250 linear feet for pipe line installation (minimum one test per pipe line), and additional tests as requested by WW Associates.

End of Section

Section 02660
Water Piping System

1 GENERAL

1.1 Description: This section specifies all water piping work on this project, including the following applications:

1.1.1 Raw water piping

1.1.2 Finished water piping

1.1.3 Backwash discharge piping

1.1.4 Drain/floor drain piping

1.1.5 Raw water pump suction/discharge piping

1.1.6 Inlet, outlet, drain and overflow piping for water tanks

1.2 Related Requirements: The following sections contain requirements that relate to this section.

1.2.1 Section 15051 – Plumbing System

1.3 Reference specifications are referred to by abbreviation as follows:

1.3.1 American Association of State Highway and Transportation Officials ..... AASHTO

1.3.2 American National Standards Institute ..... ANSI

1.3.3 American Society for Testing and Materials ..... ASTM

1.3.4 American Water Works Association ..... AWWA

1.3.5 National Sanitation Foundation ..... NSF

1.3.6 Virginia Department of Health ..... VDH

1.4 All products in contact with drinking water shall meet NSF/ANSI Standard 61, and either NSF/ANSI 61, Annex G or NSF 372 for compliance with new “lead free” content requirements.

1.5 Project Conditions: Separation of Water Lines and Sanitary Sewers.

1.5.1 Follow VDH standards for separation of water mains and sewer lines.

1.5.2 Parallel Installation

1.5.2.1 Normal Conditions: Water lines shall be constructed at least 10 feet horizontally from a gravity sanitary sewer or sewer manhole whenever possible; the distance shall be measured edge-to-edge.

1.5.2.2 Unusual Conditions: When local conditions prevent a horizontal separation of at least 10 feet, the water line may be laid closer to a sewer or sewer manhole provided that:

1.5.2.2.1 The bottom of the water line is at least 18 inches above the top of the sewer.

1.5.2.2.2 Where this vertical separation cannot be obtained, the gravity sanitary sewer shall be constructed of AWWA approved water pipe pressure-tested in place to 50 psi without leakage prior to backfilling. If a sewer manhole is involved, it shall be of watertight construction and tested in place. No water pipe shall pass through or come in contact with any part of a sewer manhole.

1.5.3 Crossing

1.5.3.1 Normal conditions: Water lines crossing over sewers shall be laid to provide a separation of at least 18 inches between the bottom of the water line and the top of the sewer whenever possible.

1.5.3.2 Unusual conditions: When local conditions prevent a vertical separation described in crossing, normal conditions, paragraph above, the following construction shall be used.

1.5.3.2.1 Sewers passing over or under water lines shall be constructed of the materials described above in parallel construction.

1.5.3.2.2 Water lines passing under sewers shall, in addition, be protected by providing:

1.5.3.2.2.1 A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water line,

1.5.3.2.2.2 Adequate structural support for the sewers to prevent excessive deflection of the joints and settling on and breaking water line.

1.5.3.2.2.3 That the length of the water line be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer.

1.5.4 Sanitary Sewers or Sewer Manholes: No water pipes shall pass through or come in contact with any part of a sewer or sewer manhole.

1.6 Submittals: Provide the following shop drawings in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.6.1 Pipe and Fittings: Catalog cuts and certificates of compliance for pipe, fittings, linings, and materials for approval. Certificates shall state that materials furnished comply with the standards specified in this section.

1.6.2 Pipe Restraint Devices

1.6.3 Valves: Catalog cuts and certificates of compliance for valves.

1.6.4 Inline Static Mixers

1.6.5 Pitless Adapter

1.6.6 Piping Insulation and Heating System

1.6.7 Bacteriological Test Reports

1.7 NSF Compliance

1.7.1 All products in contact with finished or potable water shall be certified compliant with NSF 61-G, and shall bear the NSF-61-G certification mark.

2 PRODUCTS

2.1 Piping Application

2.1.1 The following piping systems, 3 inches and larger in diameter, shall be constructed of mechanical joint Special Thickness Class 52 ductile iron pipe unless otherwise indicated. Provide restrained joints at all fittings and pipe joints as specified herein:

2.1.1.1 Below grade piping

2.1.1.2 Below grade piping beneath buildings or structures.

2.1.2 The following piping systems, 3 inches and larger in diameter, shall be constructed of flanged joint Special Thickness Class 53 ductile iron pipe unless otherwise indicated:

2.1.2.1 Above grade exterior piping at finished water tank.

2.1.3 The following piping systems, 2-4 inches in diameter, shall be constructed of solvent welded Schedule 80 polyvinyl chloride (PVC) pipe unless otherwise indicated.

2.1.3.1 Above grade interior piping at Treatment Building and exterior piping at raw water tank

2.1.4 The following piping systems, 1-inch and smaller in diameter, shall be constructed of solvent welded Schedule 80 chlorinated polyvinyl chloride (CPVC) pipe unless otherwise indicated:

2.1.4.1 Domestic water piping inside Treatment Building.

2.1.5 Accessories: Provide flanges, joint restraints, connecting pieces, transition glands, transition sleeves, tapping saddles, and other adapters as required for complete and operable piping systems for the service indicated. Provide restrained joints where indicated on the drawings and as specified in this section.

2.2 Pipe

2.2.1 Ductile Iron Pipe

2.2.1.1 Ductile iron pipe shall be Special Thickness Class 52 unless otherwise indicated and shall meet requirements of ANSI/AWWA C150 and C151.

2.2.1.2 Flanged ductile iron pipe shall be Special Thickness Class 53 unless otherwise indicated and shall meet requirements of ANSI/AWWA C115.

2.2.1.3 Fittings shall meet requirements of ANSI/AWWA C110 and C153 with pressure rating not less than that of the pipe.

2.2.1.4 Provide mechanical joints for underground piping. Jointing materials shall meet requirements of ANSI/AWWA C111.

2.2.1.5 Mechanical joint retainer glands shall be ductile iron and shall be manufactured by EBAA Iron, Inc, or approved equal by American Cast Iron Pipe Company, Ford Meter Box Company, or Romac Industries, Inc.

2.2.1.6 Cement mortar lining with bituminous seal coat for ductile iron pipe and cast iron fittings shall meet requirements of ANSI/AWWA C104. Cement mortar lining shall be standard thickness. Bituminous seal coat shall only be provided on exterior, below grade piping.

2.2.1.7 Exterior, bituminous coating shall meet requirements of ANSI/AWWA C110, C115, C151, and C153, as applicable.

2.2.1.8 Provide flanged joints for all above ground piping and as indicated on the drawings. Flanges shall meet requirements of Class 125 ANSI B16.1.

2.2.1.9 Flanged joint gaskets shall be full face, made of rubber, and shall meet requirements of ANSI/AWWA C111/A21.11.

2.2.1.10 Flanged ductile iron pipe and fittings for interior applications shall be provided with the manufacturer's standard primer and receive the following field-applied coating system.

2.2.1.10.1 Surface Preparation: SSPC SP-7 Brush-Off Blast Cleaning.

2.2.1.10.2 Prime Coat: Not Required.

2.2.1.10.3 Intermediate Coat: Tnemec Series N69 Hi-Build Epoxoline II (polyamidoamine epoxy) at 4.0 to 6.0 mils dry film thickness (DFT), or approved equal by Sherwin-Williams or Carboline Company. Color shall be as approved by the Owner.

2.2.1.10.4 Finish Coat: Tnemec Series N69 Hi-Build Epoxoline II (polyamidoamine epoxy), at 4.0 to 6.0 mils dry film thickness (DFT), or approved equal by Sherwin-Williams or Carboline Company. Color shall be as approved by the Owner.

2.2.1.10.5 Total Thickness of New Coating System: 8.0 to 12.0 mils dry film thickness (DFT).

2.2.1.10.6 Surface preparation and application of coating systems shall be performed in accordance with the manufacturer's written recommendations.

2.2.2 Polyvinyl Chloride (PVC) Piping

2.2.2.1 Pipe, couplings, and fittings shall be Schedule 80 meeting the requirements of ASTM D1785, manufactured of material meeting the requirements of ASTM D1784, Type 1120. Provide ASTM D2467 Schedule 80 fittings and ASTM D2564 solvent cement.

2.2.2.2 Provide screwed joints and flanges as required to connect dissimilar pipe materials, valves, equipment, and appurtenances.

2.2.3 Chlorinated Polyvinyl Chloride (CPVC) Piping

2.2.3.1 Pipe, couplings, and fittings shall be Schedule 80, manufactured from CPVC compound with a cell class of 24448 for pipe and 23447 for fittings per ASTM D 1784 and conform with NSF 61.

2.2.3.2 Pipe and fittings shall conform to ASTM D 2846.

2.2.3.3 Provide ASTM F 493 solvent cement.

2.2.3.4 Provide screwed joints and flanges as required to connect dissimilar pipe materials, valves, equipment, and appurtenances.

2.2.3.4.1 Transition fittings shall have brass male or female connections with integral CPVC socket connections.

2.3 Pipe Labeling

2.3.1 Above grade piping 1-inch in diameter and larger shall be labeled. Provide labeling every 15 linear feet of pipe and spell out the pipe system. Labels shall be either black for light colored piping or white for dark colored piping.

2.3.2 Detectable tape shall be provided for all below grade piping systems and shall have a metallic core protected by a plastic jacket. The tape shall be continuously marked indicating that a water main is buried beneath the tape.

2.4 Valves

2.4.1 Gate Valves

2.4.1.1 Gate Valves: Gate valves smaller than 3 inches shall be constructed of ASTM B 62 Class 350 bronze body, solid wedge bronze disc, rising bronze stem, and union bronze bonnet. Valves shall have threaded end connections. Valves shall be suitable for 350 psig nonshock cold water service at 70 ºF. Gate valves shall be Milwaukee Valve Company, Velan Valve Corporation, or approved equal.

2.4.1.2 Gate valves 3 inches and larger shall meet requirements of AWWA C500 “AWWA Standard for Gate Valves for Water and Sewerage Systems,” or valves 3 inches through 12 inches shall meet requirements of AWWA C509 “AWWA Standard for Resilient Seated Gate Valves for Water and Sewerage Service.” The valves shall be rated for working pressure of 350 psig. Valve ends shall be compatible with piping systems in which valves are installed. Valve shall be cast iron body, bronze

mounted. Valves shall have EPDM o-ring seals and shall open counterclockwise. Asbestos packing will not be acceptable.

2.4.1.2.1 Gate valves for underground service shall have restrained mechanical joint with retainer glands end connections, meeting the requirements of AWWA C111/ANSI A21.11, with non-rising stems (NRS) rated for a working pressure of 350 psig.

2.4.1.2.2 Gate valves for above grade service shall have flanged end connections meeting the requirements of ANSI B16.1, with non-rising stems (NRS).

2.4.1.2.3 Valves listed above shall be manufactured by Kennedy Valve Manufacturing Company, Inc., Clow Valve, or Mueller Company.

2.4.2 Ball Valves

2.4.2.1 Ball valves for service with polyvinyl chloride (PVC) piping shall be constructed of ASTM D 1784 PVC body, ball, carrier, and stem with TFE ball seat and Viton "o" rings and gaskets. Socket welded construction shall be PVC full port, True Union (Double Union/Double Block through 3-inch diameter) design. Flanged construction shall be PVC flanges conforming to 150-pound drilling. Valves shall be suitable for 150-psi nonshock cold water service at 73°F. Valves shall be Nibco/Chemtrol, or approved equal by Hayward.

2.4.3 Check Valves

2.4.3.1 Ball check valves for service with polyvinyl chloride (PVC) piping shall be constructed of ASTM D 1784 PVC body, ball, carrier with Viton ball seal and seal carrier "o" ring. Socket welded end construction shall be PVC True Union Design and shall insure full ball movement. Flanged construction shall be PVC flanges conforming to 150-pound drilling. Valves shall be suitable for 150-psi nonshock cold water service at 73°F. Valves shall be Nibco/Chemtrol, or approved equal by Hayward.

2.4.3.2 Silent Check Valves (Finished Water Tank)

2.4.3.2.1 Check valves 6 inches in diameter shall have ASTM A 536, Grade 65-45-12 ductile iron body, stainless steel seat, plug, and spring. The valve plug must be center guided at both ends with a through integral shaft. The seat and plug shall be hand replaceable in

the field for ease of maintenance. Check valves shall have 250-psi working pressure rating.

2.4.3.2.2 Check valves shall have full flow area equal to or greater than the pipe size, resilient seat, NSF 61 epoxy coating, and flanged end connections.

2.4.3.2.3 Manufacturer shall be Cla-Val Company, or approved equal by DeZurik/APCO, GA Industries, Clow Valve, or Val-Matic

2.4.3.3 Inline Check Valves (Finished Water Tank): Tideflex Series 39 or approved equal by Cla-Val Company

2.4.4 Combination Air Release Valves

2.4.4.1 Air release valves shall be APCO Model 143C combination air valves or approved equal as manufactured by Cla-Val Company or ARI USA, Inc. Valves shall have the following dimensions:

2.4.4.1.1 Inlet Diameter: 1-inch NPT

2.4.4.1.2 Outlet Diameter: 1-inch NPT

2.4.4.1.3 Large Orifice Diameter: 1-inch

2.4.4.1.4 Small Orifice Diameter: 5/64-inch

2.4.4.1.5 Valves shall have ASTM A 536 GR 65-45-12 ductile iron body and cover, and ASTM D 4181 Delrin leverage frame, ASTM A 276 stainless steel plug, Buna-N needle and seat, and ASTM A 240 stainless steel float. Valve shall be rated for the same pressure as the piping on which it is installed.

2.5 Inline Static Mixers

2.5.1 Inline static mixers shall be sized as indicated on the drawings and rated for 150-psi working pressure. Mixer housing shall be constructed of filament wound fiberglass reinforced plastic (FRP) with ANSI B16.5 Class 150 FRP flat face flanged end connections and two (2) ¾-inch NPT ports with injection quills. Mixer housing shall contain a minimum of three Type 316 stainless steel inline flash mixing elements.

2.5.2 Mixers shall be motionless inline type manufactured by Komax Systems, Inc., or approved equal by Koflo Corporation.

2.6 Pitless Adapter

2.6.1 Pitless adapter shall be constructed of Type 304 stainless steel. The adapter shall have a large gasket for more efficient sealing on the casing and shall have a chamfered slide for easy installation.

2.6.2 Pitless adapter shall meet PAS-97 and be certified by the Water Systems Council.

2.6.3 Pitless adapter shall have a working load of at least 6,000 pounds.

2.6.4 Pitless adapter shall fit a 6-inch well casing pipe.

2.6.5 Pitless adapter shall be Merrill Manufacturing Model SPK804 with 3-inch discharge, or approved equal by Baker Manufacturing Company/Monitor.

2.7 Piping Insulation and Heat System

2.7.1 Provide insulation system suitable for outdoor conditions for all exposed above grade piping and as required to prevent freezing. Piping insulation system shall consist of heat tracing, fiberglass insulation, and aluminum jacket.

2.7.2 Heat Tracing

2.7.2.1 Provide 120-volt AC electric heat tracing, thermostats and continuity lights and junction boxes to maintain pipe contents at 40ºF in a 0ºF ambient temperature. Heat trace shall be self-regulating rapid trace, 5 watts/foot type SRL as manufactured by Chromalox.

2.7.2.2 Composition: Tracing shall be composed of two copper conductors sized for the rating indicated, separated by a conductive matrix such that a constant heat output is produced per foot at any temperature in the range specified, degraded by the allowable voltage drop for specified running length. The active (conductive) element shall be covered with a minimum plastic coating 5 mils thick. The plastic coating shall be chemically inert in the temperature range of operation and installation ambient temperature, and shall not attack or be attacked by any metal or plastic piping nor any normal surface finish or piping, nor any normal insulating material installed over the tracing. The tracing shall not be affected by direct sunlight, ambient temperature, operating temperature, rain, or salt laden atmosphere. Heat trace shall be capable of being overlapped without burnout.

2.7.2.3 Thermostats/controls shall be Chromalox Model RT, DL Series, single point on-off temperature controller with NEMA 4X enclosure constructed of high strength polymer. Control

thermostat shall include corrosion resistant wiring, control enclosure terminal block ¾-inch conduit opening, and MP-1 mounting plate. Switch rating shall conform to the requirements specified on the drawings. Provide all required connection, end seal kits, and accessories as required for complete, operable installation. Mount unit in a position that prevents condensation from draining into the enclosure from the connecting conduit.

2.7.2.4 Fiberglass Insulation: ASTM C 547 fibrous glass insulation, minimum density 3 pounds per cubic foot, provided with a factory applied vapor barrier jacket. Minimum thickness 1-inch.

2.7.2.5 Aluminum Jacket: Corrugated type, not less than 0.016-inch thick. Jackets shall be secured with stainless steel or aluminum bands not less than ⅜-inch wide with stainless steel or aluminum screws at 8 inches on center. Seams shall be lapped not less than 2 inches. Provide neat finish at valves, fittings, hangers and appurtenances.

2.8 Wall and Floor Penetrations

2.8.1 Sleeves through concrete or masonry walls or slabs shall be either cast iron or galvanized, schedule 40 steel, unless otherwise noted.

2.8.2 Pipe to sleeve sealant shall be grouting compound. Grouting Compound shall be as manufactured by 3M Company or be an equivalent product having tensile strength of 80 psi and elongation property of 700% in accordance with ASTM D 3574 Test E, and linear dimension change shall not exceed 18% when subject to wet and dry cycles in accordance with ASTM D 756, Procedure G and ASTM D 1042.

2.8.3 Mechanical Type Pipe to Wall Sleeve Seals: Mechanical type pipe to wall sleeve seals shall be “Link-Seal” pipe to wall closures manufactured by GPT Industries or approved equal. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to fill annular space between pipe and wall opening and shall provide watertight seal between pipe and wall opening.

2.9 Restrained Flange Adaptors: Restrained flange adapters for joining plain-end ductile iron pipe or HDPE pipe to flanged items shall be Series 2100 MEGAFLANGE adapter as manufactured by EBAA Iron, Inc. or approved equal.

3 EXECUTION

3.1 Inspection and Preparation: Prior to all piping work, carefully inspect the installed work or excavation by other trades and verify that all such work is complete to the point where the piping may installed in accordance with these documents. Follow the drawings in laying out work and check drawings of other

trades to verify sufficient space to install piping. Undimensioned drawings are intended to indicate the general arrangement of piping systems and are not intended to convey precise locational information. Coordinate with other trades to permit all phases of the work to be installed. Offsets, fittings, and extra pipe, necessary to avoid interference or provide maximum headroom and space shall be furnished and installed without additional expense to the Owner. If the piping is installed without coordinating with other phases of the work and so as to cause interference, the necessary changes shall be made at no additional cost to the Owner.

3.2 Pipe Laying/Fitting

3.2.1 Take all precautions necessary to insure that pipe, valves, fittings, and other accessories are not damaged in unloading, handling, and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.

3.2.2 Bedding of pipe shall be as specified in Section 02200 – Earthwork.

3.2.3 Do not lay pipe when trench bottom is muddy or frozen, or has standing water.

3.1.2 Exercise care to keep foreign material and dirt from entering pipe during storage, handling, and installation. Close ends of in-place pipe at the end of any work period to preclude the entry of animals and foreign material.

3.1.3 Use only those tools specifically intended for cutting the size and material and type pipe involved. Make cut to prevent damage to pipe or lining and to leave a smooth end at right angles to the axis of the pipe.

3.2 Lay water main piping with bell ends facing the direction of laying. Where grade is 10 percent or greater, pipe shall be laid uphill with bell ends upgrade. Lay water main piping with a minimum cover of 36 inches unless otherwise indicated.

3.3 Join mechanical joint pipe as follows:

3.3.1 Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter from the joint. Paint the bell and the spigot with soap solution. Slip cast-iron gland on spigot end with lip extension of gland toward end of pipe. Paint rubber gasket with or dip into soap solution and place on spigot end with thick edge toward gland.

3.3.2 Push the spigot end forward to seat in the bell. Then carefully press the gasket into the bell so that it is located evenly around the joint. Move the

gland into position, insert bolts, and screw nuts up finger tight. Then tighten all nuts to torque listed below.

Bolts Size – Inches	Torque Feet – Pounds
⅝	40-60
¾	60-90
1	70-100
1¼	90-120

3.3.3 Tighten nuts on alternate sides of the gland until pressure on the gland is equally distributed.

3.3.4 Permissible deflection of mechanical joint pipe shall not be greater than listed in AWWA C600.

3.4 Join and assemble solvent welded PVC and CPVC pipe joints in accordance with requirements of ASTM D 2855.

3.5 Use sleeves where pipes, valves, stem extensions, or equipment parts pass through concrete or masonry walls or slabs. Sleeves shall be or sufficient size to allow sealing around pipes and clearance for valve stem or equipment. Extend vertical sleeves through slabs 1-inch above top surface. Sleeves are not required where an existing concrete structure is core drilled and drill hole is smooth enough to provide a reliable watertight seal.

3.5.1 Use cast iron or steel sleeves with intermediate collars to anchor and provide water stops on sleeves that pass through exterior walls below grade. Seal around pipes using grouting compound or "Link-Seal" pipe to wall closures manufactured by GPT Industries. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to fill annular space between pipe and wall opening and shall provide watertight seal between pipe and wall opening. Grouting compound shall be mixed and placed in accordance with the recommendations of the manufacturer. Mechanical pipe to wall seal shall be installed in accordance with the written recommendations of the manufacturer.

3.6 Acceptance Tests

3.6.1 After the piping has been installed, subject the line or any valved section of the line to a hydrostatic pressure test. Fill the system with water at velocity of approximately 1 foot per second while necessary measures are taken to eliminate all air. After the system has been filled, raise the pressure by pump to 150 psig. Measure pressure at the low point on the system compensating for gage elevation. Maintain this pressure for 2 hours. If pressure cannot be maintained, determine cause, repair, and repeat the test until successful.

3.6.2 A leakage test shall be conducted concurrently with the pressure test. Leakage shall be determined with a calibrated test meter furnished by the contractor. Leakage will be defined as the quantity of water required to maintain a pressure within 5 psi of the specified test pressure, after air has been expelled, and the pipe filled with water. Leakage shall not exceed that quantity obtained by the formula below. If leakage exceeds that determined by the formula, find and repair the leaks and repeat the test until successful. The leakage formula shall be as follows:

$$L = SD(\sqrt{P})/148{,}000$$

Where L = testing allowance (makeup water), in gph
S = length of pipeline tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during leakage test, in psig

3.6.3 All visible leaks shall be repaired regardless of the amount of leakage.

3.7 Disinfect and test water mains and accessories in accordance with AWWA C651 standards and as specified herein.

3.7.1 Preliminary Flushing: The main shall be flushed prior to disinfection, except when the tablet method is used. Flushing shall be at a velocity of not less than 3 feet per second. Adequate provisions shall be made for drainage of flushing water.

3.7.2 Form of Chlorine for Disinfection

3.7.2.1 Liquid chlorine shall be used only when suitable equipment is available and only under the direct supervision of a person familiar with the physiological, chemical, and physical properties of this element and who is properly trained and equipped to handle any emergency that may arise. Introduction of chlorine-gas directly from the supply cylinder is unsafe and shall not be permitted.

3.7.2.2 Calcium hypochlorite contains 70% available chlorine by weight. It shall be either granular or tabular in form. The tablets, six to eight to the ounce, are designed to dissolve slowly in water. A chlorine-water solution shall be prepared by dissolving the granules or tablets in water in the proportion requisite for the desired concentration.

3.7.2.3 Sodium hypochlorite is supplied in strengths from 5.25% to 16% available chlorine. The chlorine-water solution shall be prepared by adding hypochlorite to water.

3.7.2.4 Application: The hypochlorite solutions shall be applied to the water main with a gasoline or electrically powered chemical feed pump designed for feeding chlorine solutions. For small applications, the solutions may be fed with a hand pump; for example, a hydraulic test pump. Feed lines shall be of such material and strength as to withstand safely the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the hypochlorite solution is applied to the main.

3.7.3 Methods of Chlorine Application

3.7.3.1 Continuous Feed Method: Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant, measured rate into the newly laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of 50 mg/L available chlorine. To assure that this concentration is maintained, the chlorine shall be measured at intervals not exceeding 1,200 feet in accordance with the procedures described in the current edition of "Standard Methods" and AWWA M12 – "Simplified Procedures for Water Examination." In the absence of a meter, the rate may be determined either by placing a pitot gage at the discharge or by measuring the time to fill a container of known volume.

During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24-hour period, the treated water shall contain no less than 25 mg/L chlorine throughout the length of the main.

3.7.3.2 Tablet Method: Use only when allowed by the Engineer. Do not use this method if trench water or foreign material has entered the main or if the water is below 41°F (5°C). This method may be used for mains up to 12 inches in diameter, and where the total length of the main is less than 2,500 feet.

Place tablets in each section of pipe and also in hydrants, hydrant branches, and other appurtenances. Enough tablets shall be used

to ensure that a chlorine concentration of 25 mg/L is provided in the water. Attach tablets using Permatex No. 1 adhesive or other approved adhesive, except for the tablets placed in hydrants and in the joints between the pipe sections. Tablets shall be free of adhesive except on the one broad side to be attached. Place all tablets at the top of the main. If the tablets are attached before the pipe section is placed in the trench, mark the position of the tablet in the pipe and assure that the pipe is placed with the tablet at the top.

When installation is completed, fill the main with water at a velocity of less than 1 foot per second. The water shall remain in the pipe for at least 24 hours. Operate valves so that the strong chlorine solution will not flow back into the line supplying the water.

3.7.4 Final Flushing: After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 mg/L. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipeline. Contractor shall provide dechlorination of all flushed water prior to discharge.

3.7.5 Bacteriologic Tests

3.7.5.1 After final flushing and before the water main is placed in service, samples shall be collected and tested for bacteriologic quality and shall show the absence of coliform organisms. Samples shall be collected at intervals not exceeding 1,200 feet, and tested by the Owner. In addition, provide one set at the end of the piping and at least one from each branch greater than one pipe length.

3.7.5.2 Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate. If laboratory results indicate the presence of coliform bacteria, the samples are unsatisfactory, and disinfection shall be repeated until the samples are satisfactory.

3.7.5.3 A sampling tap consisting of a corporation cock with metal pipe shall be installed within 2 feet of valves. The corporation stop inlet shall be male, 1-inch in size, and the outlet shall have 1-inch I.P. threads and a cap.

3.7.6 The Contractor has two options for bacteriological testing for total coliform analysis.

3.7.6.1 Option A: Before approving a main for release, take an initial set of samples and then resample again after a minimum of 16 hours using the sampling site procedures outlined. Both set of samples must pass for the main to be approved for releases.

3.7.6.2 Option B: Before approving a main for release, let it sit for a minimum of 16 hour without any water use. Then collect, using the sampling site procedures and without flushing the main, two sets of samples a minimum of 15 minutes apart while the sampling taps are left running. Both sets of samples must pass for the main to be approved for release.

3.7.7 Special Case Disinfection

3.7.7.1 If it is not possible to disinfect certain piping, valves, and fittings as described in the above sections while maintaining plant operation and water production, proceed as follows, pending approval of the Owner and Engineer:

3.7.7.1.1 During installation, observe every precaution to prevent foreign material and trench water from entering the piping, fittings, and valves.

3.7.7.1.2 Disinfection: Swab the interior and exterior of piping, fittings, and valves with a 5 percent hypochlorite solution. Obtain 5 percent hypochlorite solution by mixing approximately 3 pounds of granulated calcium hypochlorite with 5 gallons of water.

3.7.7.1.3 Flushing: After pipe, fittings, and valves have been swabbed, thoroughly flush with potable water. Contractor shall provide dechlorination of all flushing water prior to discharge.

3.7.7.1.4 During installation, use extreme care to ensure foreign material is kept out of the pipe and clean hands and equipment prior to touching the disinfected piping.

3.7.8 Upon completion of the disinfection procedures above, the Contractor shall dechlorinate the water prior to discharge into the receiving channel. All equipment, supplies, and labor required to dechlorinate the water shall be provided by the Contractor.

3.7.9 Cleaning, disinfection, and testing will be the responsibility of the Contractor. The Contractor shall furnish the water required for these operations at his own cost and expense. No separate payment, other than that included in the contract lump sum, will be allowed.

3.7.10 Testing and disinfection of the completed sections shall not relieve the Contractor of his responsibility to repair or replace any cracked or defective pipe. All work necessary to secure a tight line shall be done at the Contractor's expense.

End of Section

Section 02720
Drainage Systems

1 GENERAL

1.1 System Description: Work in this section includes drainage piping system work on this project, including foundation drains, yard drains, and roof drain leaders.

1.2 Reference specifications are referred to by abbreviation as follows:

1.2.1 American Association of State Highway and Transportation Officials ..... AASHTO

1.2.2 American National Standards Institute ..... ANSI

1.2.3 American Society for Testing and Materials ..... ASTM

1.2.4 Virginia Department of Transportation ..... VDOT

1.2.5 United States Bureau of Reclamation ..... USBR

1.3 Submittals: Provide the following in timely manner.

1.4 Shop Drawings of the following:

1.4.1 Pipe

1.4.2 Drainage Structures

2 PRODUCTS

2.1 Piping Application

2.1.1 Roof Drain Leader

2.1.1.1 Roof drain leader piping, 4-6 inches in diameter, shall be constructed of solvent welded Schedule 40 polyvinyl chloride (PVC) pipe and fittings.

2.1.2 Yard Drains

2.1.2.1 Yard drain piping, 4-6 inches in diameter, shall be constructed of solvent welded Schedule 40 polyvinyl chloride (PVC) pipe and fittings.

2.1.2.2 Yard drain piping, 8 inches and larger in diameter, shall be constructed of SDR-35 PVC push-on joint pipe, unless otherwise noted

2.1.3 Accessories: Provide flanges, connecting pieces, transition glands, transition sleeves, and other adapters as required for complete and operable piping systems for the service indicated.

2.2 Pipe

2.2.1 Schedule 40 Polyvinyl Chloride (PVC) Piping

2.2.1.1 Pipe: PVC Compound Cell Classification 12454-B polyvinyl chloride meeting ASTM D1784. Pipe shall be Schedule 40 for gravity applications meeting ASTM D1785. Joints shall be solvent welded, meeting requirements of ASTM D 2855.

2.2.1.2 Fittings

2.2.1.2.1 Socket: Schedule 40 solvent-welded meeting ASTM D 2466.

2.2.2 SDR 35 Polyvinyl Chloride (PVC) Piping

2.2.2.1 Pipe: Polyvinyl chloride (PVC) plastic gravity sewer piping shall meet requirements of ASTM D 3034 and be integral bell, gasketed joint pipe with dimension ratio (DR) of 35 and minimum pipe stiffness (PS) of 46 psi. Pipe joint shall meet requirement of ASTM D 3212. Rubber gaskets shall meet physical requirements specified in ASTM F 477 in all respects.

2.3 Drop inlets and other storm drainage items shall be in accordance with the latest edition of the VDOT Road and Bridge Standards.

2.4 Casting for VDOT-type inlets shall have the word “STORM” instead of “VDOT.”

2.5 Pipe to precast concrete storm drainage structure connections shall be installed in accordance with the latest edition of the VDOT Road and Bridge Specifications.

2.6 Grout shall be non-shrink type and conform to the latest edition of the VDOT Road and Bridge Specifications, Section 218 “Hydraulic Cement Mortar and Grout” and be listed on the VDOT approved product list.

2.7 Yard Drain Structures

2.7.1 Yard drain structures shall include the drain basin type as indicated on the contract drawings and referenced within the contract specifications. The ductile iron grates for each of these fittings are to be considered an integral part of the surface drainage inlet and shall be furnished by the same manufacturer. The surface drainage inlets shall be as manufactured by Nyloplast a division of Advanced Drainage Systems, Inc., or approved equal.

2.7.2 Materials

2.7.2.1 The drain basins required for this contract shall be manufactured from PVC pipe stock, utilizing a thermoforming process to reform the pipe stock to the specified configuration.

2.7.2.2 The sumps shall be filled with concrete or other approved material to prevent standing water within the structure.

2.7.2.3 The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. This joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The flexible elastomeric seals shall conform to ASTM F477. The pipe bell spigot shall be joined to the main body of the drain basin or catch basin.

2.7.2.4 The raw material used to manufacture the pipe stock that is used to manufacture the main body and pipe stubs of the surface drainage inlets shall conform to ASTM D1784 Cell Class 12454.

2.7.2.5 The grates and frames furnished for all surface drainage inlets shall be ductile iron and shall be made specifically for each basin so as to provide a round bottom flange that closely matches the diameter of the surface drainage inlet. Grates for drain basins shall be capable of supporting various wheel loads as specified by Nyloplast. Ductile iron used in the manufacture of the castings shall conform to ASTM A536, Grade 70-50-05. Grates and covers shall be provided painted black.

2.8 Flexible couplings for connecting pipes of dissimilar materials shall be as manufactured by Fernco of Davison, Michigan.

2.9 Downspout connectors shall be Universal Downspout Connectors as manufactured by Fernco of Davison, Michigan. Connectors shall be cut to provide a tight fit around downspout and roof drain leader piping.

2.10 Detectable Marking Tape and Tracing Wire

2.10.1 Plastic marking tape consisting of one layer of aluminum foil laminated between two layers of inert plastic film. Tape shall be resistant to alkalis, acids and other destructive agents commonly found in the soil. The laminate shall be strong enough that the layers cannot be separated by hand.

2.10.2 Tape shall be a minimum of 4½-mils thick with a minimum tensile strength of 60 pounds in the machine direction and 58 pounds in the transverse direction per 3-inch wide strip. Tape color shall be APWA Color Coded for marking the particular utility line and shall be imprinted with a continuous

warning message to indicate the type of utility being marked, the message normally being repeated every 16 to 36 inches. Tape shall be inductively locatable and conductively traceable using a standard pipe and cable locating device. Tape shall be 3-inch wide Terra Tape "Sentry Line Detectable 620," or approved equal.

2.10.3 In addition to the marking tape, a tracing wire of 12 gauge copper shall be installed and taped directly on the pipe in a manner that a continuous trace results.

3 EXECUTION

3.1 Maintain drainage on site to prevent erosion, damaging water, and standing water during all phases of construction.

3.2 Keep excavations clear of water while work is being installed. Control subsurface water in accordance with Section 02200 – Earthwork.

3.3 Take all precautions necessary to insure that pipe, fittings, and related items are not damaged in unloading, handling, and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.

3.4 Do not lay pipe or concrete when trench conditions or weather are unsuitable for such work. Keep pipe interior clean and free from dirt or waste materials.

3.5 Lay pipe so as to maintain a true alignment and grade as indicated on drawings. After completion, the pipe shall exhibit a full circle of light when lighted at one manhole and viewed from the next.

3.5.1 Commence laying piping at the lowest point on a section of line and lay pipe upgrade with bell or groove ends upstream.

3.5.2 Pipe Joint: Preparatory to making pipe joints, clean and dry all surfaces of joint pipe and jointing material. Use lubricants, primers, adhesives, and similar materials as recommended by the manufacturers. Place, fit, join, and adjust the jointing materials or factory fabricated joints as recommended by manufacturer to obtain the degree of water tightness required. As soon as possible after the joint is made, place sufficient backfill material, as specified in Section 02200 – Earthwork, along each side of pipe to resist forces that might tend to move pipe off line and grade.

3.5.3 Backfill as specified in Section 02200 – Earthwork. Place backfill over the pipe immediately after the pipe has been laid.

3.6 Join solvent welded polyvinyl chloride (PVC) pipe in accordance with the manufacturer's written recommendations.

3.7 As each joint is laid, visually inspect to be certain that no jointing compound, gasket, or trash is protruding from the joint or lying inside the pipe.

3.8 Construct drop inlet or manhole channel with smooth semicircular bottoms matching inside diameters of the connecting sewers. Change directions of flow with smooth curve of as large a radius as the inlet or manhole size will permit. Change size and grade of channels gradually and evenly. Channels may be formed directly in the concrete bottom, made of channel pipe, laid in concrete, or constructed by laying full section sewer pipe through the manhole and breaking out the top half when the surrounding concrete has hardened. Manhole floors outside the channels shall be smooth and shall have slope between 1 and 2 inches per foot toward the channels.

3.9 Construct inlets, endwalls, and other storm drainage items as detailed in the latest edition of the VDOT Road and Bridge Standards or on the drawings, as applicable.

3.10 Concrete placement limitations shall be in accordance with Section 217.10 of the latest edition of the VDOT Road and Bridge Specifications.

3.11 Downspout Connectors

3.11.1 Install new downspout connectors on each gutter downspout connection to a roof drain leader. Connector shall provide a tight seal around downspout and roof drain leader piping to prevent debris from entering the drainage piping system.

3.12 Yard Drainage Structures

3.12.1 Yard drainage structures shall be installed in accordance with the manufacturers written instructions. Bedding and backfill for surface drainage inlets shall be well placed and compacted uniformly in accordance with Section 02200 – Earthwork. The drain basin body will be cut at the time of the final grade is achieved. No brick, stone or concrete block will be allowed to set the grate to the final grade height. For load rated installations, a concrete slab shall be poured under and around the grate and frame. The concrete slab must be designed taking into consideration local soil conditions, traffic loading, and other applicable design factors.

End of Section

Section 02735
Pipe Supports and Anchors

1 GENERAL

1.1 Reference specifications are referred to by abbreviation as follows:

1.1.1 American National Standards Institute..... ANSI

1.1.2 American Society for Testing and Materials..... ASTM

1.1.3 Manufacturers Standardization Society of the Valve and Fittings Industry.....MSS

1.2 Piping systems shall be supported in accordance with ANSI B31.1 “Power Piping” so as to maintain required pitch of lines, prevent vibration, and provide for expansion and contraction movement. Provide hangers in accordance with MSS SP-58 and MSS SP-69.

1.3 Acceptable Manufacturer: Anvil, Elcen Metal Products, F&S Central, or Michigan Hanger Company. Anvil figure numbers establish the quality standard.

2 PRODUCTS

2.1 Hangers and Rigid Supports

2.1.1 Adjustable swivel split ring hanger shall be fabricated of black malleable iron and be approved by Factory Mutual and be UL listed. Hanger shall be Anvil Figure 104.

2.1.2 Adjustable clevis type hanger shall be black carbon steel and be approved by Factory Mutual and be UL listed. Hanger shall be Anvil Figure 260.

2.1.3 Pipe roll hangers shall consist of a cast iron roll and steel roll rod. Hanger shall be Anvil Figure 171.

2.1.4 Brackets shall be heavy welded carbon steel, of dimensions required to adequately support piping. Brackets shall be hot dipped galvanized after fabrication in accordance with ASTM A 123. Brackets shall be Anvil Figure 199.

2.1.5 U-bolts shall be standard weight, hot dipped galvanized carbon steel, furnished with four finished hex nuts. U-bolts shall be Anvil Figure 137.

2.1.6 Short strap shall be carbon steel, Anvil Figure 262. One-hole clamp shall be black finished malleable iron, Anvil Figure 126.

2.1.7 Adjustable pipe saddle support shall be cast iron saddle, locknut nipple, and cast iron reducer, factory assembled. Stantion type support shall allow

vertical adjustment by turning locknut nipple. Adjustable pipe saddle support shall be Anvil Figure 264. Adjustable pipe saddle support shall include pipe stand with base flange of suitable size to carry load. Provide expansion anchors for connecting base flange to finished floor, minimum four anchors required.

2.2 Hanger rods shall be ASTM A 575 or A 576 hot rolled carbon steel and meet mechanical property requirements of ASTM A 663.

2.3 Beam clamps shall be fabricated specifically for the structure to which the hanger rod is attached.

3 EXECUTION

3.1 Install rigid pipe hangers as follows:

3.1.1 Uninsulated pipe 2 inches and smaller – Anvil Figure 104

3.1.2 All piping 2½ inches and larger – Anvil Figure 260

3.2 Where necessary due to space limitations, provide pipe roll hanger equal to Anvil Figure 171 for piping 2½ inches and larger.

3.3 Space supports or hangers for horizontal piping as follows unless otherwise indicated on the drawings. Provide additional supports for concentrated loads at valves or specialties.

Nominal Pipe Size, Inches	Maximum Span in Feet Steel or Iron Pipe	Plastic Pipe
½-inch	4	2
¾-inch through 1½-inch	6	3
2-inch and 2½-inch	10	4
3-inch	12	5
4-inch and 5-inch	14	6
6-inch	16	6
8-inch and 10-inch	18	7
12-inch and 14-inch	22	8
16-inch and 18-inch	27	-
20-inch	30	-
24-inch	32	-

3.3.1 Provide pipe hanger or support within 18 inches or every change in direction for piping 1½ inches and below and within 3 feet of every change in

direction for piping 2 inches and larger. Horizontal "No-Hub" piping shall be supported at each joint.

3.3.2 Vertical Piping: Support metal piping at each floor, but at not more than 10-foot intervals. Support plastic at each floor and at midpoint between floors, but not at more than 5-foot intervals.

3.4 Support hangers for pipe by using malleable iron or galvanized steel concrete inserts, concrete anchor bolts, beam clamps with lock nuts or retaining straps, or other special fastening devices, as required, for the support of hangers. As an option where direct attachment to frame members is not possible, auxiliary frame members may be provided which shall span at least two structural frame members.

3.4.1 Where pipe cannot be suspended from overhead supports, use substantial cast iron or welded steel wall brackets to support the hangers, pipe seats, or roll stands, as conditions demand.

3.5 Use hot rolled steel hanger rods sized as follows:

3.5.1 For 2-inch pipe and smaller – ⅜-inch diameter

3.5.2 For 2½-inch through 3½-inch pipe – ½-inch diameter

3.5.3 For 4-inch and 5-inch pipe – ⅝-inch diameter

3.5.4 For 6-inch pipe – ¾-inch diameter

3.5.5 For 8-inch and larger – ⅞-inch diameter

End of Section

Section 02936
Seeding

1 GENERAL

1.1 Related Requirements: The following sections contain requirements that relate to this section.

1.1.1 Section 01400 – General Requirements

1.1.2 Section 02200 – Earthwork

1.2 Submittals: Provide the following items in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements:

1.2.1 Seed Test Report

1.2.2 Fertilizer Analysis

1.3 Reference specifications are referred to by abbreviation as follows:

1.3.1 American Society of Testing and Materials ..... ASTM

1.3.2 Virginia Department of Transportation ..... VDOT

2 PRODUCTS

2.1 Topsoil: Topsoil shall be the top 6 inches of original soil from the site. Topsoil obtained off-site shall be fertile, friable loam, containing not less than 2% by weight of finely divided, decomposed vegetation. Topsoil shall be free of subsoil, clay lumps, brush, weeds, roots larger than 1½-inch in diameter, stones larger than 1½-inch in diameter, and other material toxic or harmful to growth.

2.2 Fertilizer: Fertilizer shall meet requirements of Federal Specification O-F-241. Provide fertilizer that is complete, inorganic, uniform in composition, and suitable for application with approved equipment. Proportions of fertilizer nutrients shall be the following:

2.2.1 Permanent Seeding

2.2.1.1 5% total nitrogen

2.2.1.2 10% available phosphoric acid

2.2.1.3 5% soluble potash

2.2.2 Temporary Seeding

2.2.2.1 10% total nitrogen

2.2.2.2 20% available phosphoric acid

2.2.2.3 10% soluble potash

2.3 Grass Seed: Grass seed, tested within 6 months of sowing, shall have the following characteristics:

2.3.1 Permanent Seeding (for Residential Lawn Areas)

Species	%Weight	%Purity	%Germination
Kentucky 31 tall fescue	85	98	90
Perennial ryegrass	15	98	90

2.3.2 Temporary Seeding

Seeding Date	Species	%Wgt.	%Purity	%Germ.	Seed Rate (lb/acre)
Feb.15-Apr.30	Oats	100	98	85	100
May 1-Aug.15	Millet	100	98	80	50
Aug. 16-Nov. 15	Rye	100	96	85	140

2.4 Lime: Lime shall be ground agriculture grade limestone containing not less than 85% calcium and magnesium carbonates. Fineness shall be such that 100% will pass a No. 20 sieve, and not less than 50% will pass a No. 100 sieve. Burnt lime or hydrated lime may be substituted in equivalent carbonates, if requested.

2.5 Mulch: Type II mulch composed of threshed straw of cereal grain, pine needles or wood fiber which shall be free of objectionable weed seeds or other harmful material.

2.6 Asphalt Adhesive: Asphalt adhesive for use with Type II mulch shall be emulsified asphalt meeting requirements of ASTM D 977, Grade SS-1.

2.7 Mulch Binder: Synthetic mulch binder for use with Type II mulch shall be Curasol, DCA-70 Petroset, or Terra Tack.

2.8 Jute Mesh (VDOT EC-2 Soil Stabilization Blanket): Jute mesh shall be as defined in the VDOT Road and Bridge Specifications, Section 244, “Roadside Development Materials.” Installation locations shall be as specified herein.

2.9 VDOT EC-3 Soil Stabilization Matting: C 125 Erosion Control Blanket manufactured by North American Green, 14649 Highway 41 North, Evansville, Indiana 47711, Telephone: (800) 772-2040, or Curlex III High Velocity Blanket manufactured by American Excelsior Company, 850 Avenue H East, Arlington, Texas, 76011, Telephone: (800) 777-7645. Installation locations shall be as specified herein.

3 EXECUTION

3.1 General

3.1.1 Before seeding, 4 inches of topsoil shall be spread in areas to be seeded. In general, the topsoil shall come from the stockpiles created during the initial clearing of the site. If there is insufficient topsoil in the stockpiles, the Contractor shall provide topsoil from an offsite source at no additional cost to the Owner.

3.1.2 Material shall be delivered in unbroken containers, clearly marked by the manufacturer as to their contents. Seed, limestone, and fertilizer shall be labeled as to proportions, analysis, and quality. Store all materials in a manner affording protection from damage by weather or vandalism.

3.1.3 Seed only when the wind velocity is less than 15 miles per hour.

3.1.4 All areas disturbed by excavation, grading, or other construction operations, except areas to be paved or otherwise permanently stabilized, shall be seeded as specified for permanent seeding. Temporary seeding shall be provided when required at no additional cost to the Owner.

3.1.5 Remove all soiling or staining off finished structures or pavements resulting from seeding work. Maintain paved areas in clean condition.

3.2 Temporary Seeding

3.2.1 Use in areas when final grading has not been completed, when permanent seeding cannot be performed due to the specified permanent seeding dates, or when required for erosion control.

3.2.2 Apply fertilizer at a rate of 15 pounds per 1,000 square feet (600 pounds per acre) or equivalent. Apply lime at a rate of 50 pounds per 1,000 square feet.

3.2.3 For loose soil, work lime and fertilizer into soil and then seed. For packed or hard soil, loosen top layer while working lime and fertilizer into soil and then seed at the rate specified for the temporary seeding species.

3.2.4 Seed only between February 15 and November 15. Use mulch between November 16 and February 14.

3.3 Permanent Seeding

3.3.1 For all areas to receive permanent seeding, apply fertilizer at the rate of 50 pounds per 1,000 square feet and apply lime at the rate of 100 pounds. per 1,000 square feet.

3.3.2 Apply fertilizer and lime uniformly and mix well into the top 4 inches of the seedbed.

3.3.3 Prepare soil for permanent seeding by tillage of topsoil in place to loosen thoroughly and break up all clods to a depth of 6 inches. Remove all stumps and roots, coarse vegetation, stones larger than 1½ inches, and all construction debris. Soil shall be worked by suitable agricultural equipment to a depth of not less than 4 inches. Surface shall be uniform, smooth, and drainable. A firm and compact seedbed is required.

3.3.4 Sow permanent grass seed between dates of March 1 and April 15 or September 1 and November 15.

3.3.5 Sow seed by mechanical seeder as follows:

3.3.5.1 Mix seed thoroughly with clean dry sawdust and broadcast at rate of 6 pounds of seed per 1,000 square feet for permanent seeding or as specified elsewhere for temporary seeding.

3.3.5.2 Apply Type II mulch uniformly to depth of approximately 1¼ inches.

3.3.5.3 Anchor Type II mulch by the following methods:

3.3.5.3.1 Apply light tack coat of asphalt emulsion or synthetic mulch binder.

3.3.5.3.2 On slopes steeper than 4(H):1(V), anchor with VDOT EC-2 jute mesh fastened to wooden stakes.

3.3.5.3.3 On slopes steeper than 2(H):1(V), anchor with VDOT EC-3 soil stabilization matting fastened in accordance with the manufacturer's written recommendations.

3.3.6 Sow seed by hydraulic seeder as follows:

3.3.6.1 Prepare homogeneous slurry equal to the seed mixture used for mechanical seeding as specified in this section.

3.3.6.2 Distribute slurry uniformly at rate equal to the rate specified for mechanical seeding.

3.3.6.3 Apply mulch, jute mesh, and soil stabilization blankets as specified for sowing by mechanical seeder.

3.4 Maintenance of Seeded Areas

3.4.1 The Contractor is advised that final payment for the project will not be received until a uniform stand of grass acceptable to the Engineer has been established.

3.4.2 Reseed and mulch spots larger than one square foot without uniform stand of grass. In areas where jute mesh or soil stabilization blankets have been applied, the mesh or blanket shall be removed prior to reseeding, and reapplied after reseeding activities are complete. Reseeding shall include application of fertilizer, lime, and seed in accordance with the agronomic loading rates specified herein. Reseeding shall be performed multiple times during the course of a planting season and over the course of multiple planting seasons until a uniform stand of grass is established.

3.4.3 Maintain all seeded areas until uniform stand of grass is acceptable to the Engineer.

3.4.4 In the event that growth is not established by the final project inspection, continue the specified attention until the stand is accepted by the Engineer.

3.4.5 Correct or repair all undue settling for a period of one year after final inspection.

3.4.6 Water as necessary.

3.4.7 Mowing: Maintain grass height between 2 and 4 inches.

End of Section

Section 03300
Cast-in-Place Concrete

1 GENERAL

1.1 Reference publications are referred to by abbreviations as follows:

1.1.1 American Concrete Institute.....ACI

1.1.2 American Society for Testing and Materials..... ASTM

1.1.3 Concrete Reinforcing Steel Institute .....CRSI

1.1.4 National Institute of Standards and Technology .....NIST

1.2 Quality Assurance

1.2.1 Provide the services of an independent inspection agency to perform inspection as specified in this section. The inspection agency shall be approved by WW Associates, Inc.

1.2.2 The independent testing agency, including branch office used, referred to in this Section and Section 1 of ACI 301 shall meet the requirements of ASTM E 329 and shall have been inspected within the past 3 years by the cement and concrete reference laboratory of the NIST and shall have corrected any deficiencies noted. Project sponsor as defined in ASTM E 329 shall be the Contractor.

1.3 Submittals: Provide the following in a timely manner.

1.3.1 Shop drawings of reinforcing steel in accordance with ACI 301. All construction joints shall be indicated on the shop drawings.

1.3.2 Complete concrete mix designs and documentation in accordance with ACI 301 Section 4.2.3 indicating compliance with one of the paths allowed in the flow chart. Include the following documentation:

1.3.2.1 Specific mix designs proposed.

1.3.2.2 Quantity and types of admixtures.

1.3.2.3 Strength test results used to establish standard deviation, and calculated standard deviation in accordance with ACI 301, Paragraph 4.2.3.2, if that procedure is followed.

1.3.2.4 Calculated required average compressive strength.

1.3.2.5 Strength test records used to verify that required average compressive strength is met in accordance with ACI 301, Paragraph 4.2.3.3, if that procedure is followed.

1.3.2.6 Trial mixtures, strength test thereof, water-cement ratio curve, and selected water-cement ratio to meet the required average compressive strength in accordance with ACI 301, Paragraph 4.2.3.4.b, if that procedure is followed.

1.3.3 List of materials and work requiring inspection; inspections to be performed; and a list of the individuals, approved agencies, and firms intended to be retained for conducting such inspections. These lists shall be submitted to WW Associates for approval and to the building official.

1.3.4 Inspection reports.

2 PRODUCTS

2.1 Concrete work shall meet applicable requirements of ACI 301-05 "Specifications for Structural Concrete," except as modified by the supplemental requirements specified in this section. For numbers in parentheses, refer to ACI 301 paragraphs.

2.1.1 (1.6.4) All of the testing services of Sections 1.6.4.1, 1.6.4.2, and 1.6.4.3 shall be paid for by the Contractor. If the concrete is placed by pumping, the strength test shall be taken at the truck discharge and at the point of placement.

2.1.1.1 The testing representative shall sample concrete in accordance with the following schedule for each design mixture placed in any one day:

Strength Tests	1 Set of 3 Cylinders per 50 CY or fraction thereof
Slump Test	1 Test per 50 CY or fraction thereof or if consistency varies
Temperature	1 Test per 50 CY or fraction thereof
Air Entrainment	1 Test per 50 CY or as necessary for control

2.1.2 (3.1) Reinforcement General

2.1.2.1 Details of reinforcing

2.1.2.1.1 Verify the location of all sleeves, embedments, attachments, openings, and structural supports for the equipment provided.

2.1.2.1.2 All reinforcing shall be as follows unless otherwise noted on the drawings:

2.1.2.1.3 Reinforcing shall be detailed, fabricated, and placed in accordance with ACI 315-99, with the exception of development lengths and splice lengths.

2.1.2.1.4 Splice lengths at locations not shown on the drawings shall be detailed on the shop drawings to conform to ACI 315-99. Use the splice category appropriate for the actual bar spacing and concrete cover.

2.1.2.1.5 Unless otherwise detailed, dowels in walls shall match size and spacing of main reinforcing bars.

2.1.3 (3.2.1.1) Reinforcing steel shall meet requirements of ASTM A 615 Grade 60 and shall be deformed.

2.1.4 (3.2.2.2) Welding of bar reinforcement will not be permitted.

2.1.5 (3.3.2.3) Cover requirements for concrete exposed to weather shall be used at all surfaces of liquid retention structures, except where concrete is deposited against earth.

2.1.6 (3.3.2.4) Where concrete will be exposed to view in the finished structure, the portions of all bar supports within ½-inch of the concrete surface shall be noncorrosive or protected against corrosion.

2.1.7 (4.2.1.1) Cement shall be as follows:

2.1.7.1 Portland cement for all concrete shall be ASTM C150, Type II.

2.1.7.2 ASTM C989 Ground iron blast furnace slag may be mixed with ASTM C150 Portland cement to produce the equivalent of ASTM C595 Type IS (MS) blended cement, except that the blast furnace slag content shall not exceed 50 percent by weight of the total cementitious material.

2.1.7.3 ASTM C618 fly ash or pozzolan may be mixed with ASTM C150 Portland cement to produce the equivalent of ASTM C595 Type IP (MS) blended cement, except that the total fly ash and pozzolan content shall not exceed 25 percent by weight of the total cementitious material. Loss on ignition of fly ash or pozzolan shall not exceed 3 percent.

2.1.7.4 (4.2.1.2) Aggregates for slabs on grade shall conform to the following:

2.1.7.4.1 The nominal maximum size aggregate shall not be larger than the requirements of 4.2.2.3 – size of coarse aggregate. The combined aggregates shall be well graded from the coarsest to the finest with not more

than 18 percent nor less than 8 percent, unless otherwise permitted, of the combined aggregate retained on any individual sieve with the exceptions that the No. 50 may have less than 8 percent retained, sieves finer than No. 50 shall have less than 9 percent retained, and the coarsest sieve may have less than 8 percent retained.

2.1.7.4.2 Aggregates used in concrete shall have a combined aggregate distribution similar to the aggregates used in the concrete represented by field test data or used in trial mixtures. Reports of individual aggregates shall include sieve sizes 1½ inches, 1-inch, ¾-inch, ½- inch, 3/8 inch, No. 4, No. 8, No. 16, No. 30, and No. 50 in accordance with ASTM E11.

2.1.7.5 (4.2.1.2) Coarse aggregate shall be a calcareous aggregate such as limestone or dolomite.

2.1.7.6 (4.2.2.4) Concrete shall be air entrained, except for interior slabs, which shall be non-air entrained.

2.1.7.7 (4.2.2.5) Air entraining or water reducing admixtures or both will be permitted. Other admixtures shall be submitted for approval before submitting the mix designs and shall not be used without written approval.

2.1.7.8 (4.2.2.6) Calcium chloride shall not be used as an admixture, nor as an ingredient in any admixture. Chloride ions in admixtures shall not exceed 0.1 percent by weight of cement content.

2.1.7.9 (4.2.2.9) The 28-day compressive strength of all concrete shall be 4,000 pounds per square inch.

2.1.7.10 (4.2.2.9) Concrete for liquid retention structures shall have a water-cementitious material ratio of not more than 0.45

2.1.7.11 (5.3.1) Foundation concrete shall not be placed until the soil subgrade for foundation bearing has been examined by the Geotechnical Engineer and found satisfactory for the design bearing capacity.

2.2 Moisture barrier beneath slabs on grade shall be minimum 6-mil polyethylene, with reinforced backing, with joints lapped not less than 6 inches.

2.3 Nonshrink grout for setting base plates, leveling plates, and bearing plates for columns and machine bases shall be premixed and noncorrosive and shall meet the requirements of ASTM C1107. Water for mixing grout shall be potable.

2.4 Joint sealant shall be Sikaflex 2C NS/SL by Sika Chemical Corporation, Eucolastic by Euclid Chemical Company or Stonflex MN6/MP6 by Stonhard, Inc.

2.5 Provide anchor rods as required to suit the equipment provided. Anchor rods shall be ASTM A36 or ASTM F1554, Grade 36 unless otherwise noted.

2.6 Adhesive anchors shall be HVA Adhesive Anchors by Hilti Fastening Systems, Chem-stud by the Rawlplug Company, ET Epoxy-Tie Adhesive anchors by the Simpson Strong-Tie Co. The anchor shall consist of a polyester resin adhesive capsule and a chisel-pointed threaded steel rod. Steel shall be zinc plated ASTM A 307. This type of adhesive anchor shall not be used in masonry. Allowable working (service) loads shall be as follows for 4,000-psi concrete:

Diameter (Inches)	Shear (Pounds)	Tension (Pounds)
½	1,800	2,850
⅝	2,750	4,550
¾	3,850	6,100
⅞	4,925	7,700

2.7 Special inspection of materials

2.7.1 Provide the following special inspections:

2.7.1.1 Review documentation for materials furnished to verify conformance to quality standards for materials specified herein.

2.7.1.2 Review mix design for conformance to Chapter 4 of ACI 301.

2.7.1.3 Inspect concrete mixing techniques for compliance with Section 4.3 of ACI 301.

2.7.2 Special inspection of materials will not be required for the following elements:

2.7.2.1 Other concrete items of a minor nature, such as duct banks and thrust blocks.

3 EXECUTION

3.1 Refer to applicable sections of ACI 301-05, except as modified by the supplemental requirements specified in this section. For numbers in parentheses, refer to ACI 301 paragraphs.

3.1.1 (5.3.2.1) Comply with ACI 306.1 for cold weather concreting and with the recommendations of ACI 305 R for hot weather concreting.

3.1.2 (5.3.3) All formed concrete which will be exposed to public view shall receive a smooth form finish.

3.2 Backfilling adjacent to foundation walls shall not occur until structural elements designed to brace walls have been placed and such concrete has reached 70 percent of its 28-day design compressive strength. Backfilling adjacent to cantilever retaining walls shall not occur until wall concrete has reached its 28-day design compressive strength.

3.3 Chamfer all exposed edges of concrete 1-inch.

3.4 Special Inspection of Field Work

3.4.1 Provide the following special inspections:

3.4.1.1 Inspect installation of reinforcing steel to verify compliance with contract drawings and Sections 3.3 of ACI 301.

3.4.1.2 Inspect formwork for compliance with Section 2.3 of ACI 301. Inspect form removal for compliance with Section 2.3.2 of ACI 318.

3.4.1.3 Test concrete strength, air content, and slump in accordance with Section 1.6.4.2 of ACI 301.

3.4.1.4 Inspect concrete placement for compliance with Section 5.3.2 of ACI 301.

3.4.1.5 Inspect curing for compliance with Section 5.3.6.1 of ACI 301.

3.4.2 Special inspection of field work will not be required for the following elements, except that concrete strength, air content, and slump shall be tested in accordance with Section 1.6.4.2 of ACI 301.

3.4.2.1 Other concrete items of a minor nature such as duct banks and thrust blocks.

End of Section

Section 03450
Precast Concrete Structures

1 GENERAL

1.1 General Requirements

1.1.1 The precast concrete Backwash Wastewater Storage Wetwell shall be as manufactured by Concrete Pipe and Precast, LLC or approved equal by Oldcastle Precast, or Tindall Corporation, and shall meet the dimensions shown on the contract drawings.

1.2 Submittals: Provide the following in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.2.1 Preconstruction Submittals

1.2.1.1 Submit quality control procedures established by the precast manufacturer in accordance with the NPCA Quality Control Manual for Precast Concrete Plants.

1.2.2 Shop Drawings

1.2.2.1 Drawings for Precast Concrete Unit

1.2.2.2 Submit shop drawings furnished by the manufacturer for approval by the Owner and WW Associates, Inc. Provide detailed layout for this project. These drawings shall demonstrate that the applicable industry design standards have been met. Installation and construction information shall be included on shop drawings upon request. Details of steel reinforcement size and placement as well as supporting design calculations, if appropriate, shall be included. The precast concrete unit shall be produced in accordance with the contract drawings. Drawings shall indicate assumptions used in the design of standard units.

1.2.2.3 Wetwell Access Ladders and Ladder Safety Extensions

1.2.2.4 Wetwell Access Hatch

1.2.3 Precast Concrete Unit Data

1.2.3.1 Standard Precast Concrete Units

1.2.3.1.1. The manufacturer shall supply cut sheets showing conformance to project drawings and requirements and to applicable industry design standards listed in this specification.

1.2.3.2 Anchorage, Lifting Inserts and Devices: For anchors, lifting inserts and other devices, the manufacturer shall provide product data sheets and proper installation instructions upon request. The Precast concrete unit dimensions and safe working load shall be clearly indicated.

1.2.3.3 Accessory Items: For items including, but not limited to, sealants, coatings, gaskets, pipe entry connectors, steps, racks and other items installed before or after delivery, the manufacturer shall include proper installation instructions and relevant product data upon request.

1.2.4 Design Data: Upon request, the manufacturer shall supply precast concrete unit design calculations and concrete mix design proportions and appropriate mix design test data. Structural design calculations shall be signed by a licensed professional engineer.

1.2.5 Test Reports

1.2.5.1 Upon request, the manufacturer shall supply copies of material certifications and/or laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolans, ground granulated blast-furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

1.2.5.2 Upon request, the manufacturer shall submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the project conditions. Such tests may include compressive strength, flexural strength, plastic or hardened air content, freeze-thaw durability, abrasion and absorption. Special tests for precast concrete items shall be clearly detailed in the specifications.

1.2.5.3 Upon request, the manufacturer will supply copies of in-plant QA/QC inspection reports.

1.2.6 Certificates: Submit quality control procedures established in accordance with NPCA Quality Control Manual for Precast Concrete Plants or verification of current NPCA Plant Certification.

1.2.7 Delivery Time: Delivery time shall be 2 weeks from shop drawing approval.

1.3 Design

1.3.1 Precast Concrete Unit Design: Design standard precast concrete unit to withstand indicated design load conditions in accordance with applicable industry design standards ACI 318, ACI 350, ASTM, ACPA Design Manual, PCI MNL-120, and AASHTO. Design must also consider

stresses induced during handling, shipping and installation in order to avoid product cracking or other handling damage. Design loads for precast concrete units shall be indicated on the shop drawings.

1.3.2 Joints and Sealants: Precast removable top slab shall be equipped with a watertight gasket.

1.3.3 Concrete Mix Design:

1.3.3.1 Concrete Proportions: Selection of proportions for concrete shall be based on the methodology presented in ACI 211.1 for normal weight concrete, ACI 211.2 for lightweight concrete and ACI 211.3 for no-slump concrete. The concrete proportions shall be developed using the same type and brand of cement, the same type and brand of pozzolan, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete unit for the project. Accelerators containing calcium chloride shall not be used in precast concrete containing reinforcing steel or other embedded metal items.

1.3.3.1.1. Upon request, the manufacturer shall submit a mix design for each strength and type of concrete that will be used. Submitted mix designs shall include the quantity, type, brand and applicable data sheets for all mix design constituents as well as documentation indicating conformance with applicable reference specifications.

1.3.3.1.2. The use of self-consolidating concrete is permitted, provided the mix design proportions and constituents meet the requirements of this specification.

1.3.3.2 Durability and performance requirements

1.3.3.2.1. Concrete Compressive Strength: Precast concrete units shall have a minimum 28-day compressive strength of 4,000 psi.

1.3.3.2.2. Water-Cement Ratio: Concrete that will be exposed to freezing and thawing shall contain entrained air as specified herein and shall have water-cement ratios of 0.45 or less. Concrete which will not be exposed to freezing, but which is required to be watertight, shall have a water-cement ratio of 0.48 or less if the concrete is exposed to fresh water, or 0.45 or less if exposed to brackish water or sea water. For corrosion protection, reinforced concrete exposed to deicer salts,

brackish water or seawater shall have a water-cement ratio of 0.40 or less.

1.3.3.2.3. Air Content: The air content of concrete that will be exposed to freezing conditions shall be within the limits given below.

Nominal Maximum Aggregate Size (in)	Air Content %	
	Severe Exposure	Moderate Exposure
⅜	6.0 to 9.0	4.5 to 7.5
½	5.5 to 8.5	4.0 to 7.0
¾	4.5 to 7.5	3.5 to 6.5
1	4.5 to 7.5	3.0 to 6.0
1½	4.5 to 7.0	3.0 to 6.0
* For specified compressive strengths greater than 5,000 psi, air content may be reduced 1%		

1.4 Quality Assurance: The manufacturer shall demonstrate adherence to the standards set forth in the NPCA Quality Control Manual for Precast Concrete Plants. The manufacturer shall meet the following requirements:

1.4.1 NPCA Plant Certification: The manufacturer shall be certified by the NPCA Plant Certification Program prior to and during production of the products for this project.

1.4.2 Quality Control

1.4.2.1 Quality Control: The manufacturer shall show that the following quality control tests are performed as required and in accordance with the ASTM International standards indicated.

1.4.2.1.1. Slump: A slump test shall be performed for each 150 cu yd of concrete produced per mix design, or once a day, whichever comes first. Slump tests shall be performed in accordance with ASTM C 143. Slump flow tests on self-consolidating concrete mixes shall be performed in accordance with ASTM C 1611.

1.4.2.1.2. Temperature: The temperature of fresh concrete shall be measured when slump or air content tests are made and when compressive test specimens are made in accordance with ASTM C 1064

1.4.2.1.3. Compressive Strength: At least four compressive strength specimens shall be made for each 150 cubic yards of concrete of each mix design in accordance

with the following applicable ASTM standards; C 31, C 39, C 192, C 497 (no-slump concrete).

1.4.2.1.4. Air Content: Tests for air content shall be made on air-entrained, wet-cast concrete for each 150 cu yd of concrete, per mix design, but not less often than once each day when air-entrained concrete is used. The air content shall be determined in accordance with either ASTM C 231 or ASTM C 173 for normal weight aggregates and ASTM C 173 for lightweight aggregates.

1.4.2.1.5. Density (Unit Weight): Tests for density shall be performed a minimum of once per week to verify the yield of batch mixes. Density tests shall be performed for each 100 cu yd of lightweight concrete in accordance with ASTM C 138. Density tests shall be performed for each 100 cu yd of concrete per mix design, but not less often than once per day when volumetric batch equipment is used.

1.4.2.1.6. The manufacturer shall submit documentation demonstrating compliance with the above subparagraphs.

1.5 Handling, Storage and Delivery

1.5.1 Handling: Precast concrete unit shall be handled and transported in a manner to minimize damage. Lifting devices or holes shall be consistent with industry standards. Lifting shall be accomplished with methods or devices intended for this purpose as indicated on shop drawings. Upon request, the manufacturer shall provide documentation on acceptable handling methods for the product.

1.5.2 Storage: Precast concrete unit shall be stored in a manner that will minimize potential damage.

1.5.3 Delivery: Precast concrete unit shall be delivered to the site in accordance with the delivery schedule. Upon delivery to the jobsite all precast concrete units shall be inspected by the Owner or WW Associates, Inc. for quality and final acceptance.

2 PRODUCTS

2.1 Precast Concrete Unit Materials

2.1.1 Cement: ASTM C 150 (Type I, II, III or V) and ASTM C 595 (for Blended Cements)

2.1.2 Silica Fume: ASTM C 1240

2.1.3 Fly Ash and Pozzolans: ASTM C 618

2.1.4 Ground Granulated Blast-Furnace Slag: ASTM C 989

2.1.5 Water: ASTM C 1602

2.1.5.1 The use of reclaimed/recycled process water shall be permitted.

2.1.6 Aggregates

2.1.6.1 The nominal maximum aggregate size should not exceed one-fifth the narrowest dimension between sides of forms, nor three-quarters the minimum clear spacing between individual reinforcing bars or wires.

2.1.6.2 Aggregates shall conform to ASTM C 33. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalis in the cement. Upon request, the manufacturer shall provide documentation indicating the aggregates are not susceptible to alkali-aggregate reaction.

2.1.6.3 Aggregates for Lightweight Concrete: ASTM C 330

2.1.7 Admixtures

2.1.7.1 Air-Entraining: ASTM C 260

2.1.7.2 Accelerating, Retarding, Water Reducing [Moderate to High]: ASTM C 494

2.1.7.3 Corrosion Inhibitors: ASTM C 1582

2.1.8 Reinforcement

2.1.8.1 Reinforcing Bars: Specify ASTM A 706 reinforcing steel when welding or bending of reinforcement bars is critical. In addition, ASTM A 775 epoxy-coated reinforcing may be specified where extra reinforcement corrosion protection is required.

2.1.8.1.1. Deformed Billet-Steel: ASTM A 615

2.1.8.1.2. Deformed Low-Alloy Steel: ASTM A 706

2.1.8.2 Reinforcing Wire

2.1.8.2.1. Plain Wire: ASTM A 185

2.1.8.2.2. Deformed Wire: ASTM A 496

2.1.8.3 Welded Wire Reinforcement

2.1.8.3.1. Plain Wire: ASTM A 185

2.1.8.3.2. Deformed Wire: ASTM A 497

2.1.8.4 Epoxy Coated Reinforcement

2.1.8.4.1. Reinforcing Bars: ASTM A 775

2.1.8.4.2. Wires and Welded Wire Reinforcement: ASTM A 884

2.1.8.5 Galvanized Reinforcement: ASTM 767

2.1.9 Inserts and Embedded Metal: All items embedded in concrete shall be of the type required for the intended for the intended use and meet the following standards.

2.1.9.1 Structural Steel Plates, Angles, etc.: ASTM A 36

2.1.9.2 Hot-Dipped Galvanized: ASTM A 152

2.2 Coating System: Protective coating for interior of precast concrete wetwell sections shall be two coats of coal tar solution, such as International Protective Coat "Intertuf 100," Pittsburgh Paint "Coal Cat 97-640/97-641," Kop-Coat Protective Coatings "Bitumastic 300-M," or approved equal.

2.3 Access Hatch: The precast concrete wetwell shall be equipped with an access hatch as shown on the drawings.

2.3.1 The access hatch shall have a ¼-inch thick, mill finish, extruded aluminum channel frame, incorporating a continuous concrete anchor. A 1½-inch drainage coupling shall be located in the front left corner of the channel frame. Hatch drain shall be equipped to outfall outside of the vault.

2.3.2 A bituminous coating shall be applied to the frame exterior where it will come into contact with concrete.

2.3.3 The door panel shall be ¼-inch aluminum diamond plate, reinforced to withstand a live load of 300 psf uniform live load with a maximum allowable deflection of 1/150 of the span and shall not protrude into the channel frame when in the open position. Doors shall open to 90 degrees and automatically lock with a T-316 stainless steel hold open arm with an aluminum release handle. For ease of operation, the hold open arm shall incorporate an enclosed stainless steel compression spring assist. Doors

shall close flush with the frame and rest on a built-in neoprene cushion/gasket. Hinges and all hardware shall be T-316 stainless steel.

2.3.4 Hatch shall be equipped with locking hasp and associated hardware. Unit shall lock with a T-316 stainless steel slam lock with removable key and have a non-corrosive handle. Coordinate keying of lock with the Owner.

2.3.5 Unit shall carry a lifetime guarantee against defects in material and/or workmanship.

2.3.6 The access hatch shall be a Series W2C hatch as manufactured by Halliday Products, Inc., or approved equal.

2.4 Access Ladder

2.4.1 The access ladder shall be constructed entirely of aluminum. The rails shall be ½-inch x 2¾-inch aluminum extrusion and shall be spaced 16 inches apart. The wall mounted standoffs shall be ⅜-inch x 2½-inch flat bar and welded to the rails at a maximum of 60 inches on center. The standoffs shall be a minimum of 7 inches and manufactured to fit flush with the wall. 1⅜-inch diameter Type "D" rungs with flat slip resistant surface shall be spaced at 12 inches on center and welded to the outside of each rail.

2.4.2 The access ladder shall be a Series L1D ladder as manufactured by Halliday Products Inc., or approved equal.

2.4.3 Ladder Safety Extension: The ladder safety extension shall be constructed entirely of aluminum and stainless steel. The aluminum housing shall mount to the ladder by means of stainless steel channel clamps secured to the ladder rungs with stainless steel "U" bolts. The aluminum telescoping post shall extend 37 inches (for Model A) above the top of the housing and lock into position with a stainless steel pin. The ladder safety extension shall be a Model A Series L1E safety extension as manufactured by Halliday Products Inc., or approved equal.

3 EXECUTION

3.1 Site Access: The Contractor shall be responsible for coordinating access to the site with the Owner to facilitate hauling, storage and proper handling of the precast concrete unit.

3.2 Installation: Manufacturer shall conform to the NPCA Quality Control Manual for Precast Concrete Plants unless specified otherwise.

3.2.1 Precast concrete wetwell shall be installed to the lines and grades shown in the contract documents.

3.2.2 Precast concrete wetwell shall be lifted by suitable lifting devices at points provided by the manufacturer.

3.2.3 Precast concrete wetwell shall be installed in accordance with applicable industry standards. Upon request, the manufacturer shall provide installation instructions.

3.2.4 Forms: Forms for manufacturing precast concrete units shall be of the type and design consistent with industry standards and practices. Forms shall be capable of consistently providing uniform products and dimensions. Forms shall be constructed so the forces and vibrations to which the forms will be subjected cause no damage to the precast concrete unit. Forms shall be cleaned of concrete build-up after each use. Form release agents shall be applied according to the manufacturer's recommendations and shall not be allowed to build up on the form casting surfaces.

3.2.5 Reinforcement: Applicable ASTM International and/or ACI 318 standards for placement and splicing.

3.2.5.1 Cages of reinforcement shall be fabricated either by tying the bars, wires or welded wire reinforcement into rigid assemblies or by welding, where permissible, in accordance with AWS D1.4. Reinforcing shall be positioned as specified by the design and so that the concrete cover conforms to requirements. The tolerance on concrete cover shall be one-third of that specified but not more than ½-inch. Concrete cover shall not be less than ½-inch, unless otherwise specified. Positive means shall be taken to assure that the reinforcement does not move during the casting operations.

3.2.6 Embedded Items: Embedded items shall be positioned at locations specified in the design documents. Welding shall be performed in accordance with AWS D1.1 when necessary. Inserts, plates, weldments, lifting devices and other items to be embedded in precast concrete unit shall be held rigidly in place so that they do not move during casting operations.

3.2.7 Concrete

3.2.7.1 Concrete Mixing: Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

3.2.7.2 Concrete Placing: Conventional concrete shall be deposited into forms as near to its final location as practical. Self-consolidating concrete shall be placed in a manner in which it flows and consolidates without segregation or air entrapment. The free fall of the concrete shall be kept to a minimum. Concrete shall be consolidated in such a manner that segregation of the concrete is

minimized and honeycombed areas are kept to a minimum. Consolidation efforts are often not required when using self-consolidating concrete. Vibrators used to consolidate concrete shall have frequencies and amplitudes sufficient to produce well-consolidated concrete.

3.2.7.3 Cold Weather Concreting: Recommendations for cold weather concreting are given in detail ACI 306R. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather. All concrete materials and all reinforcement, forms, fillers, and ground with which concrete is to come in contact shall be free from frost. Frozen materials or materials containing ice shall not be used. In cold weather the temperature of concrete at the time of placing shall not be below 45°F. Concrete that freezes before its compressive strength reaches 500 psi shall be discarded.

3.2.7.4 Hot Weather Concreting: Recommendations for hot weather concreting are given in ACI 305R. During hot weather, proper attention shall be given to constituents, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation that could impair required strength or serviceability of the member or structure. The temperature of concrete at the time of placing shall not exceed 90°F.

3.2.7.5 Concrete Curing: Commence curing operations immediately following the initial set of the concrete and completion of surface finishing.

3.2.7.5.1. Curing by Moisture Retention: Moisture shall be prevented from evaporating from exposed surfaces until adequate strength for stripping the precast concrete unit from the forms is reached by one of the following methods:

3.2.7.5.1.1. Cover with polyethylene sheets a minimum of 6 mils thick (ASTM C 171)

3.2.7.5.1.2. Cover with burlap or other absorptive material and keep continually moist

3.2.7.5.1.3. Use of a membrane-curing compound applied at a rate not to exceed 200 square feet per gallon, or per manufacturers' recommendations (ASTM C 309)

3.2.7.5.2. Surfaces that will be exposed to weather during service shall be cured as above a minimum of 7 days. Forms shall be considered effective in preventing evaporation from the contact surfaces. If air temperature is below 50°F the curing period shall be extended.

3.2.7.5.3. Curing with Heat and Moisture: Concrete shall not be subjected to steam or hot air until after the concrete has attained its initial set. Steam, if used, shall be applied within a suitable enclosure, which permits free circulation of the steam in accordance with ACI 517.2R. If hot air is used for curing, precautions shall be taken to prevent moisture loss from the concrete. The temperature of the concrete shall not be permitted to exceed 150°F. These requirements do not apply to products cured with steam under pressure in an autoclave.

3.2.7.6 Surface Finish: Unformed surfaces of wet-cast precast concrete products shall be finished as specified. Surfaces shall be finished using a strike-off to level the concrete with the top of the form.

3.2.7.6.1. Formed Non-Architectural Surfaces: Surfaces shall be cast against approved forms in accordance with standard industry practices in cleaning forms, designing concrete mixes, placing and curing concrete. Normal color variations, form joint marks, small surface holes caused by air bubbles, and minor chips and spalls will be accepted. Major imperfections, excessive honeycombing or other major defects shall not be permitted.

3.2.7.6.2. Unformed Surfaces: Surfaces shall be finished with a vibrating screed, or by hand with a float. Normal color variations, minor indentations, minor chips and spalls will be accepted. Major imperfections, excessive honeycombing or other major defects shall not be permitted.

3.2.7.7 Stripping Precast Concrete Unit from Forms: Precast concrete units shall not be removed from the forms until the concrete reaches the compressive strength for stripping required by the design. Stripping strengths shall be routinely measured to ensure product has attained sufficient strength for safe handling.

3.2.7.8 Patching and Repair

3.2.7.8.1. Repairing Minor Defects: Defects that will not impair the functional use or expected life of a precast concrete unit may be repaired by any method that does not impair the product.

3.2.7.8.2. Repairing Honeycombed Areas: When honeycombed areas are to be repaired, all loose material shall be removed and the areas cut back into essentially horizontal or vertical planes to a depth at which coarse aggregate particles break under chipping rather than being dislodged. Proprietary repair materials shall be used in accordance with the manufacturer's instructions. If a proprietary repair material is not used, the area shall be saturated with water. Immediately prior to repair, the area should be damp, but free of excess water. A cement-sand grout or an approved bonding agent shall be applied to the chipped surfaces, followed immediately by consolidating an appropriate repair material into the cavity.

3.2.7.8.3. Repairing Major Defects: Defects in precast concrete products which impair the functional use or the expected life of products shall be evaluated by qualified personnel to determine if repairs are feasible and, if so, to establish the repair procedure.

3.2.7.9 Shipping Precast Concrete Unit: Precast concrete unit shall not be shipped until it is at least 7 days old, unless it can be shown that the concrete strength has reached at least 75% of the specified 28-day strength, or that damage will not result, impairing the performance of the product.

3.2.7.10 Lift Eyes: Provide lifting eyes for each 5 foot section of lids.

3.2.8 Watertightness: Watertight joints, pipe-entry connectors and inserts shall be used to ensure the integrity of the entire system.

End of Section

Section 08331
Overhead Coiling Doors

1 GENERAL

1.1 Related Documents

1.1.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 Summary

1.2.1 This section includes coiling roll-up service doors. Contractor shall provide roll-up doors and required accessories at specified locations with quantities, dimensions, and sizes as indicated on the drawings.

1.3 System Description

1.3.1 Door operation shall be operated as specified herein and as indicated on the drawings.

1.3.2 Door shall be designed for 20,000 cycles usage.

1.3.3 Door shall withstand 90 psf wind load.

1.4 References

1.4.1 ASTM A 653/A 653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

1.4.2 ASTM A 36 – Standard Specification for Carbon Structural Steel, Hot Rolled Steel

1.4.3 ASTM A 123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products

1.5 Submittals: Provide the following in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.5.1 Product Data: Include construction details, materials, individual components and profiles, and finishes.

1.5.2 Shop Drawings: Show fabrication and installation details of roll-up door and frame. Include plan, elevations, sections, details, and attachments to other work.

1.5.3 Operation and Maintenance Instructions: Manufacturer's recommended operation, troubleshooting, and maintenance instructions.

1.6 Quality Assurance

1.6.1 Manufacturer: Roll-up door shall be manufactured by a firm with a minimum of five years experience.

1.6.2 Single-Source Responsibility: Manufacturer shall provide door, tracks, and accessories for door.

1.7 Delivery, Storage, and Handling

1.7.1 Deliver materials in original packaging supplied by manufacturer with intact labels.

1.7.2 Store materials away from harmful environmental conditions and construction.

2 PRODUCTS

2.1 Acceptable Manufacturers

2.1.1 Kinnear/Wayne Dalton

2.1.2 Raynor Garage Doors, Inc.

2.1.3 Overhead Door Corporation

2.1.4 C.H.I. Overhead Doors

2.2 Materials

2.2.1 Curtain: Fabricate from interlocking curved slats, roll-formed from galvanized steel strip.

2.2.1.1 Fabricate from ASTM A 653/A 653M galvanized steel strip, G90 coating.

2.2.1.2 Minimum 22 gauge.

2.2.1.3 Insulate with polyurethane foam, ¾-inch thick, laid for complete coverage and concealed by a 24 gauge back slat.

2.2.1.4 Ductile, cast iron, hot-dip galvanized endlocks/windlocks riveted to ends of each slat to prevent lateral movement and to limit slat deflection and bending stress.

2.2.2 Bottom Bar: Two roll formed steel angles, extended into guides, designed to reinforce curtain bottom. Equip with water tight vinyl weatherstrip.

2.2.2.1 Fabricate from ASTM A 36 steel and galvanize per ASTM A 123.

2.2.3 Guides: Form from structural steel angles, sized to retain curtain, with a minimum thickness of 3/16 inch. Bolt to steel wall angles, sized to support door. Assemble and attach guides to wall channel with 3/8 inch minimum bolts no more than 24 inches on center. Provide removable bellmouth curtain stops. Equip with water tight vinyl weather seals.

2.2.3.1 Fabricate from ASTM A36 steel.

2.2.4 Counterbalance Assembly: Steel pipe barrel sized to support curtain load with a maximum deflection of 0.03 inches per foot of width. Heat-treated helical torsion springs encased in a steel pipe and designed to include an overload factor of 25 percent to ensure minimum effort to operate.

2.2.4.1 Provide prelubricated sealed bearings to support each end of counterbalance assembly.

2.2.4.1.1 Provide adjustable wheel outside bracket for adjusting spring tension.

2.2.5 Brackets: One quarter inch minimum thickness steel plates bolted to wall angles. Size plates to support curtain and barrel. Provide ball bearings at rotating support points. Provide flanges for hood attachment.

2.2.5.1 Fabricate from ASTM A 36 steel plates.

2.2.6 Hood: Form from 24 gauge galvanized steel sheet with top and bottom reinforcements to reduce deflection.

2.2.6.1 Form from ASTM A 653/A 653 M steel sheet.

2.2.7 Operation: Provide electric motor actuators for all roll-up doors with manual chain hoist override. Motor shall be minimum ½ HP in size, suitable for the electrical service characteristics shown on the contract drawings.

2.3 Finishes

2.3.1 Provide baked-on epoxy primer and polyester finish coat on galvanized steel curtain slats.

2.3.1.1 Slat color shall be selected by the Owner from the manufacturer's standard colors.

2.3.2 Provide black rust-inhibiting primer on guides and brackets.

2.4 Locking

2.4.1 Provide slide locks on bottom bar on coil side.

3 EXECUTION

3.1 Examination

3.1.1 Verify that dimensions are correct and project conditions are in accordance with manufacturer's installation instructions. Do not proceed with installation until unacceptable conditions have been corrected.

3.2 Installation

3.2.1 Install unit in accordance with manufacturer's instructions.

3.2.2 Ensure that unit is installed plumb and true, free of warp or twist, and within tolerances specified by manufacturer for smooth operation.

3.3 Field Testing

3.3.1 Test door for regular operation.

3.4 Demonstration

3.4.1 Instruct Owner's personnel in correct operation and maintenance of unit.

3.5 Adjust and Clean

3.5.1 Clean unit in accordance with manufacturer's instructions.

3.5.2 Restore slight blemishes in finishes in accordance with manufacturer's instructions to match original finish. Remove and provide new unit where repairs are not acceptable to Owner.

End of Section

Section 11100
Vertical High Density Cross-Linked Polyethylene Storage Tanks

1 GENERAL

1.1 Requirements

1.1.1 The Contractor shall provide a vertical, high density cross-linked polyethylene tank and accessories for use as a raw water storage tank, complete and in place, in accordance with the Contract Documents.

1.1.2 Unit Responsibility: The Contractor shall be responsible for furnishing the vertical tank(s) and its accessories for the storage as noted.

1.2 References, Codes, and Standards

1.2.1 American Society of Testing Materials (ASTM).

1.2.1.1	D638	Tensile Properties of Plastics
1.2.1.2	D883	Standard Definitions of Terms Relating to Plastics
1.2.1.3	D1505	Density of Plastics by the Density-Gradient Technique
1.2.1.4	D1525	Test Method for Vicat Softening Temperature of Plastics
1.2.1.5	D1693	ESCR Specification Thickness ⅛-inch F50-10% Igepal
1.2.1.6	F412	Standard Terminology Relating to Plastic Piping Systems

1.2.2 ANSI Standards: B-16.5, Pipe Flanges and Flanged Fittings

1.2.3 Building Code: International Building Code, IBC 2012

1.2.4 ARM: Low Temperature Impact Resistance (Falling Dart Test Procedure)

1.2.5 NSF/ANSI Standard 61, AWWA – Drinking Water System Components

1.2.6 ASTM D 1998, Standard Specification for Polyethylene Upright Storage Tanks

1.3 Submittals

1.3.1 Shop Drawings: Sufficient data shall be included to show that the product conforms to Specification requirements. Provide the following additional information:

1.3.1.1 Vertical Tank and Fitting Material

1.3.1.1.1 Resin Manufacturer Data Sheet

1.3.1.1.2 Fitting Material

1.3.1.1.3 Gasket style and material

1.3.1.1.4 Bolt material

1.3.1.2 Dimensioned Tank Drawings

1.3.1.2.1 Location and orientation of openings, fittings, accessories, restraints and supports.

1.3.1.2.2 Details of manways, flexible connections, and vents.

1.3.1.3 Calculations shall be stamped and signed by a registered professional engineer licensed in the Commonwealth of Virginia.

1.3.1.3.1 Wall thickness. Hoop stress shall be calculated using 600 psi at 100°F.

1.3.1.3.2 Tank restraint system. Show seismic and wind criteria.

1.3.2 Electrical heat tracing installation details

1.3.3 Insulation data

1.3.4 Manufacturer’s warranty

1.3.5 Supporting documentation of Manufacturer’s certification to NSF/ANSI Standard 61 – Drinking Water System Components for water treatment chemicals.

1.3.6 Manufacturer’s Qualifications: Submit to the Engineer a list of 5 installations in the same service as proof of manufacturer's qualifications.

1.3.7 Factory Test Report

1.3.7.1 Material, specific gravity rating at 600 psi at 100°F design hoop stress.

1.3.7.2 Wall thickness verification.

1.3.7.3 Fitting placement verification.

1.3.7.4 Visual inspection

1.3.7.5 Impact test

1.3.7.6 Gel test

1.3.7.7 Hydrostatic test

1.4 Quality Assurance

1.4.1 The Contractor shall provide a vertical tank of high density cross-linked polyethylene. Tanks furnished under this Section shall be supplied by Poly Processing Company or approved equal by Snyder Industries who has been regularly engaged in the design and manufacture of chemical storage tanks for over 10 years.

1.4.2 Tanks shall be manufactured from virgin materials.

1.4.3 Tanks shall be manufactured from materials certified to NSF/ANSI Standard 61 for storage of drinking water and submit form from NSF supporting certification.

1.5 Warranty

1.5.1 The tank and associated appurtenances shall be provided with a 5-year full replacement warranty.

2 PRODUCTS

2.1 General

2.1.1 Tanks shall be rotationally-molded, vertical, high density cross-linked polyethylene, one-piece seamless construction, cylindrical in cross-section and vertical with flat bottoms. Tanks shall be adequately vented as prescribed in Poly Processing Company's Technical Bulletin, Venting-Design for ACFM (air cubic feet per minute). Where indicated, tanks shall be provided with ancillary mechanical fittings and accessories. Tanks shall be marked to identify the manufacturer and date of manufacture, and the serial numbers shall be permanently embossed into the tank.

2.2 Polyethylene Storage Tanks

2.2.1 Service: Storage tanks shall be suited for the following operating conditions:

2.2.2 High density cross-linked polyethylene resin used in the tank manufacture shall be Poly CL™ or approved equal and shall contain ultraviolet stabilizer. The tank material shall be rotationally molded and be a resin that is commercially available at the time of tank manufacture.

2.2.3 The internal tank wall shall have Type II HDPE resin certified NSF/ANSI 61 for storage of drinking water and bonded to the internal high density cross-linked polyethylene wall during the rotational molding process.

2.2.4 Tank Schedule per the following specifications:

Table 1 – Cross-linked Polyethylene Storage Tanks		
Description	**Unit**	Potable Water
Material Being Stored	N/A	
Number of Tanks	N/A	1
Tank Configuration	N/A	Vertical
Tank Outside Diameter	ft-inch	10'-2"
Tank Overall Height[1]	ft-inch	9'-2"
Tank Sidewall Height	ft-inch	7'-9¼"
Nominal Tank Storage Capacity	gallons	5,000
Tank Material of Construction	N/A	XLPE
Fitting Material of Construction	N/A	Polyvinyl Chloride (PVC)
Gasket Material of Construction	N/A	EPDM
Bolt Material of Construction	N/A	Type 316 Stainless Steel
Tank Insulation/Heating	---	Yes

Note 1: Approximate overall height is measured along the straight cylindrical portion of the tank and includes the dome top.

2.2.5 Fittings

2.2.5.1 Tank fittings shall be according to the fitting schedule in 2.05B above. Threaded fittings shall use American Standard Pipe Threads. If tanks are insulated, fittings shall be installed at the factory prior to application of the insulation.

2.2.5.2 Integrally Molded Flanged Outlet (IMFO): The outlet shall be an integral part of the tank, molded from the same material as the tank and located flush with the tank bottom to provide complete drainage of liquid through the sidewall of the tank. Metal and alloy inserts installed during or post production and located above the tank bottom shall not be used.

2.2.5.3 Bolted flange fittings shall be constructed of one 150 pound flange with ANSI bolt pattern, one flange gasket and stud bolts with gaskets. Stud bolts shall have chemical resistant polyethylene injection molded heads and gaskets to provide a sealing surface between the bolt head and the interior tank wall. Stud bolt heads shall be color coded for visual ease of identifying the bolt material

by onsite operators. Green – 316 Stainless Steel, Black – Titanium, Red – Alloy C-276, Blue – Monel. All materials shall be compatible with chemical service and as indicated in the fitting schedule above. For NSF/ANSI 61 certification, EPDM or Viton GF gaskets shall be supplied.

2.2.6 Piping Supports: Piping attached to the tank shall be supported at 6-foot maximum intervals.

2.2.7 U-Vents: Each tank must be vented for the material and flow and withdrawal rates expected. Vents shall comply with OSHA 1910.106(F)(iii)(2)(IV)(9). U-vents shall be furnished complete with insect screen.

2.2.8 All fittings on the 1/3 lower sidewall of tanks with capacities greater than 1,000 gallons shall have 100% virgin PTFE Flexijoint® expansion joint. Expansion joint shall have a minimum of 3 convolutions, stainless steel limit cables and FRP composite flanges. Galvanized parts will not be accepted.

2.2.8.1 Expansion joint shall meet the following minimum performance requirements:

2.2.8.1.1 Axial Compression ≥ 0.67-inch

2.2.8.1.2 Axial Extension ≥ 0.67-inch

2.2.8.1.3 Lateral Deflection ≥ 0.51-inch

2.2.8.1.4 Angular Deflection ≥ 14º

2.2.8.1.5 Torsional Rotation ≥ 4º

2.2.9 Tank Insulation and Heat System

2.2.9.1 Insulation and heating systems for use with polyethylene tanks shall be designed to meet specific requirements such as tank material type, tank size, low ambient temperature, and desired maintenance temperature.

2.2.9.2 All control components of the heating system shall be mounted in watertight, high impact plastic boxes with a gasketed cover.

2.2.9.3 All heating system components shall be NEMA 4 rated and factory pre-wired for the electrical service indicated on the drawings. All connections shall be labeled to prevent errors in field installation.

2.2.9.4 Each control box shall carry a decal attached to the inside surface of the cover, on which an electrical wiring diagram will be printed.

2.2.9.5 Each control box shall contain two temperature controls. One control shall regulate the maintenance temperature setting and the other control shall regulate the high temperature setting. The maintenance temperature setting should be set at the desired maintenance temperature. The high temperature setting shall be adjusted to 10 degrees above the desired maintenance temperature to a maximum of 130ºF. All control systems shall be designed with a power off failure mode.

2.2.9.6 The heating panels shall be designed to wrap around and lie flat against the surface of the tanks. The heating panels shall have a maximum heating density of 0.022 watts per square centimeter. All heating panels and sensor bulbs shall be attached to the tank 2-inch wide duct tape. Under no circumstances shall cable type heaters be used with polyethylene tanks.

2.2.9.7 Insulation used shall be spray-applied polyurethane foam with a density of 2.0-3.0 lb/ft^3 with a minimum "R" value of 16. The foam shall be applied to all external tank surfaces except the tank bottom shell.

2.2.9.8 Upon completion of application and curing of the insulation, two full coverage coats of latex mastic coating shall be applied to the surface of the insulation in such a manner as to seal the insulation from the outside environment. The latex mastic shall be white in color with excellent ultraviolet (UV) resistance.

2.2.10 Wall thickness for a given hoop stress shall be calculated in accordance with ASTM D 1998. Tanks shall be designed using a hoop stress no greater than 600 psi. In no case shall the tank thickness be less than design requirements per ASTM D 1998.

2.2.10.1 The wall thickness of any cylindrical portion at any fluid level shall be determined by the following equation:

$T = P \times OD/2SD$ or $0.433 \times SG \times H \times OD/2SD$

Where:

T	=	wall thickness, in
P	=	pressure, psi
SG	=	specific gravity, gm/cc
H	=	fluid head, ft
OD	=	outside diameter, ft
SD	=	hydrostatic design stress, 600 psi

2.2.10.1.1 The minimum wall thickness shall be sufficient to support its own weight in an upright position without

external support but shall not be less than 0.187-inch thick.

2.2.10.2 On closed top tanks, the top head shall be integrally molded with the cylindrical wall. Its minimum thickness shall be equal to the thickness of the top of the straight sidewall. In most cases, flat areas shall be provided for attachment of large fittings on the dome of the tank.

2.2.10.3 The bottom head shall be integrally molded with the cylindrical wall. Minimum Knuckle radius shall be 1.5 inches:

2.2.11 Tank shall have at least 3 lifting lugs. Lugs shall be designed for lifting the tank when empty.

2.2.12 Tank shall be equipped with manway. Manway shall be 24-inches in diameter or greater and equipped with Poly Processing Company's F.S.2650® combined manway and vent to prevent over pressurization of tank. Manway must be capable of relieving a volume flow rate of up to 2650 ACFM. Gaskets shall be closed cell, cross-linked polyethylene foam, Viton, or EPDM materials.

2.2.13 Tanks must be vented to allow for performance at atmospheric pressure, in accordance with the following matrix:

Venting Requirements For Polyethylene Tanks

Mechanical Pump Fill	**Pneumatic Fill**								
IF ≤ 1000 gallons	**IF** - Vent length ≤ 3 feet			**IF -** Vent length > 3' and ≤ 30'			**IF** - Scrubber Application		
Vent size should equal size of largest fill or discharge fitting	**AND - Vent** screen mesh size ≥ 1/4" or no screen used			**AND -** 3 or less 90° elbows with no other restrictions or reduction in pipe size			**Vent pipe size throughout scrubber system CANNOT be reduced!** Centerline of dispersion pipe not to be submersed > 6 inches		
IF > 1000 gallons	**Emergency Pressure Relief Cover Required**			**Emergency Pressure Relief Cover Required**			Perforated dispersion pipe must be same diameter or larger, as vent. Sum of perforations ≥ cross sectional area of pipe		
Vent size should exceed the largest fill or discharge fitting by 1 inch	Tanker Discharge	Inlet/Fitting Size	Minimum Vent Size	Tanker Discharge	Inlet/Fitting Size	Minimum Vent Size	Tanker Discharge	Inlet/Fitting Size	Minimum Vent Size
	2"	2"	4"	2"	2"	6"	2"	2"	6"
	3"	2"	6"	3"	2"	6"	3"	2"	8"
	3"	3"	6"	3"	3"	8"	3"	3"	10"

(2) 2 inch vents **DO NOT EQUAL** 4 inch venting capacity rev. Nov 2006

For detailed venting guidelines, please visit our Technical Resources at www.polyprocessing.com

2.2.14 Tank color shall be natural (unpigmented).

2.3 Tank Accessories

2.3.1 Ladder

2.3.1.1 Stainless steel access ladders shall be provided with the polyethylene chemical storage tanks at locations as shown. Safety cages shall be added to ladders as required per OSHA.

2.3.1.2 Ladders must be secured to the tank and secured to the concrete to allow for tank expansion/contraction due to temperature and loading changes. Use proper chemical resistant materials when anchoring to tank dome or sidewall.

2.3.1.3 All ladders shall be designed to meet applicable OSHA standards. Reference: OSHA 2206; 1910.27; fixed ladders.

2.3.2 Restraint System

2.3.2.1 Metal components shall be stainless steel, edge softeners, and tension ring with stainless steel cables and clamps.

2.3.2.2 Tank restraint system shall be supplied and the design of same certified by a Structural Engineer registered in the Commonwealth of Virginia. Design shall conform to the most recent adopted edition of the IBC Code for seismic and wind load. Anchor bolts as required by the calculations shall be supplied by the tank manufacturer

2.3.3 Level indication shall be provided in accordance with Section 13300 – Flow and Level Instruments.

3 EXECUTION

3.1 Factory Testing

3.1.1 Material Testing

3.1.1.1 Perform gel and low temperature impact tests in accordance with ASTM D 1998 on condition samples cut from each polyethylene chemical storage tank.

3.1.1.2 Degree of Crosslinking. Use Method C of ASTM D 1998- Section 11.4 to determine the ortho-xylene insoluble fraction of cross-linked polyethylene gel test. Samples shall test at no less than 60 percent.

3.1.2 Tank Testing

3.1.2.1 Dimensions: Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D 1998. Fitting placement tolerance shall be ±½-inch vertical and ±2 degrees radial.

3.1.2.2 Visual: Inspect for foreign inclusions, air bubbles, pimples, crazing, cracking, and delamination.

3.1.2.3 Hydrostatic test: Following fabrication, the bottom tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top sidewall for a minimum of 1 hour and inspected for leaks. Following successful testing, the tank shall be emptied and cleaned prior to shipment.

3.2 Delivery, Storage, and Handling

3.2.1 The tank shall be shipped upright or lying down on their sides with blocks and slings to keep them from moving. Avoid sharp objects on trailers.

3.2.2 All fittings shall be installed and, if necessary, removed for shipping and shipped separately unless otherwise noted by the Contractor.

3.2.3 Upon arrival at the destination, inspect the tank(s) and accessories for damage in transit. If damage has occurred, Poly Processing Company shall be notified immediately.

3.3 Installation

3.3.1 Install the tanks in strict accordance with Poly Processing Company's Tank Installation Manual and shop drawings.

3.3.2 Installation will be inspected by manufacturer to verify system flexible connections, venting and fittings are properly installed. In addition to on-sight inspection, tank systems shall be reviewed using tank manual check list as supplied by the manufacturer as listed below.

3.3.3 Manufacturer shall provide a 1-hour training session to prepare operators to service and maintain the tank system.

3.3.4 Manufacturer's trained technician shall perform an onsite inspection of installation. Inspection will verify installation, plumbing connections, venting, and applicable ancillary equipment such as ladders, restraints, etc. A verification of proper installation certificate shall be supplied when equipment passes installation checklist.

3.3.5 Tank manuals shall consist of installation check lists, tank drawing(s) as built, fitting drawings referencing nozzle schedule on tank drawing, materials of construction, and recommended maintenance program.

3.4 Field Testing

3.4.1 Poly Processing Company recommends that all tanks be hydro-tested for 24 hours prior to commissioning.

End of Section

Section 11105
Bolted Steel Potable Water Tank

1 GENERAL

1.1 Scope of Work

1.1.1 Furnish and erect an epoxy coated, bolted-steel water storage tank, including foundation, tank structure and tank appurtenances as shown on the contract drawings and described herein.

1.1.2 All required labor, materials and equipment shall be included.

1.2 Reference Specifications where applicable to work under this section are referred to by abbreviation as follows:

1.2.1 American Institute of Steel Construction..... AISC

1.2.2 American National Standards Institute ..... ANSI

1.2.3 American Society of Civil Engineers ..... ASCE

1.2.4 American Society of Mechanical Engineers..... ASME

1.2.5 American Society for Testing and Materials ..... ASTM

1.2.6 American Water Works Association ..... AWWA

1.2.7 Occupational Safety and Health Administration .....OSHA

1.3 Qualifications of Tank Supplier

1.3.1 The Engineer's selection of factory applied flat panel epoxy coated bolt together tank construction for this facility has been predicated upon specific criteria, construction methods, and optimum coating for resistance to internal and external tank corrosion. Deviations from the specified design, construction or coating details, will not be permitted. Bent-flange API-12B style tanks are not considered as being equal to this flat panel tank specification and will not be considered an acceptable alternate.

1.3.2 The bidder shall offer a new tank structure as supplied from a U.S.A. manufacturer specializing in the design, fabrication and erection of factory applied epoxy coated, bolt together tank systems. The manufacturer shall employ a staff of full time design engineers. The manufacturer shall own and operate its own production, fabrication, and coating plant. Steel used for the tanks shall be smelted and produced in the U.S.A.

1.3.3 The tank shown on the contract drawings are based on a TecStore™ Tank as manufactured by CST Storage of DeKalb, Illinois. Bolted steel potable water storage tanks manufactured by Tarsco Bolted Tank as manufactured by TF Warren Company of Spring, Texas and Tank Connection of Parsons, Kansas shall be considered as approved equals.

1.3.4 Erection of the structure shall be by the tank supplier who must be licensed in the state in which the structure is built. The Contractor shall be fully responsible for the entire installation including piping, backfill, concrete foundation, erection, and the ultimate water tightness of the complete installation.

1.4 Submittals

1.4.1 Shop Drawings: Sufficient data shall be included to show that the product conforms to specification requirements. Provide the following additional information:

1.4.1.1 Tank and Piping Materials

1.4.1.2 Dimensioned tank drawings, including tank foundation construction drawings stamped and signed by a registered professional engineer licensed in the Commonwealth of Virginia.

1.4.1.3 Location and orientation of openings, fittings, accessories, restraints and supports.

1.4.1.4 Details of manways, connections, and vents.

1.4.1.5 Details of cathodic protection system

1.4.1.6 Design calculations, stamped and signed by a registered professional engineer licensed in the Commonwealth of Virginia.

1.4.1.7 Supporting documentation of Manufacturer's certification to NSF/ANSI Standard 61 – Drinking Water System Components for drinking water.

1.5 Warranty

1.5.1 Structure: If within a period of one year from the date of completion (but not more than 14 months from the date of delivery of the product to the erection site), the tank, or any part thereof shall prove to be defective in material or workmanship upon examination by the manufacturer, the manufacturer shall supply an

identical or substantially similar replacement part F.O.B. the manufacturer's factory, or, at the manufacturer's option, shall repair or allow credit for such part.

1.6 Inspection

1.6.1 On or near the 1-year anniversary date of initial tank use (but not more than 14 months from the date of delivery of the tank materials to the erection site), the manufacturer's authorized dealer shall perform a visual inspection of the tank interior coating and appurtenances, tank exterior coating and appurtenances, and the immediate area surrounding the tank. A written summary of this inspection will be filed with the tank Owner and the tank Manufacturer.

2 PRODUCTS

2.1 Bolted Steel Potable Water Tank

2.1.1 Design Criteria

2.1.1.1 Tank Size

2.1.1.1.1 The factory epoxy coated bolt together tank shall have a nominal diameter of 14 feet with a nominal sidewall height (to roof eave) of 24 feet.

2.1.1.2 Tank Capacity

2.1.1.2.1 Tank capacity shall be 27,000 gallons (nominal, U.S. gallons) at 24 feet of liquid depth.

2.1.1.3 Floor Elevation

2.1.1.3.1 Finished floor elevation shall be as shown on the drawings.

2.1.2 Tank Design Standards

2.1.2.1 The materials, design, fabrication and erection of the bolt together tank shall conform to the AWWA Standard for "Factory-Coated Bolted Steel Tanks for Water Storage" – ANSI/AWWA D103-09.

2.1.2.2 The tank coating system shall conform solely to Section 12.6 in ANSI/AWWA D103.

2.1.2.3 The tank sidewall panels shall be flat with no formed flange. Bent-flange API-12B style tanks are not considered as being equal to this specification and are not considered to be an acceptable alternate.

2.1.2.4 All materials furnished by the tank manufacturer, which are in contact with stored water, shall be certified and listed by the National Sanitation Foundation (NSF) to meet ANSI/NSF Additives Standard No. 61. Certification of a coating type alone will not be sufficient to meet this requirement. Certification of a distributor, and not the tank manufacturer, will not be accepted.

2.1.3 Design Loads

2.1.3.1 Specific Gravity: 1.0 (Min. design shall be 1.0)

2.1.3.2 Design Freeboard: 8 inches

2.1.3.3 Wind Velocity 100 mph

2.1.3.4 Allowable Soil Bearing Capacity: 1,500 psf

2.1.3.5 Roof Snow Load: 30 psf

2.1.3.6 Earthquake Seismic Zone: AWWA D103

2.1.4 Materials Specifications

2.1.4.1 Plates and Sheets

2.1.4.1.1 Plates and sheets used in the construction of the tank shell, tank floor (when supplied) and tank roof, shall comply with the minimum standards of AWWA D103, Section 4.4.

2.1.4.1.2 Design requirements for mild strength steel shall be ASTM A1011 Grade 30 with a maximum allowable tensile stress of 14,566 psi per AWWA D103.

2.1.4.1.3 Design requirements for high strength steel shall be ASTM A1011 Grade 50 with a maximum allowable tensile stress of 26,000 psi per AWWA D103.

2.1.4.2 Rolled Structural Shapes

2.1.4.2.1 Material shall conform to minimum standards of ASTM A36 or ASTM A992.

2.1.4.3 Horizontal Wind Stiffeners

2.1.4.3.1 Design requirements for intermediate horizontal wind stiffeners shall be of the "web truss" design with extended tail to create multiple layers of stiffener, permitting wind loads to distribute around tank.

2.1.4.3.2 Web truss stiffeners shall be of steel with hot dipped galvanized coating.

2.1.4.3.3 Rolled steel angle stiffeners are not permitted for intermediate stiffeners.

2.1.4.4 Bolt Fasteners

2.1.4.4.1 Bolts used in tank lap joints shall be ½-inch 13 UNC-2A rolled thread, and shall meet the minimum requirements of AWWA D103, Section 4.2.

2.1.4.4.2 Bolt Material

2.1.4.4.3 SAE J429 (1-inch and 1¼-inch bolt length) heat treated to:

2.1.4.4.3.1 Tensile Strength: 120,000 psi minimum.

2.1.4.4.3.2 Proof Load: 85,000 psi minimum.

2.1.4.4.3.3 Allowable shear stress: 29,454 psi.

2.1.4.4.4 SAE J429 (>1¼-inch bolt length) heat treated to:

2.1.4.4.4.1 Tensile Strength: 150,000 psi minimum.

2.1.4.4.4.2 Proof Load: 120,000 psi minimum.

2.1.4.4.4.3 Allowable shear stress: 36,818 psi.

2.1.4.4.5 Bolt Finish – Zinc, mechanically deposited.

2.1.4.4.5.1 2.0 mils minimum under bolt head, on shank and threads.

2.1.4.4.6 Bolt Head Encapsulation

2.1.4.4.6.1 High impact polypropylene copolymer encapsulation of entire bolt head up to the splines on the shank.

2.1.4.4.6.2 Resin shall be stabilized with an ultraviolet light resistant material such that the color shall appear black. The bolt head encapsulation shall be certified to meet the NSI/NSF Standard 61 for indirect additives.

2.1.4.4.7 All bolts on the vertical tank wall shall be installed such that the head portion is located inside the tank, and the washer and nut are on the exterior.

2.1.4.4.8 All lap joint bolts shall be properly selected such that threaded portions will not be exposed to the "shear plane" between tank sheets.

2.1.4.4.9 Bolt lengths shall be sized as to achieve a neat and uniform appearance. Excessive threads extending beyond the nut after torquing will not be permitted.

2.1.4.4.10 All lap joint bolts shall include a minimum of four (4) splines on the underside of the bolt head at the shank in order to resist rotation during torqueing.

2.1.4.4.11 All exterior nuts, washers, and bolt threads will be covered with a sealer-filled protective plastic cover. Color to match tank shell.

2.1.4.5 Sealants

2.1.4.5.1 The lap joint sealant shall be a one component, moisture cured, polyurethane compound. The sealant shall be suitable for contact with potable water and shall be certified to meet ANSI/NSF Additives Standard 61 for indirect additives.

2.1.4.5.2 The sealant shall be used to seal lap joints and bolt connections and edge fillets for sheet notches

and starter sheets. The sealant shall cure to a rubber-like consistency, have excellent adhesion to the epoxy coating, low shrinkage, and be suitable for interior and exterior use.

2.1.4.5.3 Sealant curing rate at 73ºF and 50% relative humidity

2.1.4.5.3.1 Tack-free time: 6 to 8 hours

2.1.4.5.3.2 Final cure time: 10 to 12 days

2.1.4.5.4 Neoprene gaskets and tape type sealer shall not be used.

2.1.4.6 Epoxy Coating Specification

2.1.4.6.1 All ferrous metal surfaces of the tank shall be provided with an epoxy coating.

2.1.4.6.2 Surface Preparation

2.1.4.6.2.1 Following the decoiling and shearing process, sheets shall be steel grit-blasted on both sides to the equivalent of SSPC-SP10. Sand blasting and chemical pickling of steel sheets is not acceptable.

2.1.4.6.2.2 The surface anchor pattern shall be not less than 1.0 mil.

2.1.4.6.2.3 These sheets shall be evenly oiled on both sides to protect them from corrosion during fabrication.

2.1.4.6.3 Cleaning

2.1.4.6.3.1 After fabrication and prior to application of the coating system, all sheets shall be thoroughly cleaned by a caustic wash and hot rinse process followed immediately by hot air drying. Sheet edges of sidewall, floor and roof plates (where applicable) shall be mechanically rounded prior to coating. Coating of the sheet edges shall be similar to the plat

panel surfaces. The process shall be applied to all four sheet edges and shall be equal to EDGECOAT by CST Storage.

2.1.4.6.3.2 Inspection of the sheets shall be made for traces of foreign matter or rust. Any such sheets shall be re-cleaned or grit-blasted to an acceptable level of quality.

2.1.4.6.4 Coating

2.1.4.6.4.1 All parts shall be factory coated within 30 minutes after blasting; no shaping, bending, punching, flanging, or grinding may be done on the steel after blasting and before coating. Field coating, except for touch-up will not be permitted.

2.1.4.6.4.2 Coatings shall be in accordance with AWWA D103 and interior coatings shall be NSF Standard 61 approved.

2.1.4.6.4.3 Interior coating shall be Kuo-lon™ powder applied to 7 mils DFT.

2.1.4.6.4.4 Exterior coating system shall be as follows: Primer – Kuo-lon™ powder applied to 3 mils DFT. Topcoat – One coat aliphatic acrylic polyurethane applied to 1.5 mils DFT. Color shall be as approved by the Owner.

2.1.4.6.5 Factory Inspection

2.1.4.6.5.1 The manufacturer's quality system shall be ISO 9001 certified.

2.1.4.6.5.2 Coated sheets shall be inspected for mil thickness (Mikrotest or equal).

2.1.4.6.5.3 An electrical leak detection test shall be performed on the inside surface after fabrication of the sheet. Sheets with excessive electrically detected

"holidays" shall be rejected so as to minimize field touch up.

2.1.4.6.6 Packaging

2.1.4.6.6.1 All sheets that pass Factory Inspection and Quality Control checks shall be protected from damage prior to packing for shipment.

2.1.4.6.6.2 Heavy paper or plastic foam sheets shall be placed between each panel to eliminate sheet-to-sheet abrasion during shipment.

2.1.4.6.6.3 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 eliminates contact or movement of finished panels during shipment.

2.1.4.6.6.4 Shipment from the factory will be by truck, hauling the tank components exclusively.

2.1.5 Foundation

2.1.5.1 The tank foundation shall be a part of this contract and shall be installed by the tank supplier.

2.1.5.2 The tank foundation shall be designed by the manufacturer to safely sustain the structure and its live loads.

2.1.5.3 Tank footing design shall be based on the soil bearing capacity as determined by geotechnical analysis performed by a licensed geotechnical engineer and listed herein.

2.1.6 Tank Floor

2.1.6.1 Concrete Floor

2.1.6.1.1 The floor design shall be reinforced concrete with an embedded epoxy coated steel starter sheet per AWWA D103-09, Section 13.4.6 and the manufacturer's design, and shall be an integral

element of the tank assembly. The tank foundation and floor slab (performed in two separate pours) with embedded starter sheet shall be constructed by the tank supplier using manufacturer trained personnel regularly engaged in this type of tank construction.

2.1.6.1.2 Leveling of the starter ring shall be required and the maximum differential elevation within the ring shall not exceed ⅛-inch, nor exceed 1/16-inch within any 10 feet of length.

2.1.6.1.3 A leveling plate assembly (per Harvestore Products, Inc. - U.S. Patent No. 4,483,607), consisting of two 18-inch long anchor rods (¾-inch diameter) and a slotted plate (3½-inch x 11-inch x ⅜-inch thick) shall be used to secure the starter ring, prior to encasement in concrete. Installation of the starter ring on concrete blocks or bricks, using shims for adjustment, will not be permitted. The foundation with anchor bolts/leveling plates shall be a separate pour from the concrete floor.

2.1.6.1.4 Two water stop seals made of a butyl rubber elastomer special for this application shall be placed on the inside surface of the starter ring below the concrete floor line. These materials shall be installed as specified by the tank manufacturer.

2.1.7 Sidewall Structure

2.1.7.1 Field erection of the epoxy coated, bolted steel tank shall be in strict accordance with the procedures outlined by the manufacturer and performed by an authorized dealer of the tank manufacturer, regularly engaged in erection of these tanks, using factory trained and certified erectors.

2.1.7.2 Specialized erection jacks and building equipment developed and manufactured by the tank manufacturer shall be used to erect the tanks.

2.1.7.3 Particular care shall be taken in handling and bolting of the tank panels and members to avoid abrasion of the coating system. Prior to a liquid test, all surface areas shall be visually inspected by the Engineer.

2.1.7.4 An electrical “holiday” test shall be performed during erection using a wet sponge low voltage (max. 9 volt) leak detection device. All electrical “holiday” points found on the inside surface shall be repaired in accordance with manufacturer’s published touch up procedures.

2.1.7.5 The placement of sealant on each panel may be inspected prior to placement of adjacent panels. However, the Engineer’s inspection shall not relieve the bidder from his responsibility for liquid tightness.

2.1.7.6 No backfill shall be placed against the tank sidewall without prior written approval and design review of the tank manufacturer. Any backfill shall be placed according to the strict instructions of the tank manufacturer.

2.1.8 Roof

2.1.8.1 Tank shall include a radially sectioned roof fabricated from epoxy coated, bolted steel panels, as produced by the tank manufacturer, and shall be assembled in a similar manner as the sidewall panels utilizing the same sealant and bolting techniques, so as to assure a water/air tight assembly. The roof shall be clear span and self-supporting. Both live and dead loads shall be carried by the tank walls. The exterior coating color shall be as approved by the Owner.

2.1.8.2 The manufacturer shall furnish a roof opening which shall be placed near the outside tank ladder. The opening shall have a clear dimension of at least twenty-four (24) inches in one direction and eighteen (18) inches in the other direction. The opening shall have a gasketed, weathertight “shoebox” cover overlapping the frame by 2 inches, hinged on one side, and equipped with a locking device.

2.1.9 Roof Vent

2.1.9.1 A properly sized vent assembly in accordance with AWWA D103 shall be furnished and installed above the maximum water level of sufficient capacity so that at maximum design rate of water fill or withdrawal, the resulting interior pressure or vacuum shall not exceed ½-inch water column.

2.1.9.2 The overflow pipe shall not be considered to be a tank vent.

2.1.9.3 The vent shall be constructed of aluminum such that the hood can be unbolted and used as a secondary roof access.

2.1.9.4 The vent shall be so designed in construction as to prevent the entrance of birds and/or animals by including an expanded aluminum screen (½-inch) opening. An insect screen of 23 to 25 mesh polyester monofilament shall be provided and designed to open should the screen become plugged by frost or debris.

2.1.10 Appurtenances

2.1.10.1 Pipe Connections

2.1.10.1.1 Where pipe connections are shown to pass through tank panels, they shall be field located, saw cut, (acetylene torch cutting or welding is not permitted), and utilize an interior and exterior flange assembly and the tank shell reinforcing shall comply with AWWA D103. A single component urethane sealer shall be applied on any cut panel edges or bolt connections.

2.1.10.1.2 Exterior above grade piping shall be provided in accordance with Section 02660 – Water Piping System.

2.1.10.2 Outside Tank Ladder

2.1.10.2.1 An outside tank ladder shall be furnished and installed as shown on the contract drawings.

2.1.10.2.2 Ladders shall be fabricated of aluminum and utilize grooved, skid-resistant rungs.

2.1.10.2.3 Safety cage and step-off platforms shall be fabricated of galvanized steel. Ladders shall be equipped with a hinged lockable entry device.

2.1.10.3 Access Doors

2.1.10.3.1 One bottom access door shall be provided as shown on the contract drawings in accordance with AWWA D103.

2.1.10.3.1.1 The manhole opening shall be a minimum of 24 inches in diameter. The access door (shell manhole) and the tank shell reinforcing shall

comply with AWWA D103, Sec. 5.1.

2.1.10.4 Cathodic Protection: The tank manufacturer shall provide a passive sacrificial zinc anode cathodic protection system. The cathodic protection system shall have a means for testing and replacement. Electrical continuity between all tank sidewall panels shall be the responsibility of the tank manufacturer.

2.1.10.5 Level instrument shall be provided in accordance with Section 13300 – Flow and Level Instruments.

2.1.10.6 Identification Plate: A manufacturer's nameplate shall list the tank serial number, tank diameter and height, and maximum design capacity. The nameplate shall be affixed to the tank exterior sidewall at a location approximately 5 feet from grade elevation in a position of unobstructed view.

3 EXECUTION

3.1 The tank shall be installed in accordance with the manufacturer's recommendations and written instructions.

3.2 Surface preparation shall be performed in accordance with the manufacturer's written recommendations.

3.3 Field Testing

3.3.1 Hydrostatic

3.3.1.1 Following completion of erection and cleaning of the tank, the structure shall be tested for liquid tightness by filling tank to its overflow elevation.

3.3.1.2 Any leaks disclosed by this test shall be corrected by the erector in accordance with the manufacturer's recommendations.

3.3.1.3 Water required for testing shall be furnished by the Owner at the time of tank erection completion, and at no charge to the tank erector. Disposal of test water shall be the responsibility of the tank builder.

3.3.1.4 Labor and equipment necessary for tank testing shall be included in the price of the tank.

3.3.2 Disinfection

3.3.2.1 Cleaning, disinfection, and testing shall be the responsibility of the Contractor. Water for these operations shall be furnished by the Owner, but the Contractor shall provide loading, hauling, dechlorination, and discharging the water.

3.3.2.2 The tank structure shall be disinfected at the time of testing by chlorination in accordance with AWWA Standard C652 "Disinfection of Water Storage Facilities."

3.3.2.3 Disinfection shall not take place until tank sealant is fully cured.

3.3.2.4 Acceptable forms of chlorine for disinfection shall be:

3.3.2.4.1 Liquid chlorine as specified in AWWA C652.

3.3.2.4.2 Sodium hypochlorite as specified in AWWA C652.

3.3.2.4.3 Calcium hypochlorite (HTH) will not be acceptable.

3.3.2.5 Acceptable methods of chlorination per AWWA C652:

3.3.2.5.1 Section 4.1.1.

3.3.2.5.2 Section 4.1.2 – Chemical feed pump only (4.1.2.1.)

3.3.2.5.3 Section 4.3

3.3.2.5.4 Section 4.2 will not be acceptable.

End of Section

Section 11200
Raw Water Pumping Equipment

1 GENERAL

1.1 System Description: Raw water pumping equipment shall consist of, but not be limited to, all work associated with the vertical, in-line, multi-stage centrifugal raw water pumps for the Water Treatment Facility.

1.2 Reference specifications where applicable to work under this section are referred to by abbreviation as follows:

1.2.1 American Iron and Steel Institute.....AISI

1.2.2 American National Standards Institute..... ANSI

1.2.3 American Society for Testing and Materials..... ASTM

1.2.4 Food and Drug Administration.....FDA

1.2.5 National Electrical Code.....NEC

1.2.6 National Electrical Manufacturers Association.....NEMA

1.2.7 Underwriters Laboratory ..... UL

1.3 Quality Assurance

1.3.1 The water pumping equipment shall be provided as a package system as specified, as indicated on the drawings, and as required to provide a complete installation ready for operation.

1.3.2 The Contractor shall insure that the pumps and motors are properly installed with no pipe strain transmitted to the pump casing.

1.3.3 The water pumping equipment specified in this section shall be furnished by one equipment supplier as an integrated design package. The supplier shall provide all equipment and appurtenances and be responsible for the complete and satisfactory operation of the entire integrated system. The equipment supplier shall be the water pumping equipment manufacturer.

1.3.4 The equipment supplier shall have unit responsibility for its equipment startup. Provide services of experienced manufacturer-trained technicians for one site visit for startup. The site visit shall consist of a total of three 8-hour working days on the site to demonstrate satisfactory pump operation and to provide training and instruction of the Owner’s personnel for equipment operation.

1.3.5 Water pumps manufactured by Goulds Water Technology (a Xylem brand) shall be the design standard. The contract drawings and design of the raw water pumps are based on the design standard. Berkeley Pumps and Grundfos shall be considered approved equal manufacturers contingent upon final approved pump selection. Other manufacturer substitutions not listed above will not be allowed and will be considered a non-responsive bid.

1.3.6 If water pumping equipment other than the design standard is used, the Contractor shall provide a similar arrangement and revise the dimensional layout as necessary. Such revisions to the design must be approved by the Engineer in the shop drawing phase of construction, and shall be revised and constructed at no additional cost to the Owner. Equipment supplied other than the design standard shall conform to the paragraph entitled "Project Conditions" and all additional requirements specified in this section.

1.4 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.4.1 Certified pump curves

1.4.2 Catalog cuts, shop drawings, and wiring diagrams for equipment and accessories.

1.4.2.1 Pumps

1.4.2.2 Pump Motors

1.4.2.3 Inertia Base Frames

1.4.2.4 Pump Control Panel

1.4.2.5 Pressure Gauges

1.4.3 Pump operational test reports

1.4.4 Instrumentation and controls data for the following:

1.4.4.1 Instrumentation and controls, including equipment, point to point wiring diagrams, point to point instrumentation diagrams, and sequence of operation.

1.4.5 Operation and Maintenance Manual: Submit O&M manual in PDF electronic format.

1.4.5.1 The manuals' identification shall be inscribed on the cover.

1.4.5.2 The manuals shall include the names, addresses, and telephone numbers of the local representatives for each item of equipment and each system.

1.4.5.3 The manuals shall have a table of contents and be assembled to conform to the project manual table of contents with the tab sheets placed before instructions covering the subject. Additionally, each manual shall contain a comprehensive index of all manuals submitted in accordance with this paragraph.

1.4.5.4 Manuals and specifications shall be furnished which provide full and complete coverage of the following subjects:

1.4.5.4.1 Operational Requirement: This document shall describe, in concise terms, all the functional and operational requirements for the system.

1.4.5.4.2 Maintenance: Documentation of all user performed maintenance on all system components, including inspection, and periodic replacement of defective units. This shall include calibration, maintenance, and repair of all equipment, instrumentation, and controls, plus diagnosis and repair or replacement of all system hardware.

1.5 Project Conditions

1.5.1 Equipment furnished in accordance with this section shall be installed at the location and in the space allocated on the contract drawings.

1.5.2 Pump manufacturers shall supply pumps as complete units, including motors, drives, and all other required accessories and appurtenances, to ensure compatibility and integrity of the individual components, and provide the specified warranty for all components. Assembly by the Contractor of pumps, motors, shafting, couplings, and the like supplied by various independent manufacturers will not be allowed.

1.5.3 Pump motors shall be sized such that the motor does not overload at any point on the operating curve. Other motor requirements shall be as specified in this section.

1.5.4 Electrical Motors, Controllers, Starters, and Disconnects: Furnish motors, controllers, starters, and disconnects with their respective pieces of equipment. Motors, controllers, starters, and disconnects shall conform to and shall have electrical connections in accordance with the National Electrical Code. Controllers and starters shall have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished.

1.5.5 Any structural, piping, electrical requirements, wiring, instrumentation and controls, drawings, or other modifications required to accommodate equipment offered shall be done at no additional cost to the Owner.

1.6 Warranty: The pump unit or any part thereof shall be warranted against defects in material or workmanship within one year from the date of substantial completion, and shall be replaced at no charge with a new or remanufactured part, F.O.B. factory or authorized warranty service station.

1.7 Functional Description

1.7.1 Raw water pumps are constant speed and are equipped with either Hand or Automatic Mode. In the automatic mode, with one pump running, the pump will activate upon level demand at the Finished Water Storage Tank. The pump will deactivate when upon high level in the Finished Water Storage Tank. The pump will alternate to the second pump on the next duty cycle.

1.7.2 Should the designated pump not activate, as indicated by the discharge flow switch, the second pump shall be activated, a status alarm shall be indicated at the local pump control panel.

2 PRODUCTS

2.1 Raw Water Pumps

2.1.1 General Description

2.1.1.1 The design standard for the raw water pumps shall be a vertical in-line multi-stage centrifugal pump, Goulds Water Technology, e-SV series, Model 15SV.

2.1.2 Pump Station Performance Requirements

2.1.2.1 Number of Units: As indicated on the contract drawings

2.1.2.2 Type of Drive: Constant Speed

2.1.2.3 Discharge Diameter: As indicated on the contract drawings

2.1.2.4 Suction Diameter: As indicated on the contract drawings

2.1.2.5 Operating Condition – One (1) Pump Operating at 3,600 RPM

2.1.2.5.1 Primary Design Point: 39 GPM at 139 feet total dynamic head (TDH)

2.1.2.5.2 Secondary Design Point: 42 GPM at 133 feet total dynamic head (TDH)

2.1.2.5.3 Shutoff Head: 175 feet

2.1.2.5.4 Number of Stages: 10

2.1.3 Materials of Construction

2.1.3.1 Suction/Discharge Base, Pump Head, Motor Stool: ASTM A 48 Class 30 Cast Iron

2.1.3.2 Impellers, Diffuser Chamber, Outer Sleeve: 304 Stainless Steel

2.1.3.3 Shaft: 316 or 431 Stainless Steel

2.1.3.4 Impeller Wear Rings: 304 Stainless Steel

2.1.3.5 Shaft Journals and Chamber Bearings: Silicon Carbide

2.1.3.6 O-rings: EPDM

2.1.3.7 Shaft couplings for motor flange sizes 184TC and smaller shall be made of cast iron or sintered steel. Shaft couplings for motor flange sizes larger than 184TC shall be made of ASTM A 536 Grade 60-40-18 ductile iron.

2.1.4 Suction/Discharge Base

2.1.4.1 The suction/discharge base shall have ANSI Class 250 flanges with a maximum working pressure of 360 psig.

2.1.5 Impellers

2.1.5.1 The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement.

2.1.6 Shaft Seal

2.1.6.1 The shaft seal shall be a balanced o-ring cartridge type with the following features:

2.1.6.1.1 Collar, Drivers, Spring: 316 Stainless Steel

2.1.6.1.2 Shaft Sleeve, Gland Plate: 316 Stainless Steel

2.1.6.1.3 Stationary Ring: Silicon Carbide

2.1.6.1.4 Rotating Ring: Silicon Carbide

2.1.6.1.5 O-rings: EPDM

2.1.6.2 Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling, and motor.

2.1.6.3 The maximum working temperature shall be 250°F.

2.1.7 Motor

2.1.7.1 The motor shall be vertical, premium efficiency, inverter-duty rated, in accordance with the latest NEMA standards, and shall have the following characteristics:

2.1.7.1.1 Enclosure: Totally enclosed fan cooled (TEFC)

2.1.7.1.2 Insulation: NEMA Class F

2.1.7.1.3 Electrical Service: As indicated on the drawings

2.1.7.1.4 Speed: 3,500 RPM

2.1.7.1.5 Minimum Motor Size: 3 HP

2.1.7.2 Motors shall have a NEMA C-Flange for vertical mounting. Motors weighing over 50 pounds shall have lifting provisions.

2.1.7.3 Drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump.

2.1.7.4 Each motor shall have a sufficient horsepower rating to operate the pump at any point on the pump's head-capacity curve without overloading the nameplate horsepower rating of the motor, regardless of service factor. The motor shall be designed for continuous duty operation, NEMA Design B, and shall have a service factor of at least 1.15. The service factor shall be reserved for variations in voltage and frequency.

2.1.8 Nameplates

2.1.8.1 Motor: List all data pertinent to proper installation of each motor and identification of motor for maintenance and replacement parts, including as a minimum:

2.1.8.1.1 Serial number

2.1.8.1.2 Manufacturer’s model number

2.1.8.1.3 Horsepower

2.1.8.1.4 Speed

2.1.8.1.5 Voltage

2.1.8.1.6 Number of phases

2.1.8.1.7 Service factor

2.1.8.1.8 Time rating

2.1.8.1.9 Manufacturer's number of each bearing

2.1.8.2 Pump: List all data pertinent to proper installation of each pump and identification of motor for maintenance and replacement parts, including as a minimum:

2.1.8.2.1 Serial number

2.1.8.2.2 Manufacturer's model number

2.1.8.2.3 Design conditions

2.1.8.2.4 Speed

2.1.8.2.5 Manufacturer's name and address

2.1.8.2.6 Other pertinent data

2.2 Inertia Base Frames: The pump manufacturer shall provide an inertia base frame to support each raw water pump as indicated on the contract drawings.

2.3 Pump Control Panel

2.3.1 General

2.3.1.1 The pump control panel shall be assembled and tested by the same manufacturer supplying the pumps to ensure suitability and assurance of experience in matching controls to motors and to ensure single source responsibility for the equipment.

2.3.1.2 The Contractor shall furnish all labor, materials, equipment and incidentals required to provide each vendor supplied duplex pump control panel as specified herein.

2.3.1.3 The pump control panel shall be assembled and tested by a shop meeting UL Standard 508 for industrial controls. Each pump control panel shall be assembled and tested by the same manufacturer supplying the pump to insure suitability and

assurance of experience in matching controls to motors and to insure single source responsibility for the equipment.

2.3.2 Construction

2.3.2.1 The controls for each raw water pump shall be contained in a stainless steel enclosure meeting NEMA 4X requirements with a hinged door and neoprene gasket.

2.3.2.2 The enclosure shall have provisions for padlocking. A nameplate shall be permanently affixed to the panel and include the model number, voltage, phase, hertz, ampere rating and horsepower rating. A warning label against electric shock shall be permanently affixed to the outer door. All fasteners shall be 300 series stainless steel or Type 6063T5 aluminum, or thermoplastic. The outer door shall be attached to the enclosure using captured, quarter turn thermoplastic screws and non-corrosive lift off hinge. The hinge shall permit the outer door to be separated from the main enclosure, when opened, by a simple upward motion. A hinge arrangement which requires unbolting for removal of the outer door is not acceptable.

2.3.2.3 A stainless steel back panel shall be provided. The back panel shall be mounted on stainless steel bolts using stainless steel nuts and lock washers to maintain enclosure integrity and shall be used as the means for mounting the components in the enclosure.

2.3.2.4 The motor starters and all electrical components for the pump control panel, except the main disconnect, shall be located in one enclosure. The starters shall meet requirements specified in Section 262920 – Motor Starters.

2.3.2.5 A run light, Hand-Off-Automatic (HOA) switch, and run time indicator shall be provided for each pump. Run light, status alarm light, and Hand-Off-Automatic switch shall be mounted on an electroplated bright zinc with clear chromate finish steel bracket. The run light, status alarm light, and Hand-Off-Automatic switch shall be properly labeled as to function. The Hand-Off-Automatic switch shall be rocker type with an electrical life of 50,000 operations. The run and status alarm lights shall match the Hand-Off-Auto switch in appearance and have an electrical life of 5,000 hours. Run light shall be green. Status alarm light shall be red. Provide an alternator for the raw water pumps.

2.3.2.6 The incoming electrical power service for the raw water pumps shall be as indicated on the drawings. Terminal blocks with box type lugs shall be supplied to terminate all wiring for floats and heat and seal sensors for the pump, if required. The pump leads shall be terminated at the overload relay or at box type terminal blocks.

2.3.2.7 Control voltage shall be 120 VAC and may be accomplished by the means of a transformer. A control fuse and on/off switch shall protect and isolate the control voltage from the line. One control voltage transformer shall be supplied.

2.3.2.8 Wire management raceways shall be used to maintain neat panel wiring bundles for maintenance and to prevent interference with operating devices. All wiring shall be color coded to facilitate maintenance and repair of each control panel. Where a color is repeated, number coding shall be added. A schematic shall be permanently attached to the inside surface of the front door.

2.3.2.9 All ground connections shall be made with ring tongue terminals and star washers to assure proper ground.

2.3.2.10 Box type lug connectors shall be made of polyamide thermoplastic to exclude aging due to heat influences. Phenolic type terminal blocks on the pump controller shall not be acceptable. Each terminal block shall be property and permanently labeled on the pump controller as to its purpose.

2.3.2.11 Wiring of the Hand-Off-Automatic switch, run light, contactor, and overload to the pump controller shall be accomplished by means of plug connectors. The header assemblies shall have male header assemblies from the corresponding devices as labeled on the pump controller for that male header assembly. Header assemblies shall be constructed of a corrosion-resistant thermoplastic material having a temperature range of -55°C to 105°C and copper alloy, bright acid tin over nickel plating contacts.

2.4 Pressure gauges for water piping shall be drawn cast gauges, having brass Bourdon tube soldered to socket and tip, stainless steel movement, and white-coated metal dial 4 ½ inches in diameter. Protect all gauges with Ashcroft No. 1092 ¼-inch tee handle cock and No. 1100 pigtail siphon filled with oil, or approved equal.

2.4.1 Pressure gauges for the discharge side of pumps shall be Ashcroft No. 1279 graduated from 0-150 psi, or approved equal.

2.4.2 Pressure gauges for the suction side of pumps shall be Ashcroft No. 1279 compound gauge graduated from 0-150 psi and 0-30 psi vacuum, or approved equal.

3 EXECUTION

3.1 The pumping units shall be installed in accordance with the instructions of the manufacturer and as shown on the drawings by the Contractor. The Contractor shall ensure that no pipe strain is transmitted to the pump casing.

3.2 Process Instruments

3.2.1 General

3.2.1.1 No instrument shall be scheduled to be installed in an area where active construction can cause it to be damaged unless the Contractor provides adequate protection for installed instrument.

3.2.1.2 Miscellaneous hardware such as fittings, fasteners, screws, etc., shall be good quality, corrosion resistant, and suitable for the service intended.

3.2.1.3 Installation of field mounted instruments shall be with rigid securing to stands or brackets in accordance the instrument manufacturer's written recommendations.

3.2.1.4 All cable, conduit, stands, supports, and appurtenances shall be installed in accordance with instrument manufacturer's written recommendations.

3.2.1.5 The instrument manufacturer/supplier shall have unit responsibility for equipment startup. Provide services of experienced, manufacturer-trained technicians for one site visit for each process instrument, consisting of a total of one 8-hour working day on the site, for installation, startup, calibration, and training and instruction of the Owner's personnel.

3.3 To ensure a properly integrated and compatible system, all equipment described in this section shall be furnished by the pump manufacturer, who shall assume full responsibility for the proper operation of the pumps and associated equipment

3.4 The Contractor shall arrange for the pump manufacturer to provide a factory trained representative as required for the purpose of supervising installation, start-up, final field acceptance testing, and providing instruction to the Owner's operating personnel in the proper operation and maintenance of the equipment in this section.

3.5 Equipment Check: After installation, the pumps shall be run to open discharge to check rotation and operation.

3.6 Performance Tests: Provide the service of the manufacturer's experienced technicians to perform testing of the system as installed. During the tests, all manufacturers' equipment shall be tested under every condition of operation, and all controls shall be tested to demonstrate performance of the required function. All adjusting and balancing shall be completed to the satisfaction of the Engineer. Warranty on adjustment of controls shall extend 1 year after the system is put into operation. All defects in the work and equipment shall be corrected by the Contractor at his own expense and the test repeated until proven satisfactory.

3.7 Startup: Follow the manufacturer's recommended startup procedures and demonstrate to the Owner that the equipment is performing as specified in this section.

End of Section

Section 11218
Submersible Vertical Turbine Pump

1 GENERAL

1.1 System Description: This section shall consist of, but not be limited to, all work associated with the following pumping equipment:

1.1.1 Submersible Well Pump

1.2 Reference Specifications where applicable to work under this section are referred to by abbreviation as follows:

1.2.1 Anti-Friction Bearing Manufacturers Association..... AFBMA

1.2.2 American Iron and Steel Institute .....AISI

1.2.3 American National Standards Institute ..... ANSI

1.2.4 American Society for Testing and Materials ..... ASTM

1.2.5 Food and Drug Administration .....FDA

1.2.6 Hydraulic Institute ..... HI

1.2.7 International Organization for Standardization ..... ISO

1.2.8 National Electrical Code .....NEC

1.2.9 National Electrical Manufacturers Association .....NEMA

1.2.10 Underwriters Laboratory..... UL

1.3 Quality Assurance

1.3.1 The water pumping equipment shall be provided as a package system as specified, as indicated on the drawings, and as required to provide a complete assembly ready for operation.

1.3.2 The water pumping equipment specified in this section shall be furnished by one equipment supplier as an integrated design package. The supplier shall provide all equipment and appurtenances and be responsible for the complete and satisfactory operation of the equipment. The equipment supplier shall be the water pumping equipment manufacturer.

1.3.3 The equipment supplier shall have unit responsibility for its equipment startup. Provide services of experienced manufacturer-trained technicians for two site visits for startup and training. The site visits shall consist of a minimum of two 8-hour working days total on the site to demonstrate

satisfactory pump operation and to provide training and instruction of the Owner's personnel for equipment operation.

1.3.4 Submersible well pumps manufactured by Xylem (Goulds Water Technology) shall be the design standard. The contract drawings and design of the booster pumps are based on the design standard. Berkeley, Hydroflo Pumps, and Grundfos shall be considered approved equals for groundwater well pumping equipment. Other manufacturer substitutions not listed above will not be allowed and will be considered a non-responsive bid. Equipment supplied other than the design standard shall conform to all requirements specified in this section.

1.4 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.4.1 Performance Statements

1.4.1.1 A statement shall be provided with the bid indicating that the pump manufacturer has reviewed the pump suction conditions on the Drawings along with the indicated normal and low water levels and that the manufacturer's pumping unit will operate without submergence, NPSH, entrance and other hydraulically related problems. If the manufacturer does not believe the units will operate properly, he shall state so and list what modifications must be made before he can guarantee correct performance.

1.4.1.2 Manufacturer shall review installation details for proposed pumping units and confirm the suitability of details for the pump installation. If details are not satisfactory, the manufacturer shall provide statement as to modification required and contractor shall include costs for this work in his bid.

1.4.2 Certified pump curves

1.4.3 Catalog cuts, shop drawings, and wiring diagrams for equipment and accessories.

1.4.4 Pump operational test reports.

1.4.5 Operation and Maintenance Manual: Submit O&M Manual in pdf electronic format.

1.4.5.1 The manuals' identification shall be inscribed on the cover.

1.4.5.2 The manuals shall include the names, addresses, and telephone numbers of the local representatives for each item of equipment and each system.

1.4.5.3 The manuals shall have a table of contents and be assembled to conform to the project manual table of contents with the tab sheets placed before instructions covering the subject. Additionally, each manual shall contain a comprehensive index of all manuals submitted in accordance with this paragraph.

1.4.5.4 Manuals and specifications shall be furnished which provide full and complete coverage of the following subjects:

1.4.5.4.1 Operational Requirement: This document shall describe, in concise terms, all the functional and operational requirements for the system.

1.4.5.4.2 Maintenance: Documentation of all user performed maintenance on all system components, including inspection, and periodic replacement of defective units. This shall include calibration, maintenance, and repair of all equipment, instrumentation, and controls, plus diagnosis and repair or replacement of all system hardware.

1.5 Project Conditions

1.5.1 Equipment furnished in accordance with this section shall be installed at the location and in the space allocated on the contract drawings.

1.5.2 Pump manufacturers shall supply pumps as complete units, including motors, drives, belts, couplings, base plates, guards, and all other required accessories and appurtenances, to ensure compatibility and integrity of the individual components, and provide the specified warranty for all components. Assembly by the Contractor of pumps, motors, shafting, couplings, and the like supplied by various independent manufacturers will not be allowed.

1.5.3 Pump shall be engineered and manufactured under a written quality assurance program. The quality assurance program shall be in effect for at least ten years, to include a written record of periodic internal and external audits to confirm compliance with such program. Pump shall be engineered and manufactured under the certification of ISO-9001:2015.

1.5.4 Pump motor shall be sized such that the motor does not overload at any point on the operating curve. Pump and motor shall be designed for continuous duty operation. Other motor requirements shall be as specified in this section.

1.5.5 Electrical Motors, Controllers, Starters, and Disconnects: Furnish motors, controllers, starters, and disconnects with their respective pieces of equipment. Motors, controllers, starters, and disconnects shall conform to

and shall have electrical connections in accordance with the National Electrical Code. Controllers and starters shall have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished.

1.5.6 Any structural, piping, electrical requirements, wiring, instrumentation and controls, drawings, or other modifications required to accommodate equipment offered shall be done at no additional cost to the Owner.

1.6 Warranty: The pump unit, motor, or any part thereof shall be warranted against defects in material or workmanship within five (5) years from the date of substantial completion, and shall be replaced, including labor, at no charge with a new or remanufactured part.

1.7 Functional Description

1.7.1 The Well No. CCO-17A pump is constant speed and equipped with either Hand or Automatic Mode. In the automatic mode, the pump will activate upon level demand at the Raw Water Storage Tank located at the Water Treatment Facility. The pump will deactivate upon receiving a High Level indication at the Raw Water Storage Tank.

1.7.2 Should the well pump not activate, as indicated by the discharge flow switch, a status alarm shall be indicated at the Water Treatment Facility.

2 PRODUCTS

2.1 Submersible Vertical Turbine Pumps

2.1.1 General

2.1.1.1 The thrust of each pump at any point on its design curve shall not exceed the standard thrust rating of the motor.

2.1.1.2 All pumping units shall be designed to withstand reversal up to 150 percent of full speed or maximum turbine speed based on the discharge pressure, whichever is greater, without damage to or failure of any part of the pumping unit.

2.1.2 Conditions of Service

2.1.2.1 The well pump shall be located inside an existing casing pipe.

2.1.3 The pumps and motors shall be designed to operate under the conditions as listed in Table 1.

TABLE 1 Submersible Vertical Turbine Pumps		
Description	**Unit**	**Domestic Well Water Pump**
A. General		
Number of pumps	---	As indicated on the contract drawings
Well yield surface elevation (at 90 gpm)	feet	275.0
Well static surface elevation	feet	450.9
Ground elevation at well	feet	As indicated on the contract drawings
Low water level in raw water tank	feet	614.5
High water level in raw water tank	feet	620.0
Drop Pipe Diameter (nominal)	inches	3
Pipe Discharge outlet diameter	inches	4
Diameter of Casing Pipe	inches	8
Manufacturer	---	Goulds Water Technology or approved equal
Model	---	65L
B. Motor (constant)		
Motor rating (see Note A)	HP	10
Approximate speed at no load	RPM	3,450
Minimum full load power factor	%	90
Service factor, continuous duty	---	1.15 SF Sine Power 1.0 SF Inverter Power
Electrical Service	---	As indicated on the contract drawings

TABLE 1 Submersible Vertical Turbine Pumps		
Description	**Unit**	**Domestic Well Water Pump**
C. Design Points (at full speed)		
Design Point 1 (Primary)		
Capacity	gpm	70
Total dynamic head	feet	412
Bowl efficiency (Minimum)	%	67.5
Design Point 2 (Secondary)		
Capacity	gpm	83
Total dynamic head	feet	260
Bowl efficiency (Minimum)	%	57
D. Miscellaneous pump requirements		
Maximum dynamic head along curve (Shutoff)	feet	560
Required net positive suction head at Design Point 1	feet	12.9
Net positive suction head at Runout Point	feet	23

NOTE A: All motors may not operate in the service factor at any point on the pump curve.

NOTE B: The pump manufacturer shall field verify all dimensions and elevations. The pumps shall be sized and designed to fit in the intended space and connect to the new and existing piping as shown on the Drawings.

2.1.4 Pump Construction

2.1.4.1 Bowl assembly: The intermediate bowls, submersible discharges, and motor brackets shall be constructed from ductile iron, ASTM A536, Class 65. They shall be flanged type construction and free of blow holes, sand holes or other faults and be machined accurately with fitted close tolerances. The bowls shall have glass enamel or epoxy enamel lined waterways for maximum efficiency. All bowls, discharges and motor brackets are to be assembled with stainless steel bolting.

2.1.4.2 Impellers: The impellers shall be investment cast Type 304 stainless steel, ASTM A296 and shall be enclosed type. They shall be free

from defects and must be investment cast, machined, backfiled and balanced for optimum efficiency and performance. They shall be securely fastened to the bowl shaft with stainless steel taper locks. C1045 steel will not be accepted.

2.1.4.3 Bowl shaft shall be constructed from PSQ 416 stainless steel, ASTM A582 pump shaft material. The shaft shall be precision machined and straightened within 0.002 – 0.004 tolerance.

2.1.4.4 The motor adapter must be constructed of ductile iron, ASTM A536, Class 65, to handle the weight and torque of the submersible motor. The water inlet must be above the motor bracket bearing to prevent early motor bracket bearing failures. The inlet area shall be protected by a Type 304 stainless steel screen with a net opening of four times the impeller eye opening.

2.1.4.5 The submersible discharge shall be constructed of ductile iron, ASTM A536, Class 65, to handle the entire weight and torque of the pump and motor assembly. The discharge shall be threaded with NPT threads and have an extra-long top bearing for stability and long pump life.

2.1.4.6 The motor coupling shall conform to NEMA standards and be constructed of 416 stainless steel. It shall be capable of handling the total torque, horsepower and thrust load of the bowl assembly.

2.1.5 Drop Pipe

2.1.5.1 Drop pipe shall be Schedule 40 Type 316 stainless steel pipe with ends machined with NPT thread. Pipe shall be connected with threaded couplings.

2.1.6 Surface Plate

2.1.6.1 The above ground discharge shall be of fabricated steel and incorporate a long radius elbow securely welded to an ANSI Class 150 flange. The discharge shall be welded and secured to a surface plate capable of holding 1½ times the total weight of the pump, motor, pipe, wire and weight of the water in the pipe. The surface plate shall also incorporate an opening for the pump cable, with sealing capability. Cable entry shall terminate in a watertight conduit box located approximately 12 inches above the top of the surface plate.

2.1.7 Flow Inducing Sleeve

2.1.7.1 The pump shall be provided with a flow inducing sleeve provided by the pump manufacturer to draw water over the motor as it

approaches the intake to provide the required cooling for the pump motor.

2.1.8 Submersible Electric Cable

2.1.8.1 The cable shall consist of three or more separate conductors (or) a single jacketed three conductor cable assembly. Each conductor shall be insulated with synthetic rubber or plastic suitable for continuous immersion in the liquid being pumped. The cable must be protected by a suitable shield or guard when it passes the bowl section to prevent damage in installation or operation.

2.1.8.2 The cable must be a continuous jacketed copper wire type and attach to the submersible motor lead with an approved water tight splice.

2.1.9 Well Pump Electric Motor

2.1.9.1 The well pump motor shall be manufactured by Franklin Electric, or approved equal, and shall be suitable for operating completely submerged in drinking water. Motor shall be submersible, induction type, premium efficiency, inverter-duty, UL 778 recognized, designed for continuous duty, underwater operation, and shall possess hermetically sealed windings. Electrical service for the pump shall be as indicated on the contract drawings. The motor speed shall be 3,450 RPM.

2.1.9.2 Motor thrust bearing rating must be ample to carry the thrust load imposed by the pump when operating under the maximum anticipated pumping head. With the motor in the "shaft up" position, direction of thrust shall be downward. Motor thrust bearing must be capable of operating with rotation in either direction, and thrust capacity, when operated in reverse rotation, shall not be less than 75% of rated thrust capacity.

2.1.9.3 An expansion chamber diaphragm shall be provided to relieve thermal expansion of internal motor fluid due to temperature variation and shall provide motor internal and external pressure balance under all conditions of temperature and pressure.

2.1.9.4 Shaft shall be Type 416 stainless steel or equivalent corrosion resistant material. Outer shell shall be of material resistant to corrosion.

2.1.10 Lifting Eyes

2.1.10.1 Pump and surface plate above ground discharge shall be equipped with permanent lifting eyes or lugs to facilitate the installation and removal of the pump.

2.1.11 Threaded Discharge Piping for Well Pumps: The Contractor shall provide new Schedule 40 Type 316 stainless steel discharge column piping suitable for submersible pump applications. One piece may be a cut length to accommodate the pump intake setting. The column piping shall be threaded and coupled together.

2.1.12 Nameplates

2.1.12.1 Motor: List all data pertinent to proper installation of each motor and identification of motor for maintenance and replacement parts, including as a minimum:

2.1.12.1.1 Serial number

2.1.12.1.2 Manufacturer's model number

2.1.12.1.3 Horsepower

2.1.12.1.4 Speed

2.1.12.1.5 Voltage

2.1.12.1.6 Number of phases

2.1.12.1.7 Service factor

2.1.12.1.8 Time rating

2.1.12.1.9 Manufacturer's number of each bearing

2.1.12.2 Pump: List all data pertinent to proper installation of each pump and identification of motor for maintenance and replacement parts, including as a minimum:

2.1.12.2.1 Serial number

2.1.12.2.2 Manufacturer's model number

2.1.12.2.3 Design conditions

2.1.12.2.4 Speed

2.1.12.2.5 Manufacturer's name and address

2.1.12.2.6 Other pertinent data

3 EXECUTION

3.1 Installation: Install equipment as shown on the contract drawings and according to the written instructions of the manufacturer. Provide all necessary interconnections, services, and adjustments required for a complete operating system.

3.2 Typical Well Pump Installation: Install the pump and motor with threaded and coupled stainless steel riser piping sized as indicated on the drawings and new 4/3 flat jacketed stranded copper submersible drop cable with ground according to the written instructions of the pump manufacturer. An approved watertight connection shall be made between the pump motor and the submersible power cable. The power cable shall be attached to the column piping above and below each coupling and in the middle of each pipe length using pipe wrap tape. Provide all necessary interconnections, services, and adjustments required for a complete operating system.

3.3 Equipment Check: After installation, the pumps shall be run to open discharge to check rotation and operation.

3.4 Disinfection: Disinfect well, equipment, and material in accordance with Article 54 of the EPA Manual of Water Well Construction Practices and as specified herein. Portions of the well above the water level shall be maintained in a wet condition with a minimum of 50 ppm of free available chlorine for a period of not less than 30 minutes. A stock chlorine solution sufficient to produce 50 ppm of free available chlorine throughout the water in the well shall be added to the well at different water level intervals from top to bottom and then agitated to distribute the chlorine solution evenly throughout the well. The chlorine shall remain in the well for a minimum of 12 hours. After the 12-hour period, pump the well free of chlorine. Disinfect piping in accordance with AWWA C601.

3.5 Performance Tests: Provide the services of the pump manufacturer's experienced engineers to perform testing of each pump system as installed. During the tests, all manufacturer's equipment shall be tested under every condition of operation, and all controls shall be tested to demonstrate performance of the required function. All adjusting and balancing shall be completed to the satisfaction of the Engineer. Warranty on adjustment of controls shall extend 1 year after the system is put into operation. All defects in the work and equipment shall be corrected by the Contractor at his own expense and the test repeated until proven satisfactory.

3.6 Startup: Follow the manufacturer's recommended startup procedures and demonstrate to the Owner that the equipment is performing as specified in this section.

End of Section

Section 11240
Water Softening Equipment
(Owner Furnished)

1 GENERAL

1.1 System Description

1.1.1 Provide as indicated a factory assembled skid mounted vertical pressure type water softener system requiring minor assembly and media loading at installation. The water softener system shall consist of a set of two (2) 36-inch diameter softener tanks in series and one (1) 39-inch diameter brine maker. The skid mounted water softener system shall be fitted and shipped with all header piping, control valves and actuators and electrical controls attached to the softener tank for ease of installation and start up. The system shall be of an approved design as fabricated by Marlo, Inc., Hungerford and Terry, Inc., or Tonka Water. or approved equal. Other manufacturer substitutions will not be allowed. All equipment and material shall be supplied in compliance with the specifications as intended for a complete and operational system. The water softener system shown on the Contract drawings is based on a design as fabricated by Marlo, Inc. Systems manufactured by Hungerford and Terry, Inc., Tonka Water, and Culligan Water shall be considered as approved equals.

1.1.2 The softening system is intended for the removal of manganese and radium 226+228 from drinking water. Under normal operation, manganese shall be reduced from a maximum level of 0.083 mg/L to less than 0.05 mg/L, and Radium-226+228 shall be reduced from a maximum level of 7.3 picocuries (pCi)/L to less than 0.73 pCi/L. The system shall treat water with an average total hardness of 94 mg/L.

1.1.3 Qualified manufacturers of water softening equipment shall have been engaged in the manufacture of this type of equipment for a period of not less than ten (10) years. Marlo Model MGT-600-2 Twin Series Softener (primary with polisher) Meter/Demand Water Softener System as manufactured by Marlo, Inc., 2227 South Street, Racine, WI 53404 (Telephone: 262-681-1300, Fax: 262-681-1318) shall be the design standard for the softener system. The drawing and design of the softening units is based on the MGT-600-2 softener.

1.1.4 Salt for brine preparation shall be NSF 60 approved for use in drinking water treatment.

1.2 Reference specifications where applicable to work under this section are referred to by abbreviation as follows:

1.2.1 American National Standards Institute..... ANSI

1.2.2 National Sanitation Foundation ..... NSF

1.2.3 Virginia Department of Health ..... VDH

1.3 Submittals

1.3.1 Detailed shop drawings of the softener system, including plan view, elevation view, equipment details, and mechanical and electrical details.

1.3.2 Product data for valves, flow controllers, vessels, pressure gauges, softening resin, and other appurtenances.

1.3.3 Written installation instructions.

1.3.4 Electrical power supply equipment and instrumentation and controls data, including equipment, point-to-point wiring diagrams, point-to-point instrumentations, control panels, and sequence of operation.

1.3.5 Operation and maintenance manuals, including approved shop drawings, recommended spare parts list, instructions on lubrication and adjustment requirements, recommended schedule of maintenance tasks, startup and operating instructions, troubleshooting instructions, and addresses and telephone numbers for equipment manufacturer and manufacturer's local service representative.

1.4 Project Conditions

1.4.1 Equipment furnished in accordance with this section shall be installed at the location and in the space allocated on the contract drawings.

1.4.2 Pump manufacturers shall supply water softeners as complete units, including valves, controllers, vessels, resin, and all other required accessories and appurtenances, to ensure compatibility and integrity of the individual components, and provide the specified warranty for all components. Assembly by the Contractor of valves, controllers, vessels, resin, and the like supplied by various independent manufacturers will not be allowed.

1.4.3 Electrical Motors, Controllers, Starters, and Disconnects: Furnish motors, controllers, starters, and disconnects with their respective pieces of equipment. Motors, controllers, starters, and disconnects shall conform to and shall have electrical connections in accordance with the National Electrical Code. Controllers and starters shall have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished.

1.4.4 Any structural, piping, electrical requirements, wiring, instrumentation and controls, drawings, or other modifications required to accommodate equipment offered shall be done at no additional cost to the Owner.

1.4.5 If water softening equipment other than the design standard is used, the Contractor shall provide a similar arrangement and revise the dimensional layout as necessary. Such revisions to the design must be approved by the Engineer in the shop drawing phase of construction, and shall be revised and constructed at no additional cost to the Owner. Equipment supplied other than the design standard shall conform to the paragraph entitled "Project Conditions" and all additional requirements specified in this section.

1.5 Guarantee

1.5.1 Under normal operating conditions, the resin shall not be washed out of the system during regeneration or service. Any mechanical equipment proving defective in workmanship or material within one year after installation or 18 months after shipment, whichever comes first, shall be replaced FOB factory.

1.5.2 The fiberglass reinforced pressure vessels shall be warranted for a period of five (5) years.

1.6 Functional Description

1.6.1 Water softeners shall be interlocked to operate simultaneously with the Raw Water Pumps. Backwash of the water softeners shall be manually initiated by County personnel. A setpoint for water throughput for each water softener shall be adjustable by County personnel at the local water softener controller in the Water Treatment Facility.

2 PRODUCTS

2.1 Performance Requirements: The water softener equipment shall be capable of meeting the following performance requirements:

2.1.1 Flow Rates

2.1.1.1 Design System Flow and Pressure Drop (per softener unit): 39 GPM at 2.3 psi.

2.1.1.2 Peak System Flow and Pressure Drop (per softener unit): 110 GPM at 25 psi.

2.1.1.3 Continuous System Flow and Pressure Drop (per softener unit): 87 GPM at 15 psi.

2.1.2 Maximum Daily Water Production: 12,250 gallons/day

2.1.3 Daily Average Water Production: 7,840 gallons/day

2.1.4 Daily Hours of Water Demand: 24 hours/day

2.1.5 Softener Unit Freeboard: 50% minimum

2.1.6 Operating Pressure Range: 30-100 psi

2.1.7 Operating Temperature Range: 35-100ºF

2.1.8 System Skid Dimensions: 129 inches x 39 inches x 89 inches (LxWxH)

2.1.9 Softening Resin Volume: Two (2) 20 ft^3 tanks

2.1.10 Water Softener Equipment Data: VDH *Waterworks Regulations* 12VAC5-590-900 requires that the design capacity for hardness removal should not exceed 20,000 grains per cubic foot when resin is regenerated with 0.3 pounds of salt per kilograin of hardness removed.

2.1.10.1 Exchange capacity: 400,000 grains/tank

2.1.10.2 Electrical Requirements: As indicated on the contract drawings

2.1.10.3 Regeneration type: Water meter

2.1.10.4 Number of Water Meters per Softening Unit: One (1)

2.1.10.5 Water Meter Size: 2-inch

2.1.10.6 Water Meter Type: Turbine

2.1.10.7 Total Number of Brine Makers: One (1)

2.1.10.8 Brine Maker Dimensions: 39 inches in diameter and 60 inches in height

2.1.10.9 Salt storage: 1,760 pounds/5 regenerations

2.1.10.10 Controls and Operator Interface for Sequence of Operation

2.2 Materials and Equipment

2.2.1 Water Softener Vessels

2.2.1.1 Each water softener vessel shall be manufactured of NSF/ANSI 44 certified fiberglass reinforced polyester (FRP). The exterior side shall be reinforced by a continuous roving glass filament overwrap of the same color as the vessel's shell. Each vessel shall be supported by a molded polypropylene structural base. Each vessel shall be designed for a working pressure of 150 psi and a temperature of 120ºF. A minimum freeboard volume of 50% shall be provided to assure adequate bed expansion during backwash.

2.2.2 Upper Distributor

2.2.2.1 The upper distribution system shall be a single plastic disperser.

2.2.3 Lower Distributor

2.2.3.1 The backwash distributor and soft water collector shall be of the hub-radial design and shall require only assembly of the riser pipe upon installation. The radials shall be designed with a higher density of slots at the outer ends to provide adequate distribution and collection of water away from the center of the tank. Internal piping material shall be constructed of polyvinyl chloride (PVC) and/or acrylonitrile butadiene styrene (ABS) plastic. A washed gravel underbedding shall be provided as a support bed for the exchange media and an aid in backwashing.

2.2.4 Main Operating Valves

2.2.4.1 Each control valve shall have 2-inch inlet and outlet connections and be constructed of lead-free brass. Each control valve shall be of the mechanically actuated, four position type to accomplish the regeneration steps of backwash, brine draw/slow rinse, fast rinse and brine tank refill. Each valve shall contain a fixed orifice eductor nozzle and self-adjusting backwash flow control. Control valves shall be Fleck Model 2900S, or approved equal.

2.2.5 Flow Meters

2.2.5.1 Each water softener unit shall shall have a 2-inch turbine-type flow meter constructed of stainless steel with threaded end connections. Flow range for each flow meter shall be 1.5-150 GPM. Flow meters shall be Clack Corporation Model V3050 WS2, or approved equal.

2.2.6 Control System

2.2.6.1 The control system shall have an integral timer for adjustable duration of the various steps in the regeneration cycle and shall allow for the manual initiation of the regeneration cycle.

2.2.6.2 The system shall have an electronic microprocessor- based controller with a 2-4 line scrolling OLED display. The display shall indicate system number, networking status, valve state, master unit, time of day, day and date, batch volume remaining, and current flow rate. In addition, a LED status light shall be provided to indicate controller status: in serve, regeneration queued or regenerating, standby, or error. Programming and time of day shall be stored in non-volatile memory.

2.2.6.3 The controller shall also be capable of providing the real time flow rate, peak flow rate, totalizer, reserve capacity, use since last regeneration, last regeneration, total number of regenerations, regeneration interval, last settings change, error log history, and average daily use.

2.2.6.4 The controller shall provide two programmable relay outputs, one of which can be used for alarm output.

2.2.6.5 The controller shall operate on 24 VDC and multi-unit communications shall be accomplished with low voltage network cables. The controller shall be capable of networking up to eight valves.

2.2.6.6 Metered units shall also provide current flow rate, peak flow rate, water usage totalization, and batch volume remaining. A calendar clock override of the water meter shall be provided to initiate regeneration.

2.2.7 Mode of Operation

2.2.7.1 The system shall consist of two resin tanks, each having a dedicated turbine type flow sensor in the softener outlet piping and operate in the twin series configuration (primary with polisher).

2.2.7.2 The outlet of the primary vessels shall be plumbed to the inlet of the polisher vessel.

2.2.7.3 As each resin tank user set volume is reached, a status alarm in the SCADA system shall activate and notify the operator that tank regeneration is required. The operator shall manually take the tank off-line. Once the tank is regenerated, it shall be placed immediately back on-line or standby depending on treated water flow demand. The controller shall be capable of continuously determining the exhaustion rate of each media tank.

2.3 Brine System

2.3.1 The combination salt storage and brine measuring tank with cover shall be constructed of rotationally-molded rigid polyethylene. The brine tank shall be equipped with an elevated salt plate for the collection of brine and shall have a chamber to house a brine valve assembly. The brine valve assembly shall include an automatic air eliminator and safety float shut-off valve. The assembly shall open automatically to educt brine, close to prevent the entrance of air after the brine has been drawn, and permit refill of the tank with the correct amount of water. Brine dosage shall be controlled by the softener control valve through an adjustment on the clock timer. The system shall be designed to allow proper refilling, regardless of the salt level in the tank.

2.3.2 Makeup water shall be distributed evenly within the brine tank. The makeup water connection shall have an air gap prior to the brine tank to protect against backsiphonage.

2.4 Softening Resin

2.4.1 The ion exchange resin shall be of a premium grade high capacity synthetic sulfonamide styrene divinyl benzene to be furnished in the sodium form. The resin shall be stable over the entire pH range, have good resistance to bead fracture, and be insoluble in all common solvents. Each cubic foot of resin shall be capable of 30,000 grains per cubic foot capacity when regenerated with 15 pounds of salt (NaCl).

2.5 Accessories

2.5.1 Water test kits for hardness test shall be supplied to conduct soap drop test.

2.6 Nameplates

2.6.1 Water softening units: List all data pertinent to proper installation of each water softener unit, brine tank, control valve, and appurtenances, and identification for maintenance and replacement parts, including as a minimum:

2.6.1.1 Serial number

2.6.1.2 Manufacturer’s model number

2.6.1.3 Design conditions

2.6.1.4 Backwash design conditions

2.6.1.5 Manufacturer’s name and address

2.6.1.6 Other pertinent data

3 EXECUTION

3.1 The entire system shall be leak and electrically tested as a unit by the manufacturer before shipment.

3.2 Instructions

3.2.1 A complete set of installation, operating, and maintenance instructions for the softener units and all appurtenances shall be provided.

3.2.2 Provide all necessary interconnections, services, and adjustments for a complete operating system.

3.3 Performance Test: Provide the services of the system manufacturers' experienced engineers to perform testing of the system installed. During the tests, all manufacturers' integrated equipment shall be tested under every condition of operation, and controls shall be tested to demonstrate performance of the function. All adjusting and balancing shall be completed to the satisfaction of the Engineer. Provide a warranty on adjustment of the controls, and extend the warranty 1 year after the system is put into operation. All defects to the work provided by the Contractor shall be corrected at no expense, and the test repeated until proven satisfactory.

3.4 Field Service

3.4.1 The services of a factory authorized service representative shall be made available to supervise, inspect and provide operator training as required for initial start-up and system performance testing and operation.

3.4.2 Provide the services of experienced manufacturer-trained technicians for two site visits (after initial installation and startup) consisting of a total of four 8-hour working days on the site to demonstrate satisfactory operation of the equipment and to provide training and instruction of the Owner's personnel for equipment operation.

End of Section

Section 11247
Chemical Piping and Appurtenances

1 GENERAL

1.1 Description

1.1.1 Chemical piping and appurtenances shall consist of, but not be limited to, all piping, valves, and other appurtenances required for complete and operable feed systems for the following chemicals:

1.1.1.1 Sodium Hypochlorite Solution (12.5%)

1.1.2 The Contractor shall provide all labor, materials, equipment, and incidentals required to install, test, and place in satisfactory services all chemical feed systems and equipment as indicated on the drawings and as specified herein.

1.2 Submittals: Provide the following in a timely manner in accordance with Section 01400 – General Requirements.

1.2.1 Catalog cuts, performance data, shop drawings, replaceable parts lists, and certificates of compatibility with intended chemical service for the following:

1.2.1.1 Piping, Fittings, and Pipe Appurtenances

1.2.1.2 Valves

1.2.1.3 Containment Work Station

1.3 Project Conditions

1.3.1 Equipment furnished in accordance with this section shall be installed at the location and in the space allocated on the contract drawings. The Contractor shall provide all labor, materials, equipment, and incidentals required to install, test, and place in satisfactory service all chemical feed equipment as indicated on the drawings and as specified herein.

1.3.2 Any structural, piping, electrical requirements, wiring, instrumentation and controls, drawings, or other modifications required to accommodate equipment offered other than that specified as the design standard and as shown on the drawings shall be done at no additional cost to the Owner.

2 PRODUCTS

2.1 Piping Application: Pipe leakage will not be allowed.

2.1.1 Above grade chemical piping inside Water Treatment Facility: Solvent welded Schedule 80 polyvinyl chloride (PVC), unless otherwise noted.

2.1.2 Accessories: Provide chemically resistant flanges, quick disconnects,

connecting pieces, transition glands, transition sleeves, and other adapters as required for complete and operable piping systems for service indicated.

2.2 Pipe

2.2.1 Polyvinyl Chloride (PVC) Piping

2.2.1.1 Pipe, couplings, and fittings shall be Schedule 80 meeting the requirements of ASTM D1785, manufactured of material meeting the requirements of ASTM D1784, Type 1120. Provide ASTM D2467 Schedule 80 fittings and ASTM D2564 solvent cement.

2.2.1.2 Provide screwed joints and flanges as required to connect dissimilar pipe materials, valves, equipment, and appurtenances.

2.2.2 Pipe Supports for Chemical Piping: Pipe supports shall be in accordance with Section 11250 – Pipe Supports and Anchors for Chemical Piping.

2.3 Chemical Valves: Valve leakage will not be allowed. Each valve manufacturer shall provide certificates indicating valve compatibility with the intended chemical service.

2.3.1 Ball Valves

2.3.1.1 Ball valves for service with polyvinyl chloride (PVC) piping shall be constructed of ASTM D 1784 PVC body, ball, carrier, and stem with TFE ball seat and Viton "o" rings and gaskets. Socket welded construction shall be PVC full port, True Union (Double Union/Double Block through 3-inch diameter) design. Flanged construction shall be PVC flanges conforming to 150-pound drilling. Valves shall be suitable for 175-psi nonshock cold water service at 70°F. Valves shall be Nibco/Chemtrol, or approved equal by Hayward.

2.4 Corporation Stop Type Chemical Injectors

2.4.1 Chemical Injector: Injector configuration shall provide a single feed point into the center of the water main. Materials of construction shall be compatible with chemical solution and be capable of withstanding 175 psi. Insertion length shall be such that the tip of the injector is at the center of the water line.

2.4.2 Water main connection shall be a bronze corporation stop. Thread connection shall be male NPT and capable of withstanding 175 psi. Corporation stop must include an acceptable safety device to prevent accidental release of solution tube while under maximum water main pressure and/or surge conditions.

2.4.3 Solution Tube: Solution tube shall be ½-inch Hastelloy C. An acceptable locking device must be included to prevent accidental release of the solution tube from the water main while under pressure. A PVC spring loaded ball check valve with a Hastelloy spring shall be included to prevent backpressure from the main from entering the chemical feed system. A stainless steel safety chain shall be included to prevent withdrawal of solution tube past corporation stop.

Safety chain length shall be preset by manufacturer for closure of the corp. stop before withdrawal of solution tube.

2.4.4 The injector shall be equipped with a flexible hose assembly to allow removal of the injector assembly without disassembling the chemical feed piping.

2.4.5 Operator shall be able to withdraw or insert solution tube into water main while under pressure and without having to shut down the main.

2.4.6 Injector Assembly shall be Saf-T-Flo or approved equal by Siemens/Wallace & Tiernan and shall have accessories indicated on the drawings.

2.5 Containment Work Station: Enpac "Drums-Up" Product No. 8091-YE (USA Bluebook Stock No. 42657) with 19.5-gallon polyethylene sump, or approved equal.

3. EXECUTION

3.1 Installation: Install piping and equipment as shown on the drawings and according to the written instructions of the manufacturer. Provide all necessary interconnections, services, and adjustments required for complete operating chemical feed systems.

3.2 Installation of chemical piping, including equipment, materials, and workmanship, shall be in accordance with the SBCC Standard Plumbing Code.

3.2.1 Piping systems: Piping system shall be hydrostatically tested at 100 psig, and shall show no leakage or reduction of gauge pressure after 4 hours.

3.2.2 Clean and flush chemical piping of all loose dirt, grit, and other extraneous materials prior to installation.

3.3 Pipe Laying

3.3.1 Take all precautions necessary to ensure that pipe, valves, fittings, and other accessories are not damaged in unloading, handling, and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.

3.3.2 Exercise care to keep foreign material and dirt from entering pipe during storage, handling, and placing in trench. Close ends of in-place pipe at the end of any work period to preclude the entry of animals and foreign material.

3.3.3 Bedding of pipe shall be as specified in Section 02200 – Earthwork.

3.3.4 Do not lay pipe when trench bottom is muddy or frozen, or has standing water. Keep excavations clear of water while work is being installed. Control subsurface water in accordance with Section 02200 – Earthwork.

3.3.5 Use only those tools specifically intended for cutting the size and material and type pipe involved. Make cut to prevent damage to pipe or lining and to leave a

smooth end at right angles to the axis of the pipe.

3.3.6 Above grade pipe inside buildings and within the chemical pipe trenches shall be secured and supported in accordance with Section 11250 Pipe Supports and Anchors for Chemical Piping.

3.4 Join and assemble solvent welded PVC pipe joints in accordance with requirements of ASTM D 2855.

3.5 Pipe Labeling

3.5.1 Above grade piping and piping within concrete chemical pipe trenches shall be labeled. Arrows shall be provided to indicate direction of flow. Provide labeling every 15 linear feet of pipe, close to valves, adjacent to changes in direction, branches, and where pipes pass through walls or floors. Labels shall be either black for light colored piping or white for dark colored piping and shall be of such size to be clearly visible and readable.

End of Section

Section 11248
Liquid Chemical Feed Systems

1 GENERAL

1.1 Summary

1.1.1 Section Includes: Provision of peristaltic chemical feed pumps and accessories as shown on the contract drawings and as specified herein.

1.2 Description

1.2.1 The Contractor shall furnish the complete pre-assembled chemical feed system. The packaged system shall be installed by the Contractor as indicated on the drawings. Chemical feed systems shall be self-contained. Each package system shall include, but not be limited to, metering pumps, calibration column, pressure relief valves, piping, fittings, valves and controls as specified to provide a complete system.

1.2.2 Pumps shall be positive displacement peristaltic type complete with retractable roller pump head, self contained variable speed drive, flexible extruded tube element, integral tube failure detection system, and fittings as specified. Peristaltic pumping action is created by the compression of the flexible tube between the pump head rollers and track, induced forward fluid displacement within the tube by the rotation of the pump rotor, and subsequent vacuum-creating restitution of the tube.

1.2.3 Pumps shall be dry self priming, capable of being run dry without damaging effects to pump or tube, and shall have a maximum suction lift capacity of up to 30-foot vertical water column.

1.2.4 Pump shall use no check valves or diaphragms and shall require no dynamic seals in contact with the pumpage. Process fluid shall be contained within pump tubing and shall not directly contact any rotary or metallic components.

1.2.5 Flow shall be in the direction of the rotor rotation which can be reversed and shall be proportional to rotor speed.

1.2.6 Performance Requirements: Provide following chemical feed pumps. All pumps described in following schedule are ChemTech Series XP peristaltic pumps, as manufactured by Pulsafeeder.

Chemical Description	Sodium Hypochlorite
Chemical Strength	12.5%
Pump Model	XP007
Quantity	As indicated on the contract drawings
No. Heads per Pump	1
Capacity Range	0.014-0.29 GPH (0.35-7 GPD)
Maximum Discharge Pressure (psi)	110
Maximum Pump Speed (RPM)	30
Turndown Ratio	20:1
Tubing Inside Diameter	Per manufacturer's recommendations
Electrical Power	As indicated on the contract drawings

1.3 Reference specifications where applicable to work under this section are referred to by abbreviation as follows:

1.3.1 American National Standards Institute ..... ANSI

1.3.2 Canadian Standards Association..... CSA

1.3.3 National Electrical Code..... NEC

1.3.4 National Electrical Manufacturers Association ..... NEMA

1.3.5 National Sanitation Foundation ..... NSF

1.3.6 Underwriters Laboratory ..... UL

1.4 Submittals

1.4.1 Shop Drawings: Submit shop drawings for equipment in accordance with Section 01400 – General Requirements, demonstrating compliance with these specifications.

1.4.2 Certificates: Manufacturer shall certify chemical feed pumps and accessories will withstand continuous contact with intended chemicals without defects.

1.4.3 Submit written installation, operation, and maintenance instructions.

1.5 Quality Assurance

1.5.1 Basis of Design: Peristaltic pumps as manufactured by Pulsafeeder, 27101 Airport Road, Punta Gorda, FL 33982, Telephone: (800) 333-6677, Fax: (941) 575-3800, Internet: www.pulsatron.com, shall be the design standard. The drawing and design of the peristaltic pump equipment is based on the Pulsafeeder design as the base bid for this contract.

1.5.2 Supplier Requirements: To ensure all equipment required for installation of feed pumps, controls, and other accessories is properly coordinated and will function in accordance with intent of these specifications, obtain all equipment specified under

this Section, from a single supplier in whom responsibility for proper function of all equipment, regardless of manufacturer, as an integrated and coordinated system is vested. Intent of this paragraph is to establish unit responsibility for all equipment through feed pump equipment supplier. Use of word "responsibility" relating to feed pump equipment supplier is not intended to relieve ultimate responsibility for equipment coordination, installation, operation, and guarantee.

1.5.3 All electrical control panels shall be listed and labeled assemblies of a nationally recognized testing laboratory as outlined in NEC 96-7.

1.5.4 Project Conditions

1.5.4.1 Equipment furnished in accordance with this section shall be installed at the location and in the space allocated on the contract drawings.

1.5.4.2 Perform power and control wiring to control panels and between control panels and chemical feed pumps as work of Division 16.

1.5.4.3 Any structural, piping, electrical requirements, wiring, instrumentation and controls, drawings or other modifications required to accommodate equipment offered shall be done at no additional expense to the Owner.

1.5.4.4 Electrical Motors, Controllers, Starters, and Disconnects: Furnish motors, controllers, starters, and disconnects with their respective pieces of equipment. Motors, controllers, starters, and disconnects shall conform to and shall have electrical connections in accordance with the National Electrical Code. Controllers and starters shall have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished.

1.6 Delivery, Storage and Handling

1.6.1 Shipping

1.6.1.1 Ship pump and drive assembled complete. Ship tubing separately for field installation and process line connection by the Contractor.

1.6.1.2 Pack all additional spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

1.6.1.3 Deliver spare parts at the same time as pertaining equipment. Deliver to the Owner after completion of work.

1.6.2 Receiving

1.6.2.1 The Contractor shall inspect and inventory items upon delivery to site.

1.6.2.2 The Contractor shall store and safeguard equipment, material, instructions, and spare parts in accordance with manufacturer's written instructions.

1.7 Warranty

1.7.1 Unless otherwise stated, the equipment/system shall be warranted to be free of defects in material and workmanship for a period of 24 months from the date of installation, but not more than 30 months from the date of manufacture.

2 PRODUCTS

2.1 Components

2.1.1 Pump Heads

2.1.1.1 Pump manufacturer shall provide materials and head arrangement most compatible with liquid being pumped.

2.1.1.2 Pump shall consist of a fixed track with tool lockable hinged guard door and magnetic safety interlock which shall render the drive inoperable when the pump door is open.

2.1.1.3 Pump head door shall have two clear windows for viewing of rotation direction. When closed, pump door shall seal against the pump track for leak containment and controlled waste through the pump head waste port in the event of a tube failure.

2.1.1.4 Rotor assembly shall be equipped with two compression rollers which shall be retractable for tube loading, SIP, or CIP flushing cycles. Compression rollers shall be located 180 degrees apart for compression of the tube against the track twice per rotor revolution. One roller shall at all times be fully engaged with the tubing providing complete compression to prevent backflow or siphoning. Occlusion gap shall come factory set to accommodate wall thickness of tubes and tube elements.

2.1.1.5 The rotor assembly shall be close coupled to the output shaft of the drive gearmotor by a keyed shaft and shall be axially secured to the shaft by a through center retaining screw. Pump head track shall be secured to the drive via two slotted screws and shall be self locating.

2.1.2 Tubing

2.1.2.1 Pump tubing shall be in contact with the inside diameter of the track (housing) through an angle of 180 degrees and be held in place on the suction and discharge by tube retainer clamps. The tubing shall be replaceable without the use of tools.

2.1.2.2 Pump tube elements shall be industrial type, constructed of Fluran (Viton) rated for a working pressure of 100 psi and resistant to the liquid being pumped. Pump shall readily accept tubing with quick release polypropylene connectors. If required for chemical compatibility, pump manufacturer shall provide an alternate tubing material.

2.1.2.3 Supply eight (8) spare tube elements of the tubing size and material recommended by the pump manufacturer.

2.1.3 Pump Drive

2.1.3.1 Pump Safety Rating: Each pump shall be listed to UL Standard 778 – Motor Operated Pump, CSA Standard C22.2 – Process Control Equipment, and NSF/ANSI Standard 61 – Drinking Water System Components - Health Effects. Each pump shall be suitable for continuous 24-hour operation at 40ºC ambient conditions.

2.1.3.2 Electrical Power Supply: As indicated on the drawings. Supply six-foot length main power cord with a standard NEMA 5/15 U.S. 120V three-prong plug.

2.1.3.3 Enclosure Rating: NEMA 3R

2.1.3.4 Housing Material: ABS

2.1.3.5 Front panel operator controls

2.1.3.5.1 Three (3) Position Rocker Switch (ON, OFF/Standby, and Momentary ON)

2.1.3.5.2 0-100% Feed Rate Dial to adjust on time in repeating 2 second cycle.

2.1.3.6 Remote Features

2.1.3.6.1 Dry contact input for remote start/stop – functional in both the Auto and Manual modes.

2.1.3.7 Drive motor shall be permanent magnet DC with integral gearbox rated for continuous duty. Circuitry shall be microprocessor controlled PWM type with temperature and load compensation and protection. Drive speed shall be adjustable with 20:1 turndown control.

2.1.3.8 Mounting: Drive shall be self supporting and shall not require anchoring.

2.1.4 Spares

2.1.4.1 Supply a total of two spare pump head assemblies and rotors.

2.2 Accessories

2.2.1 Leak Detector

2.2.1.1 Pump manufacturer shall supply a float type leak sensor mounted to the drain port of each pump head for leak detection and pump shut down in the event of a tube failure.

2.2.2 Flexible Piping

2.2.2.1 Pump manufacturer shall supply nominal 10 feet of reinforced polyethylene flexible hose for connection of pump to process lines. Flexible hose shall have a polypropylene female cam and groove fitting for mounting to pump and male cam and groove fitting for mounting to process piping. Provide 5 feet of flexible hose for the suction and 5 feet of flexible hose for the discharge of each pump supplied.

2.2.2.2 Provide female cam and groove to male NPT adapter for connection to discharge process piping. Provide two adapters per pump, one for suction, and one for discharge.

2.2.3 Pressure Relief Valves

2.2.3.1 Pump manufacturer shall supply pressure relief valves, PVC construction with Teflon diaphragm and NPT ends suitable for 150-psi nonshock cold water working pressure at 70°F. Valve shall be field adjustable between 0-150 psi.

2.2.4 Calibration Column

2.2.4.1 Clear PVC calibration column shall be installed in the suction line and include an isolating ball valve to allow for proper drawdown and calibration. Calibration column shall be sized for a 30-60 second drawdown at maximum flow. Calibration column will have a floating yellow polypropylene level indicator for better visibility and an "o" ring sealed top with a threaded connection for attachment of a venting tube that will also serve as a standpipe. Calibration column shall be graduated in both US gal/hr and milliliters.

2.2.5 Mix Tank

2.2.5.1 Mix tank shall be vertical, NSF/ANSI 61 certified, constructed of high density linear polyethylene (HDLPE). Tank storage capacity shall be 15-gallons with gradations to measure incremental storage. The tank shall have a cover sealed to prevent the entry of contaminants and a label that reads "Sodium Hypochlorite Solution Mix Tank." The tank shall be manufactured by Pulsafeeder, or approved equal by Snyder Industries or Poly Processing.

2.2.6 Chemical Feed Pump Shelves

2.2.6.1 Each chemical feed shelf shall be constructed of vinylester fiberglass shapes and suitable for resistance to the chemicals that it may come in contact with.

2.2.6.2 Each shelf shall be sized to adequately accommodate the chemical feed, pumps, piping, and all other appurtenances supported by the shelf.

2.2.6.3 Each shelf shall be provided by the chemical feed pump manufacturer and shall be suitable for withstanding all static and dynamic loads imparted by the chemical feed pump and its appurtenances without vibration.

2.2.6.4 Dimensions: As indicated on the contract drawings.

2.2.6.5 Quantity: As indicated on the contract drawings.

3 EXECUTION

3.1 Installation

3.1.1 General: Install chemical feed pumps and accessories in conformance with the manufacturer's written recommendations, and as shown on the contract drawings.

3.1.2 The Contractor shall provide all fittings required for connection of pumps to process piping.

3.1.3 The Contractor shall provide all wiring required for power and remote input and output to pumps.

3.2 Field Quality Control

3.2.1 Manufacturer's Field Services

3.2.1.1 Provide factory trained manufacturer's representative to assist in supervising installation of equipment.

3.2.1.2 Provide service by a fully qualified manufacturer's service engineer to inspect completed installation, start equipment and place in operation, and train operators in its use and care.

3.2.1.3 Service engineer shall furnish installation certificate.

3.2.1.4 Field Test: Test pumps in presence of Engineer to determine equipment delivers chemicals within specified accuracy over range of pump. Test a minimum of four adjustments at maximum speed and 25, 50, and 75 percent speed. Test each feed rate for at least 10 minutes. Make no adjustments while test is in progress. If equipment fails to meet specifications, make necessary adjustments, modifications, or equipment changes to meet specified standards. Run new tests until equipment meets specifications.

3.3 Demonstration

3.3.1 General: Train the Owner's personnel in operation and maintenance of equipment.

End of Section

Section 11250
Pipe Supports and Anchors for Chemical Piping

1 GENERAL

1.1 Description: This section covers the requirements for non-metallic channel framing systems.

1.2 Reference specifications are referred to by abbreviation as follows:

1.2.1 American National Standards Institute..... ANSI

1.2.2 American Society for Testing and Materials..... ASTM

1.2.3 Manufacturers Standardization Society of the Valve and Fittings Industry.....MSS

1.2.4 Underwriters Laboratory ..... UL

1.3 Quality Assurance

1.3.1 The non-metallic channel framing system shall be provided as a package system as specified, and as required to provide a complete installation ready for operation.

1.3.2 The non-metallic channel framing system specified in this section shall be an integrated system furnished by one equipment supplier as an integrated design package. The manufacturer shall provide all materials and appurtenances and be responsible for the complete and satisfactory operation of the entire integrated system.

1.3.3 Experience: The manufacturer shall certify to not less than 10 years experience in the application, design, and manufacture of non-metallic channel framing systems for use in pipe support applications.

1.3.4 All products shall be manufactured in the United States.

1.4 Submittals: Provide the following in a timely manner in accordance with Section 01400 – General Requirements.

1.4.1 Catalog cuts, performance data, shop drawings, installation manual, and certificates of compatibility with intended chemical services for the non-metallic channel framing system

1.5 Piping systems shall be supported in accordance with ANSI B31.1 “Power Piping” so as to maintain required pitch of lines, prevent vibration, and provide for expansion and contraction movement. Provide hangers in accordance with MSS SP-58 and MSS SP-69.

1.6 Acceptable Manufacturer: Aickinstrut, StrutTech, or approved equal.

2 PRODUCTS

2.1 General

2.1.1 Nonmetallic channel framing shall be furnished as a system which includes all necessary fasteners, channel splice plates, brackets, sealants, hangers, pipe clamps and appurtenances.

2.1.2 Nonmetallic fasteners shall be manufactured from long glass fiber reinforced polypropylene to ensure maximum strength and corrosion resistance.

2.1.3 All components of the channel framing system shall be nonmetallic.

2.2 Materials

2.2.1 Fiberglass reinforced plastic (FRP) channel shall be pultruded glass reinforced vinylester resin having the following physical properties:

Physical Property	ASTM Test	Longitudinal Vinylester	Transverse Vinylester
Ultimate Tensile Strength (psi)	D638	35,000	10,000
Tensile Modulus (psi) x 10^6	D638	3.0	1.0
Ultimate Compressive Strength (psi)	D695	35,000	20,000
Compressive Modulus (psi) x 10^6	D695	2.5	1.2
Ultimate Flexural Strength (psi)	D790	35,000	14,000
Flexural Modulus (psi) x 10^6	D790	2.0	1.0
Shear Strength Short Beam (psi)	D2344	7,000	6,000
Izod Impact Strength (ft-lb/in)	D256	30	5

2.2.2 Some accessories shall be of injection molded, 40% long glass fiber reinforced polypropylene.

2.3 Standards

2.3.1 Glass reinforced channels specified herein shall have a flame spread rating of 25 or less when tested per ASTM E84, and shall be self-extinguishing per the requirements of UL94V0, thereby qualifying as Class 1 material in the Uniform Building Code.

2.3.2 Glass reinforced channels specified herein shall comply with the requirements of ASTM D3917 and ASTM D4385 which govern the dimensional tolerance and visual defects of pultruded shapes.

2.4 Composition

2.4.1 Glass reinforced channel shall have a synthetic surfacing veil applied on exterior surfaces to improve weatherability and inhibit ultraviolet degradation. An ultraviolet stabilizer shall be incorporated in the resin formulation to further inhibit ultraviolet degradation.

2.5 Structural Design

2.5.1 Channel shall incorporate the manufacturer's flange profile design which allows full and positive interlocking contact of channel accessories and prohibits premature flange failure from torque accessories.

2.5.2 Channel profile dimensions shall be 1⅝-inch x 1⅝-inch x ¼-inch.

2.5.3 All 1⅝-inch x 1⅝-inch channel profiles shall have a minimum pull out resistance of 1,000 pounds when the load is applied over a ⅜-inch long section of the inside flanges.

2.5.4 Channel sections shall be supplied in 10-foot lengths.

2.5.5 Universal pipe clamps shall have full interlocking contact with interior channel flanges to maximize pull-out resistance and be adjustable to accommodate a minimum ¾-inch variance in piping or conduit outside diameter sizes.

3. EXECUTION

3.1 Space supports or hangers for horizontal piping as follows unless otherwise indicated on the drawings and the manufacturer's written recommendations. Provide additional supports for concentrated loads at valves or specialties.

Nominal Pipe Size	Maximum Span (feet) Plastic Pipe
½-inch	2
¾-inch through 1½-inch	3
2-inch and 2½-inch	4
3-inch	5
4-inch	6

3.1.1 Provide pipe hanger or support within 18 inches or every change in direction for piping 1½ inches and below and within 3 feet of every change in direction for piping 2 inches and larger.

3.1.2 Vertical Piping: Support plastic piping at each floor and at midpoint between floors, but not at more than 5-foot intervals.

End of Section

Section 13300
Flow and Level Instruments

1 GENERAL

1.1 References

1.1.1 American Society of Mechanical Engineers (ASME) Publication

1.1.1.1. Fluid Meters, 6th Edition

1.1.2 Instrument Society of America (ISA) Publications

1.1.2.1. S5.1 Instrumentation Symbols and Identification

1.1.2.2. S5.4 Instrument Loop Diagrams

1.1.2.3. RP12.1 Recommended Practice for Electrical Instruments in Hazardous Atmospheres

1.1.2.4. RP12.6 Installation of Intrinsically Safe Instrument Systems in Class I Hazardous Locations

1.1.2.5. S51.1 Standard Process Instrumentation Terminology

1.1.3 National Electrical Manufacturers Association (NEMA) Publications

1.1.3.1. ICS 1 General Standards for Industrial Controls and Systems

1.1.3.2. ICS 2 Standards for Industrial Control Devices, Controllers, and Assemblies

1.1.3.3. ICS 6 Enclosures for Industrial Controls and Systems

1.1.4 American National Standards Institute (ANSI)

1.1.5 American Water Works Association (AWWA)

1.2 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.2.1 Shop drawings, product data, and details of the following:

1.2.1.1. Turbine-type flow meters and signal converter/transmitters

1.2.1.2. Guided wave radar level instruments and signal converter/transmitters

1.2.1.3. Flow switches

1.2.2 Operation and Maintenance Data: Submit detailed operation and maintenance data for magnetic flow meter equipment provided under this section.

1.3 Instrumentation loop shall be 4-20 mA. Loop loads shall be within the source load capacity.

1.4 Equipment supplier shall have unit responsibility for the start-up of the equipment and shall provide the services of an experienced mechanical serviceman for all required start up services including operator training and demonstration of satisfactory operation.

1.5 Functional Description

1.5.1 Provide a submersible pressure transducer level instrument with local transmitter capable of level indication at the Well No. CCO-17A site for continuous indication of the ground water level.

1.5.2 Provide a water turbine meter with local transmitter capable of flow indication in the Water Treatment Facility to measure raw water production from Well No. CCO-17A.

1.5.3 Provide a guided wave radar level instrument with local transmitter capable of level indication at the Finished Water Storage Tank for continuous indication of the tank water level.

1.5.4 Provide a water turbine meter with local transmitter capable of flow indication in the Water Treatment Facility to measure finished water production.

1.5.5 Provide a guided wave radar level instrument with local transmitter capable of level indication at the Backwash Wastewater Storage Wetwell for continuous indication of the backwash waste level.

2 PRODUCTS

2.1 Turbine-Type Flow Meter

2.1.1 Acceptable Manufacturers

2.1.1.1. Sensus – OMNI™ T^2

2.1.1.2. Approved equal

2.1.2 Turbine-type flow meters shall be provided with the features listed below:

2.1.2.1. Nominal Diameter: As shown on the contract drawings.

2.1.2.2. Flow Range: 1.5-200 GPM

2.1.2.3. Transmitter Installation: 50 feet cables NEMA 6/IP 68 indefinitely submersible to 30 feet

2.1.2.4. Process Connections: As shown on the contract drawings. 2-bolt oval flange

2.1.2.5. Transmitter Supply: As shown on the contract drawings.

2.1.2.6. Signal Output: 4-20 mA to system PLC

2.1.2.7. Maximum Operating Pressure: 200 psig

2.1.2.8. Straightening Vane Assembly shall be positioned directly upstream of the measuring element and be an integral component of the measuring chamber

2.1.2.9. The meter's electronic register shall not contain any mechanical gearing to display flow and accurate totalization. The register includes the following features:

2.1.2.9.1. AMR resolution units fully programmable

2.1.2.9.2. Pulse output frequency fully programmable

2.1.2.9.3. Integral data logging capability

2.1.2.9.4. Integral resettable accuracy testing feature

2.1.2.9.5. Large, easy-to-read LCD display

2.1.2.9.6. 10-year battery life guarantee

2.1.3 Performance

2.1.3.1. The meter assembly shall have performance capability of continuous operation up to the manufacturer's rated maximum flows without affecting long-term accuracy or causing any undue component wear. The meter assembly shall also provide a 25%

flow capacity in excess of the manufacturer's maximum flows for intermittent demands.

2.1.3.2. Maximum headloss through the meter/strainer assembly shall not exceed the manufacturer's listed pressure loss per meter size and flowrate.

2.1.4 Materials

2.1.4.1. Meter Maincase: Epoxy-coated ductile iron

2.1.4.2. Measuring Chamber: Thermoplastic. The measuring chamber shall consist of a measuring element, removable housing, and all-electronic register.

2.1.4.3. Strainer Screen: Stainless Steel

2.1.4.4. Strainer Body/Cover: Epoxy-coated ductile iron

2.1.4.5. Fasteners: Stainless Steel

2.1.5 Warranty: Meters shall be guaranteed against defects in material and workmanship for a period of one (1) year from date of shipment. The meter supplier shall submit nationally published literature outlining its factory maintenance program and current price schedule covering complete measuring chamber exchange.

2.2 Guided Wave Radar Level Instruments

2.2.1 Acceptable Manufacturers

2.2.1.1. Emerson – Rosemount™ 3300

2.2.1.2. Approved Equal

2.2.2 Level Instrument Features

2.2.2.1. Measurement Principle: Time Domain Reflectometry (TDR)

2.2.2.2. Guided wave radar instrumentation shall be used for level sensing/indicating and equipment control purposes. Instrumentation loop shall be 4-20 mA. Loop loads shall be within the current source load capacity. The system shall consist of two components, a sensor and an indicator/controller/transmitter. The transmitter shall be microprocessor based, field programmable and shall accept two sensor inputs. Output shall be 4-20 mA proportional to level.

2.2.2.3. The principle operation shall rely on touch-free measurement of the liquid level in a tank and the conversion of that measured variable into a signal directly proportional to level (in engineering units of inches or feet) for indication, transmission, and/or control as indicated.

2.2.2.4. The indicator/controller/transmitter shall have a NEMA 4X outdoor enclosure with readout viewing window and internal space heaters.

2.2.2.5. Integral Display that toggles between the following variables, at minimum:

2.2.2.5.1. Level, distance, volume, percent of range, and analog current output

2.2.2.5.2. Output units: ft, inch, m, or cm for level and distance; and ft^3, $inch^3$, US gals, m^3, or liters for volume

2.2.2.6. Accuracy: $\pm$ 1% of span over a temperature range of -20°F to + 140°F

2.2.2.7. Humidity: 0 to 100% relative humidity

2.2.2.8. Start-up Time: <10 sec

2.2.2.9. System shall have zero and span adjustment capabilities. The unit shall have a preassembled multi-conductor cabling for connection of sensor to the indicator/controller/transmitter. Cabling shall be molded into the sensor.

2.2.3 Performance

2.2.3.1. Measuring Range for each Application

2.2.3.1.1. Raw Water Storage Tank: 0-8.0 feet

2.2.3.1.2. Finished Water Storage Tank: 0-23.5 feet

2.2.3.1.3. Backwash Wastewater Storage Wetwell: 0-7.5 feet

2.2.3.2. Reference Conditions: twin lead probe, 77°F water

2.2.3.3. Reference Accuracy

2.2.3.3.1. $\pm$ 0.2 in (5 mm) for probes $\leq$ 16.4 feet

2.2.3.3.2. ± 0.1% measured distance for rigid probes > 16.4 feet

2.2.3.3.3. ± 0.15% measured distance for flexible probes > 16.4 feet

2.2.3.4. Repeatability: ± 0.04-inch

2.2.3.5. Update Interval: 1 per second

2.2.3.6. Measuring Range: 16 inches to 77 feet

2.2.4 Materials

2.2.4.1. Housing: Polyurethane-covered Aluminum or stainless steel (ASTM A743)

2.2.4.2. Ingress Protection: NEMA 4X, IP66, IP67

2.2.4.3. Flanges: Type 316L stainless steel

2.2.4.4. Electrical Connection: ½ - 14 NPT for cable glands or conduit entries. Optional M20 x 1.5 conduit/cable adapter or PG 13.5 conduit/cable adapter. Recommended output cabling is twisted shielded pairs, 18-12 AWG.

2.3 Well Level Monitoring System

2.3.1 Provide a submersible pressure transducer for the well, and a digital receiver/display at the well site. The device shall include a ½-inch HDPE casing pipe extending down into the well to the top of the pump as indicated on the drawings. The casing pipe shall be taped to the discharge column pipe.

2.3.2 The level monitoring system shall be a MJK North America, Inc. Model 1400 pressure transducer with a panel-mount level display, or approved equal, and satisfactory amount of cable from the well to the display location. Transducer shall be of a size easily inserted and removed from a ½-inch HDPE casing pipe without having to remove the column piping and pump from the well.

2.3.3 Electrical service for the system shall be as indicated on the electrical drawings.

2.3.4 The transducer shall be installed at the elevation indicated on the drawings. A factory installed cable shall be provided with the transducer to provide power to the transmitter, and a 4-20 mA level signal from the transducer to the local PLC Monitoring Panel. The cable shall be designed to support the weight of the pressure transducer and cable extending into the well casing.

2.3.5 The transmitter and cable shall be constructed of materials suitable for use in a drinking water well.

2.3.6 The transmitter display range shall be as indicated on the contract drawings. The digital display shall be wall-mounted in a NEMA 4X enclosure at the electrical rack at the Well No. CCO-17A site as indicated on the drawings.

2.3.7 The measuring range for Well No. CCO-17A shall be 0-280.0 feet

2.4 Flow Switches: Flow switches shall have a flow range of 0-100 GPM, rated for 350 psig, 120 volts, stainless steel toggle, adjustable setpoint with normal flow at 50 GPM, as manufactured by McDonnell & Miller, or approved equal.

2.5 Indicating Signal Converters/Transmitters

2.5.1 Display

2.5.1.1. Digital light emitting diode or liquid crystal

2.5.1.2. Digits: 7

2.5.1.3. Digit Size: ¼-inch minimum

2.5.1.4. Enclosure: Pedestal mounted NEMA 4X

2.5.1.5. Viewing Angle: Minimum 120º horizontal and 90º vertical position

2.5.1.6. Flow rate and total flow in engineering units time shared on single display

2.5.1.7. Nonvolatile memory to eliminate data loss due to power loss or transients

2.5.1.8. Automatic zeroing

2.5.1.9. Overrange indication

2.5.2 Outputs: 4-20 mA signal proportional to flow rate into 600 ohms pulses proportional to flow total. Transmitter shall interface with the SBR control panel and transmit a 4-20 mA control signal.

2.6 System Performance

2.6.1 Accuracy: ±1% of span

2.6.2 Linearity: ±0.2% of span

2.6.3 Reproducibility: ±0.25% of span

2.6.4 Speed of Response: Less than 0.5 second for 65% of full scale

2.6.5 Line Voltage Effect

2.6.5.1. Zero: ±0.035% of span for l % line voltage change

2.6.5.2. Span: ±0.055% of span for l % line voltage change

2.6.5.3. Ambient Temperature Limits: 0ºF to l60ºF

3 EXECUTION

3.1 Install flow meters piped in such a manner that the flow meters will remain full of fluid in a no-flow condition.

3.2 Install flow meters with straight, unobstructed pipe runs upstream and downstream in accordance with the manufacturer's recommendations. The Contractor shall provide a minimum straight pipe run of 2.5 pipe diameters upstream and downstream of each turbine-type flow meter.

3.3 Level Monitoring Instruments

3.3.1 Install each level monitoring instrument as indicated on the contract drawings and in accordance with the manufacturer's written recommendations.

3.3.2 The Contractor shall field verify the instrument range at each location indicated on the contract drawings, and orient the transmitter in accordance with the manufacturer's written recommendations.

3.4 All instruments shall be grounded in accordance with the National Electrical Code.

End of Section

Section 15051
Plumbing System

1 GENERAL

1.1 General Requirements

1.1.1 Contractor shall provide all materials specified herein and as required to construct new plumbing equipment within the Water Treatment Facility as shown on the drawings. The specifications included in this section represent design standards and establish the level of quality expected. Plumbing piping shall be defined as all cold and hot water piping in buildings.

1.1.2 All plumbing equipment shall be designed and constructed in accordance with the latest editions of the National Electric Code, the International Plumbing Code, and any other applicable local, state, and federal codes.

1.1.3 All products in contact with drinking water shall meet NSF/ANSI Standard 61, and either NSF/ANSI 61, Annex G or NSF 372 for compliance with new "lead free" content requirements.

1.1.4 Plumbing system specified herein shall include, but not be limited to all work associated with the following equipment:

1.1.4.1 Piping/Valves

1.1.4.2 Backflow Preventers

1.1.4.3 Hose Bibs

1.1.4.4 Sample Taps

1.1.4.5 Pressure Reducing Valves

1.1.4.6 Combination Eyewash/Safety Showers

1.1.4.7 Hot Water Heaters

1.1.4.8 Service Sinks

1.1.4.9 Lab Tables

1.1.4.10 Associated accessories and appurtenances

1.2 Submittals: Provide the following in a timely manner in accordance with Section 01400 – General Requirements.

1.2.1 Shop drawings, product data, and dimensional data for plumbing equipment.

1.3 Delivery, Storage, and Handling

1.3.1 Deliver materials so they will not be damaged or deformed. Package materials for protection against transportation damage.

1.3.2 Handling: Exercise care in unloading, storing, and erecting materials to prevent damage.

1.3.3 Store materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering so that water accumulations will drain freely. Do not store materials in contact with other materials that might cause staining, denting, or other surface damage.

2 PRODUCTS

2.1 Plumbing

2.1.1 Potable Water Piping/Valves

2.1.1.1 Piping Application

2.1.1.1.1 All hot and cold potable water piping inside the Water Treatment Facility shall be constructed of solvent welded Schedule 80 chlorinated polyvinyl chloride (CPVC) pipe.

2.1.1.1.2 Accessories: Provide flanges, joint restraints, connecting pieces, transition glands, transition sleeves, tapping saddles, and other adaptors as required for complete and operable piping systems for the service indicated.

2.1.1.2 Chlorinated Polyvinyl Chloride (CPVC) Piping

2.1.1.2.1 Pipe, couplings, and fittings shall be Schedule 80 meeting the requirements of ASTM F441, manufactured of material meeting the requirements of ASTM D1784, Type IV, Grade 1. Provide ASTM F439 Schedule 80 fittings and ASTM D2564 solvent cement.

2.1.1.2.2 Provide screwed joints and flanges as required to connect dissimilar pipe materials, valves, equipment, and appurtenances.

2.1.1.3 Valves: Valve leakage will not be allowed.

2.1.1.3.1 Ball Valves: Ball valves shall be Class 150, meeting requirements of ANSI B16.34. Valves shall have ANSI carbon steel bodies and balls. Valves shall have stainless steel stems and trim, and Viton or Teflon seats, body seals, and stem seals. Valves shall be lever operated. Valves shall be manufactured by Velan Valve Corporation, ITT-Grinnell, Worchester, Inc., or approved equal.

2.1.1.4 Provide a ball valve at the inlet of each water line.

2.2 Backflow Preventers

2.2.1 Backflow preventers shall be Series 009-QT-S reduced pressure backflow preventers as manufactured by Watts Industries, Inc., Cla-Val Company, or approved equal. Backflow preventers shall be suitable for 175-psi supply pressure and meet requirements of AWWA C511 and ASSE Standard 1013.

2.2.2 Backflow preventers shall be provided with bronze body construction, Celcon check seats, stainless steel relief valve seats and shafts, rubber check valve and relief valve assemblies, bronze strainer and test cocks, and quarter-turn, full port resilient seat ball valves. Relief valves shall be equipped with 1-inch Series No. 909-AG-C air gap.

2.3 Hose Bibs

2.3.1 Hose bibs for interior, non-freezing areas shall be anti-siphon, backflow protected, ASSE Standard 1011 approved Woodford Model 24P, ¾-inch with wheel handle, vacuum breaker, brass finish, or approved equal.

2.3.2 Exterior, freezeless hose bibs shall be anti-siphon, backflow protected, ASSE Standard 1019 Type C listed Woodford Model 19, ¾-inch with wheel handle, brass finish, rated for a maximum 125 psi backpressure, or approved equal.

2.4 Sample taps shall be threadless brass hose bibs with threaded nipple suitable for mounting in locations noted herein. Taps shall be quarter-turn handwheel type with ¾-inch diameter inlet and shall be certified under NSF 61 for Drinking Water System Components.

2.5 Pressure Reducing Valves

2.5.1 A Water Pressure Reducing Valve with integral strainer shall be installed in each water service pipe near its entrance to the building to reduce the pressure to an adjustable reduced pressure range of 25-75psi.

2.5.2 The water pressure reducing valve shall be constructed using Lead Free materials. Lead Free regulators shall comply with state codes and standards, where applicable, requiring reduced lead content. The valve shall feature a Lead Free cast copper silicon alloy body suitable for water supply pressures up to 400 psi.

2.5.3 Provisions shall be made to permit the bypass flow of water back through the valve into the main when pressures, due to thermal expansion on the outlet side of the valve, exceed the pressure in the main supply.

2.5.4 Water pressure reducing valves with built-in bypass check valves and integral strainer shall be acceptable. Approved valves shall be listed to ASSE 1003 and IAPMO and certified to CSA B356.

2.5.5 Materials

2.5.5.1 Body: Lead Free cast copper silicon alloy

2.5.5.2 Seat: Thermoplastic

2.5.5.3 Cage: Thermoplastic

2.5.5.4 Integral Strainer: Stainless steel

2.5.5.5 Diaphragm: Reinforced EPDM

2.5.5.6 Valve Disc: Elastomer

2.5.6 Valve shall be a Watts Series LFN45B-M1, or approved equal.

2.6 Combination Safety Shower/Eyewash

2.6.1 Combination safety shower and eyewash shall be ANSI Z358.1 compliant, and include a 10⅝-inch green ABS plastic shower head with integral self-regulating flow control, green Feather-Flo ABS plastic eye/face wash heads with integral flow controls and dust covers, brass shower and eyewash ball valves equipped with stainless steel ball and stem, and separate ball valve activated hose spray. Unit shall also include powder-coated cast-iron 9-inch diameter floor flange, universal sign, and 1¼-inch IPS Schedule 40 stainless steel supply column. Shower shall deliver a minimum of 20 GPM of water and eyewash shall deliver a minimum of 2.5 GPM of water at an inlet supply of 30 psi.

2.6.2 Acceptable Manufacturer: Haws Model 8320CRP for interior service, equivalent by Bradley, or approved equal. Provide Haws Model 9001 DPDT or approved equal emergency alarm, light and flow switch system for each safety shower/eyewash unit.

2.6.3 Thermostatic Mixing Valve: Haws Model 9201E, equivalent by Bradley, or approved equal. Thermostatic mixing valve shall mix hot and cold water to supply tempered water to emergency shower and eyewash fixtures requiring flow up to 31 GPM. Unit shall employ a paraffin filled thermostatic mixing element. Lowest internal pressure drop where supply pressure is low, and a high Cold Water Bypass flow rate of 20 GPM. A 0.4 GPM hot water flow if cold supply fails. The modular brass design with a one piece casting shall use internal check stops, oversized valve seats, a shuttle design that eliminates valve sticking, and a funnel design to improve temperature control with better mixing at low flow rates. Lime and calcium resistant components shall be used throughout. The outlet temperature factory setting shall be 85°F. Maximum operating pressure shall be 125 psi. Temperature adjustment range shall be 60-95°F. Maximum inlet temperature shall be 180°F; minimum inlet temperature shall be 120°F. Valve inlet and outlet shall be 1¼-inch female NPT. Valve shall be ASSE 1071 and CSA B125.3 listed

2.7 Hot Water Heaters: Ruud Model EGSP20, 20-gallon capacity with non-simultaneous elements, ¾-inch water connections, ASME rated pressure and temperature relief valve, adjustable thermostat, automatic overheat safety control, 3-year tank warranty, equivalent by A.O. Smith (ProLine Model EJCT-20), or approved equal.

2.8 Service Sinks

2.8.1 Sink shall be constructed of fiberglass reinforced polyester (FRP) resin.

2.8.2 Sink shall be furnished with and supported by four white baked enamel steel angle legs. Each leg shall be equipped with a leveling device and corrosion-resistant hardware/anchors for mounting the leg to the sink and to the floor.

2.8.3 Sink bowl shall have inside dimensions of 20-1/8"x17-3/4"x11-5/8" (LxWxD) and outside dimensions of 24"x20"x13-3/8" (LxWxD). Top of the sink assembly shall measure 34 inches from the floor.

2.8.4 Sink shall be equipped with a drain plug, 3⅞-inch high backsplash, 1⅛-inch high side splash, 4-inch faucet mounting centers, and a 2-inch drain opening. Sink drain shall be piped to the floor drain.

2.8.5 Faucet shall be Model A1CPH chrome plated, plastic constructed faucet with dual handles as manufactured by Fiat Products or approved equal.

2.8.6 Sink shall be Model FL-7 as manufactured by Fiat Products or approved equal.

2.9 Lab Table: Model HSLT3060 Science Lab Table manufactured by Natural Public Seating, or approved equal. Table top shall be black, chemical resistant, high pressure laminate on 1⅛-inch thick MDF core with Ashwood support legs and apron. Table surface shall have outside dimensions of 60 inches x 30 inches (LxW). Table top shall measure 30 inches from the floor.

3 EXECUTION

3.1 Install all products and equipment in accordance with the manufacturer's written instructions and recommendations at the locations indicated on the drawings.

3.2 Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination in accordance with the manufacturer's written recommendations. Comply with authorities having jurisdiction.

3.2.1 Locate backflow preventers as shown on the drawings.

3.2.2 Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation

of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.

3.2.3 Do not install bypass piping around backflow preventers.

3.3 Join and assemble solvent welded CPVC pipe joints in accordance with requirements of ASTM D 2855.

End of Section

Section 260500
Common Work Results for Electrical

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Basis of Design Product: Provide electrical work in accordance with the Contract Drawings and as specified herein. The new electrical system shall be design/built by the Contractor. Provide necessary items for a complete installation of electrically operated equipment specified in specifications and as shown on the Contract Drawings. The system shall be in general accord with the design presented on the contract drawings.

1.2 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For raceways, conductors, and grounding materials.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. Raceways:

1. LFMC: Zinc-coated, flexible steel with sunlight-resistant and mineral-oil-resistant plastic jacket.

2. RNC: NEMA Type EPC-80-PVC, with NEMA TC3 fittings.

3. RSC: Rigid Steel Conduit, ANSI C80.1 threaded fittings.

4. PVC coated RSC: Where specified and where indicated on the construction drawings.

5. Raceway Fittings: Specifically designed for raceway type used in Project.

2.2 CONDUCTORS AND CABLES

A. Conductors:

1. Conductors, No. 10 AWG and Smaller: Solid copper.

2. Conductors, Larger than No. 10 AWG: Stranded copper.

3. Insulation: Thermoplastic, rated at 75 deg C minimum.

4. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

2.3 GROUNDING MATERIALS

A. Conductors: Solid for No. 8 AWG and smaller, and stranded for No. 6 AWG and larger unless otherwise indicated.

1. Insulated Conductors: Tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

2. Bare, Solid-Copper Conductors: Comply with ASTM B 3.

3. Bare, Stranded-Copper Conductors: Comply with ASTM B 8.

B. Ground Rods: Copper-clad steel, sectional type; ¾ inch by 8 feet unless otherwise indicated.

2.4 ELECTRICAL IDENTIFICATION MATERIALS

A. Raceway Identification Materials: Self-adhesive, color-coding vinyl tape; flexible, preprinted, self-adhesive vinyl.

B. Conductor Identification Materials: Color-Coding Conductor Tape: Self-adhesive vinyl tape 1 to 2 inches wide.

C. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with circuit identification legend machine printed by thermal transfer or equivalent process.

D. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

E. Equipment Identification Labels: Engraved, laminated acrylic or melamine label; punched or drilled for screw mounting. White letters on a dark-gray background; red letters for emergency systems.

F. Fasteners: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.5 SUPPORT AND ANCHORAGE COMPONENTS

A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.

B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly, and provide finish suitable for the environment in which installed.

1. Channel Dimensions: Selected for structural loading.

C. Raceway and Cable Supports: As described in NECA 1.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and fittings.

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:

1. Powder-Actuated Fasteners: Threaded-steel stud.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete.

3. Concrete Inserts: Steel or malleable-iron, slotted-support-system units similar to MSS Type 18; complying with MFMA-3 or MSS SP-58.

4. Through Bolts: Structural type, hex head, high strength; complying with ASTM A 325.

5. Toggle Bolts: All-steel springhead type.

6. Hanger Rods: Threaded steel.

2.6 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 GENERAL ELECTRICAL EQUIPMENT INSTALLATION REQUIREMENTS

A. Install electrical equipment on walls and overhead to allow maximum possible headroom.

B. Install electrical equipment to provide for ease of disconnecting the equipment with minimum interference to other installations.

C. Install electrical equipment to allow right of way for piping and conduit installed at required slope.

D. Install electrical equipment to ensure that connecting raceways, cables are clear of obstructions and of the working and access space of other equipment.

E. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

F. Comply with NECA 1.

3.2 RACEWAY AND CABLE INSTALLATION

A. Indoor Raceways Applications:

1. Exposed: PVC Coated RSC.

2. Connection to Vibrating Equipment: LFMC; in wet or damp locations, use LFMC.

3. Damp or Wet Locations: PVC Coated RSC.

4. Boxes and Enclosures: Cast Metal, unless otherwise indicated.

B. Locate horizontal raceway runs above water piping.

C. Connect motors and equipment subject to vibration, noise transmission, or movement with a 48-inch maximum length of flexible conduit.

3.3 WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders, Branch Circuits, and Class 1 Control Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

C. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.4 GROUNDING

A. Underground Grounding Conductors: Install bare copper conductor, No. 2 AWG minimum. Bury at least 24 inches below grade.

B. Pipe and Equipment Grounding Conductor Terminations: Bolted.

C. Underground Connections: Welded.

D. Install grounding conductors routed along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

E. Install ground rods driven into ground until tops are 2 inches below finished floor or final grade unless otherwise indicated.

F. Make connections without exposing steel or damaging coating, if any.

G. Install bonding straps and jumpers in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

H. Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

I. Bond to equipment mounted on vibration isolation hangers and supports so vibration is not transmitted to rigidly mounted equipment.

3.5 IDENTIFICATION

A. Power-Circuit Conductor Identification: For No. 3 AWG conductors and larger, at each location where observable, identify phase using color-coding conductor tape.

B. Warning Labels for Enclosures for Power and Lighting: Comply with 29 CFR 1910.145; identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

C. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Ungrounded service, feeder, and branch-circuit conductors.

1. Colors for 480/277-V 3P/4W Circuits (Water treatment plant and elevated water tank):

a. Phase A: Brown.

b. Phase B: Orange.

c. Phase C: Yellow

2. Colors for 208/120-V Circuits (Water treatment plant and elevated water tank):

a. Phase A: Black.

b. Phase B: Red.

c. Phase C: Blue.

3. Colors for 120/240-V Circuits (Well Site):

a. Phase A: Black.

b. Phase B: Red.

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points.

D. Underground-Line Warning Tape: Continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Fasten hangers and supports securely in place, with provisions for thermal and structural movement. Install with concealed fasteners unless otherwise indicated.

B. Separate dissimilar metals and metal products from contact with wood or cementitious materials, by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.

C. Multiple Raceways or Cables: Install on trapeze-type supports fabricated with steel slotted channel.

D. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

E. 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 or required by Code:

1. To Wood: Fasten with lag screws or through bolts.

2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

3. To Existing Concrete: Expansion anchor fasteners.

4. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.

5. To Light Steel: Sheet metal screws.

6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount on slotted-channel racks attached to substrate.

F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

End of Section

Section 260526
Grounding and Bonding for Electrical Systems

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.

2. Dossert; AFL Telecommunications LLC.

3. ERICO International Corporation.

4. Fushi Copperweld Inc.

5. Galvan Industries, Inc.; Electrical Products Division, LLC.

6. Harger Lightning & Grounding.

7. ILSCO.

8. O-Z/Gedney; a brand of Emerson Industrial Automation.

9. Robbins Lightning, Inc.

10. Siemens Power Transmission & Distribution, Inc.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.

3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.

4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors except as otherwise indicated.

3. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer’s written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

b. Perform tests by fall-of-potential method according to IEEE 81.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

End of Section

Section 260533
Raceways and Boxes for Electrical Systems

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. PVC Coated RSC and fittings.

2. Nonmetal conduits, tubing, and fittings.

3. Boxes, enclosures, and cabinets.

1.2 DEFINITIONS

A. GRSC or RSC: Galvanized Rigid Steel Conduit.

B. PVC RSC: Poly Vinyl Coated Rigid Steel Conduit.

1.3 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. AFC Cable Systems, Inc.

2. Allied Tube & Conduit; a part of Atkore International.

3. Anamet Electrical, Inc.

4. Electri-Flex Company.

5. O-Z/Gedney; a brand of Emerson Industrial Automation.

6. Picoma Industries, Inc.

7. Republic Conduit.

8. Robroy Industries.

9. Southwire Company.

10. Thomas & Betts Corporation, A Member of the ABB Group.

11. Western Tube and Conduit Corporation.

12. Wheatland Tube Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. PVC Coated RSC: UL6 and ANSI C80.1

E. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

F. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cooper Technologies Company.

2. EGS/Appleton Electric.

3. Erickson Electrical Equipment Company.

4. Hoffman; a brand of Pentair Equipment Protection.

5. Hubbell Incorporated.

6. O-Z/Gedney; a brand of Emerson Industrial Automation.

7. RACO; Hubbell.

8. Robroy Industries.

9. Thomas & Betts Corporation, A Member of the ABB Group.

10. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

D. Cabinets:

1. NEMA 250, Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed: PVC coated RSC.

2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

3. Damp or Wet Locations: PVC coated RSC.

4. Boxes and Enclosures: NEMA 250, except use NEMA 250, Type 4X stainless steel for damp or wet locations.

B. Minimum Raceway Size: 3/4-inch trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Complete raceway installation before starting conductor installation.

C. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

D. Install conduits parallel or perpendicular to building lines.

E. Support conduit within 12 inches of enclosures to which attached.

F. Threaded Conduit Joints, Exposed to Wet, Damp or Corrosive Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

G. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

H. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts.

I. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

J. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

K. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

End of Section

Section 260543
Underground Ducts and Raceways for Electrical Systems

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.

1.3 DEFINITION

A. RNC: Rigid nonmetallic conduit.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

1.5 COORDINATION

A. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ARNCO Corp.

2. Beck Manufacturing.

3. Cantex, Inc.

4. CertainTeed Corp.; Pipe & Plastics Group.

5. Condux International, Inc.

6. ElecSys, Inc.

7. Electri-Flex Company.

8. IPEX Inc.

9. Lamson & Sessions; Carlon Electrical Products.

10. Manhattan/CDT; a division of Cable Design Technologies.

11. Spiraduct/AFC Cable Systems, Inc.

B. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.

C. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.

2. Warning Tape: Underground-line warning tape specified in Division 26 Section “Identification for Electrical Systems.”

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Feeders 600 V and Less: RNC**,** NEMA Type EPC-80-PVC, in direct-buried duct bank, unless otherwise indicated.

3.2 EARTHWORK

A. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

B. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

3.3 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

C. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.

2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.

3. Excavate trench bottom to provide firm and uniform support for duct bank.

4. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only.

5. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.

6. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.

7. Set elevation of bottom of duct bank below the frost line.

8. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.

9. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.

    b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.5 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

End of Section

Section 260923
Lighting Control Devices

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Indoor occupancy sensors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.

2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Bryant Electric.

2. Cooper Industries, Inc.

3. Hubbell Building Automation, Inc.

4. Leviton Manufacturing Co., Inc.

5. Lithonia Lighting; Acuity Brands Lighting, Inc.

6. Lutron Electronics Co., Inc.

7. NSi Industries LLC.

8. Philips Lighting Controls.

9. RAB Lighting.

10. Sensor Switch, Inc.

11. Square D.

B. Ceiling Mounted Occupancy Sensors:

1. Dual technology type (passive infrared and ultrasonic), 120/277 V, adjustable time delay up to 30 minutes, 360-degree field of view, with a minimum coverage area of 1,200 SF.

2. Sensor to operate at line voltage without the need for external power racks or relays.

3. Sensor to include concealed “OFF” time delay selector with settings between 5 minutes and 30 minutes.

4. Sensor settings shall be adjustable at the sensor without the need for specialized tools or programmers.

5. Switch Rating: Two sets of contacts, each located rated for 800-W LED load at 120 VAC

2.2 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260500 "Common Work Results for Electrical."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

A. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

B. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260500 "Common Work Results for Electrical."

1. Identify controlled circuits in lighting contactors.

2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

End of Section

Section 262200
Low Voltage Transformers

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Enclosure: Ventilated, NEMA 250, Type 2 and Type 3R.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

C. Energy Efficiency for Transformers Rated 15 kVA and Larger: Comply with NEMA TP 1, Class 1 efficiency levels, as tested according to NEMA TP 2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasten transformers securely in place, with provisions for thermal and structural movement. Install with concealed fasteners unless otherwise indicated.

B. Separate dissimilar metals and metal products from contact with wood or cementitious materials, by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.

End of Section

Section 262416
Panelboards

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA PB 1.

2.2 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Indoor Enclosures: Surface-mounted cabinets; NEMA 250, Type 1 with door-within-door - hinged front cover.

B. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

C. Panelboard Short-Circuit Current Rating: Fully rated for system.

2.3 PANELBOARDS

A. Mains: Circuit breaker.

B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. GFCI Circuit Breakers: Single pole configurations with Class A ground-fault protection (6-mA trip).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407.

B. Comply with mounting and anchoring requirements specified in Section 260500 "Common Work Results for Electrical."

C. Mount top of trim 90 inches above finished floor unless otherwise indicated.

D. Arrange conductors into groups; bundle and wrap with wire ties.

E. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory.

End of Section

Section 262726
Wiring Devices

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and color palette for multi-outlet assemblies.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

2.2 INDUSTRIAL-GRADE DEVICES

A. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.

2. Devices shall comply with the requirements in this Section.

B. Device Color:

1. White unless otherwise indicated or required by NFPA 70 or device listing.

C. Convenience Receptacles: NEMA WD 1, NEMA WD 6, Configuration 5-20R, and UL 498.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Eaton (Arrow Hart).

b. Hubbell Incorporated.

c. Leviton Manufacturing Co., Inc.

d. Or Approved Equal.

D. Duplex Ground-Fault Circuit-Interrupter (GFCI) Convenience Receptacles: 125-V, 20-A, straight blade, non-feed-through type. NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Eaton (Arrow Hart).

b. Hubbell Incorporated.

c. Leviton Manufacturing Co., Inc.

d. Or Approved Equal.

E. Toggle Switches: NEMA WD 1 and UL 20. Single-pole, 120/277 V, 20 A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Eaton (Arrow Hart).

b. Hubbell Incorporated; Wiring Device-Kellems.

c. Leviton Manufacturing Co., Inc.

d. Or Approved Equal.

2.3 WALL PLATES

A. Wall Plates, Damp Locations: Cast aluminum with metal weather resistant covers, listed and labeled for use in damp locations.

B. Wall Plates, Wet Locations: Cast aluminum with metal weatherproof-while-in-use cover, listed and labeled for use in wet locations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

C. Mount devices flush, with long dimension vertical, and grounding terminal of receptacles on top unless otherwise indicated. Group adjacent devices under single, multi-gang wall plates.

End of Section

Section 262816
Enclosed Switches and Circuit Breakers

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMNTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Fusible Switches, 600 A and Smaller: UL 98 and NEMA KS 1, Type HD, that accommodate specified fuses, and with lockable handle interlocked with cover in closed position.

B. Nonfusible Switches, 600 A and Smaller: UL 98 and NEMA KS 1, Type HD, with lockable handle interlocked with cover in closed position.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Description: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Electronic Trip Circuit Breakers: Field-replaceable rating plug, RMS sensing, with field-adjustable instantaneous trip settings.

2.4 ENCLOSURES

A. NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 4X.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 260529 "Hangers and Supports for Electrical Systems."

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

End of Section

Section 262920
Motor Starters

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

B. Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.

C. Coordinate features, accessories, and functions of each motor controller with ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load.

PART 2 - PRODUCTS

2.1 CONTROLLERS AND ACCESSORIES

A. Manual Controller: NEMA ICS 2, general purpose, Class A with toggle action and overload element, in each phase.

B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, non-reversing, across the line, unless otherwise indicated; with integral control transformer.

1. Combination Controller: Factory-assembled combination controller and circuit-breaker disconnecting means.

2. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Enclosures: NEMA 250, Type 4X unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

C. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall.

D. Connect selector switches to bypass only the manual and automatic control devices that have no safety functions when switch is in the hand position.

E. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

F. Set field-adjustable switches and circuit-breaker trip ranges.

End of Section

Section 264313
Surge Protection Devices

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

B. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

C. Comply with UL 1449.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SERVICE ENTRANCE SUPPRESSORS

A. Surge Protective Devices: Field-mounted, complying with UL 1449 Type 1.

1. Comply with IEEE C62.41 Category C, 200-kA short-circuit current rating.

2. Non-modular type with the following features and accessories:

a. Integral disconnect switch.

b. LED indicator lights for power and protection status.

B. Protection modes and UL 1449 Vpk for grounded wye circuits with 480Y/277 V and 208Y/120 V, three-phase, four-wire circuits shall be as follows:

1. Line to Neutral: 600 V for 208Y/120 V.

2. Line to Ground: 1800 V for 480Y/V; 1000 V for 208Y/120 V.

3. Line to Line: 2000 V for 480Y/V; 1000 V for 208Y/120 V.

C. Protection modes and UL 1449 Vpk for 120/240 V, single-phase, three-wire circuits shall be as follows:

1. Line to Neutral: 600 V.

2. Line to Ground: 1000 V.

3. Line to Line: 1000 V.

2.3 PANELBOARD SUPPRESSORS

A. Surge Protective Devices: Field-mounted, complying with UL 1449 Type 1.

1. Comply with IEEE C62.41 Category C, 200-kA short-circuit current rating.

2. Non-modular type with the following features and accessories:

a. Integral disconnect switch.

b. LED indicator lights for power and protection status.

B. Protection modes and UL 1449 Vpk for grounded wye circuits with 480Y/277 V and 208Y/120 V, three-phase, four-wire circuits shall be as follows:

1. Line to Neutral: 600 V for 208Y/120 V.

2. Line to Ground: 1000 V for 208Y/120 V.

3. Neutral to Ground: 600 V for 208Y/120 V.

4. Line to Line: 2000 V for 480Y/V; 1000 V for 208Y/120 V.

C. Protection modes and UL 1449 Vpk for 120/240-V, single-phase, three-wire circuits shall be as follows:

1. Line to Neutral: 600 V.

2. Line to Ground: 1000 V.

3. Neutral to Ground: 600 V.

4. Line to Line: 1000 V.

2.4 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Do not energize or connect electrical equipment to their sources until TVSS devices are installed and connected.

End of Section

Section 265000
Lighting

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid state luminaires that use LED technology.

2. Light fixture supports.

3. Emergency lighting units.

4. Exit signs.

1.2 SECTION REQUIREMENTS

A. Submittals: Product Data for each luminaire, including lamps.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.4 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fixtures, Emergency Lighting Units, Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Exterior Luminaires: Comply with UL 1598, and listed and labeled for installation in wet locations by a Nationally Recognized Testing Laboratory acceptable to authorities having jurisdiction.

B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2.3 LAMPS

A. With characteristics as indicated in light fixture schedule.

2.4 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

2.5 EXIT SIGNS

A. Internally Lighted Signs: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

1. Lamps for AC Operation: LEDs, 70,000 hours minimum of rated lamp life.

2.6 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.

2. Charger: Fully automatic, solid-state type with sealed transfer relay.

3. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

4. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.

2. Able to maintain luminaire position after cleaning and relamping.

3. Provide support for luminaire without causing deflection of ceiling or wall.

4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.

2. Do not attach luminaires directly to gypsum board.

F. Ceiling-Mounted Luminaires:

1. Secure to any required outlet box.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

End of Section

Geotechnical Engineering Report

Cherry Hill Water Treatment Facility
Cherry Hill Road
Culpeper County, Virginia

Underhill Project No. 19055

December 12, 2019

underhill ENGINEERING
geotechnical | geodesign | geoconstruction

underhill ENGINEERING
geotechnical | geodesign | geoconstruction

December 12, 2019

Mr. Herbert F. White, III, PE
WW Associates
PO Box 4119
Lynchburg, VA 24502

Subject: **Geotechnical Engineering Report, Cherry Hill Water System, Water Treatment Facility, Cherry Hill Road, Culpeper County, Virginia (Underhill Engineering Project No. 19055)**

Dear Mr. White:

Underhill Engineering, LLC (Underhill) is pleased to present this Geotechnical Engineering Report for the above referenced project. The geotechnical engineering services for this project are provided in accordance with Underhill Engineering's revised proposal dated October 9, 2019. We proceeded with services based on WW Associate's email authorization of October 14, 2019.

Thank you for the opportunity to provide our services. If you have any questions or require additional information, please do not hesitate to contact the undersigned.

Sincerely,

UNDERHILL ENGINEERING, LLC

Susan E. Ray, EIT, GIT
Staff Geotechnical Engineer

O. Christopher Webster, PE
Principal

COMMONWEALTH OF VIRGINIA
O. CHRISTOPHER WEBSTER
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GEOTECHNICAL ENGINEERING REPORT
TABLE OF CONTENTS

1.0 Executive Summary

This report presents the results of the subsurface exploration, soil laboratory testing, and geotechnical engineering analysis for the project site. A summary of the recommendations follows:

- Borings indicate loose and soft alluvium/colluvium underlying the topsoil and extending to about 1.5 to 2.5 ft below the ground surface. These soft soils should be removed during the topsoil stripping operation to expose the underlying competent residual soils and disintegrated rock.
- Shallow foundations consisting of strip footings or a perimeter turndown foundation are considered suitable for support of the proposed building and raw water tank when footings bear in the competent residuum of Strata B2 and C; or on new Compacted Structural Fill. A net allowable soil bearing pressure of **3,000 PSF** should be considered for the footing design for these structures.
- Subgrade soils are considered suitable for support of the proposed finished water tank with an anticipated contact pressure not exceeding **2,000** PSF. Competent subgrades are anticipated to consist of Stratum C disintegrated rock or new Compacted Structural Fill following the removal of the loose Stratum A soils as referenced above.
- Laboratory testing indicates that the on-site soils as encountered exhibit a low to medium potential for moisture-related volume change. Therefore, the bottom of footings should extend at least 2 feet below surrounding grades (the depth of local seasonal moisture change).
- Groundwater was not encountered during drilling. However, it will be important for the site grading to provide a positive slope away from the building areas.

Underhill is providing this Executive Summary solely as an overview of the findings and recommendations. Any party that relies of this report must read the full report since the Executive Summary omits several details, including those that are important to the proper interpretation and application of the report.

2.0 Scope of Services

Underhill's revised proposal dated October 9, 2019 defines the scope of services for this project. The scope is limited to the Geotechnical Engineering Services as presented therein.

3.0 Site Information

3.1 Site Description

The project site is located on the north side of Cherry Hill Road (Route 638), just west of the intersection of Cherry Hill Road and Sperryville Pike Road (Route 522) in Culpeper County, Virginia. The project site is east of the Republic Services Culpeper County Transfer station. The proposed development includes a new water treatment facility planned just northwest of the existing animal shelter building at Carol Anne & Andrews Landing, and a new 14-ft diameter, bolted-steel finished water tank east of an existing guyed-wire cellular tower.

The site for the proposed building and raw water tank is in the clearing across from the existing animal shelter building. The site for the proposed finished water tank is in the wooded area adjacent to the cellular tower, between the north and southeast guy wires. These two sites are shown in Figure 1.

Existing ground surface grades vary from about EL 608 to 610 at the proposed water treatment facility site, and from about EL 710 to 712 at the proposed bolted steel water tank site.

3.2 Proposed Construction

The proposed water treatment facility includes a new building, about 40 by 20-ft in plan dimensions, and an adjacent 10-ft diameter raw water tank, both with foundations planned as monolithic slabs with perimeter turn-down foundations. The building slab is planned at EL 610.25 and the adjacent tank slab is planned at EL 611.25, both within about 1 to 2 feet of existing grades.

The proposed 14-ft diameter, bolted-steel finished water tank is planned as a 24-ft tall structure supported by a mat slab bearing on a perimeter reinforced concrete ringwall and with 12 inches of crushed stone within the ringwall. The tank foundation is planned at EL 713.5, within about one foot of existing grades.

4.0 Field Services

4.1 Subsurface Exploration Program

Underhill's geotechnical engineering study included a subsurface exploration program consisting of four mechanically-advanced test borings drilled by Underhill's drilling subconsultant, SRM Drilling, LLC of Culpeper, Virginia.

The subsurface exploration program was performed to evaluate the subsurface conditions and develop generalized stratigraphy at the test hole locations. The evaluation of the soils' characteristics included visual and limited laboratory classification and evaluation of density or stiffness based on the results of Standard Penetration Test (SPT) N values obtained.

The approximate locations of the borings are presented in Figures 2 and 3 following the text of this report. The borings were drilled on October 24, 2019, under the observation of Underhill's engineering personnel.

The boring logs are included in Appendix A. Soil samples retrieved from the subsurface exploration program will be held for 45 days unless the Client requests other disposition.

5.0 Site Geology, Subsurface Conditions, and Soil Laboratory Testing

5.1 Site Geology

Underhill's review of the available geologic data, including the state geologic map of Virginia, indicates that the building and the raw water tank site geology consists of the Proterozoic-age Fauquier Formation, which consists of arkosic metasandstone. The finished water tank site's geology consists of layered biotite granulite and gneiss, part of the Blue Ridge Basement Complex. The boundary between the formations is just south of and runs parallel to Carol Anne & Andrews Landing.

The site's overburden stratigraphy consists of alluvium/colluvium (commonly silty sand and elastic silts), soil residuum (commonly sands and silts containing varying amounts of sand and mica), and weathered (disintegrated) rock overlying the parent material.

5.2 Generalized Subsurface Stratigraphy

Underhill developed the following generalized subsurface stratigraphy based on the results of the subsurface exploration program, the soil laboratory test results, and review of the local geology:

Topsoil:

- Boring locations B-2 and B-4 revealed topsoil to 6 inches below the surface. Boring locations B-1 and B-3 revealed topsoil to about 3 to 4 inches below the surface, respectively. The average topsoil depth encountered on the sites evaluated was 5 inches.

Stratum A (Alluvial/Colluvial Soils):

- Borings B-1 and B-2 encountered Stratum A beneath the topsoil to 2.5 and 1 feet below the surface, respectively. Borings B-3 and B-4 encountered Stratum A to 0.8 and 2.6 feet below the surface, respectively.
- Stratum A as encountered in B-1 and B-2 consists of very loose to loose SILTY SAND (SM), containing varying amounts of mica and root fragments.
- Stratum A as encountered in B-3 and B-4 consists of soft to very stiff SILT (ML) with sand, containing varying amounts of mica and root fragments.
- Natural Moisture Contents: 8.3% to 25.9% (three specimens).
- Standard Penetration Test (SPT) N values = 3 to 23.

Stratum B1 (Fine-Grained Residuum):

- Borings B-2 and B-4 encountered Stratum B1 below Stratum A to 2 and 5.3 feet below the surface, respectively. Stratum B1 was also encountered beneath Stratum C between the depths of 8.1 and 9.0 feet in Boring B-3B.
- Stratum B1 consists of very stiff to hard ELASTIC SILT (MH), containing varying amounts of sand and mica.
- Natural Moisture Contents: 6.6% and 25.3% (two specimens).
- SPT N values = 17 to 43.

Stratum B2 (Coarse-Grained Residuum):

- Borings B-2 and B-4 encountered Stratum B2 below Stratum B1 to the total depth of penetration, 15 and 20 feet, respectively. Boring B-3 encountered Stratum B2 below Stratum A

to 2.5 feet below the surface. Borings B-3B encountered Stratum B2 from 4 to 4.5 feet and from 13.5 feet to the total depth (15 feet).

- Stratum B2 consists of medium dense to dense SILTY SAND (SM), containing varying amounts of mica and pyrrhotite and WELL GRADED SAND WITH SILT (SW-SM).
- Natural Moisture Contents: 13.2% to 14.2% (three specimens).
- SPT N value = 12 to 42.

Stratum C (Disintegrated Rock Residuum):

- Four of seven borings revealed Stratum C to the total depth of penetration. Borings B-1, B-1A, B-3, and B-3A encountered auger and/or sampler refusal in Stratum C at depths of 8.5, 11, 4.4, and 1 ft, respectively. Boring B-3B encountered Stratum C beneath Stratum B2 from 4.5 to 8.1 feet below the surface, and beneath Stratum B1 from 9 feet to 13.5 feet below the surface.
- Stratum C consists of very dense DISINTEGRATED ROCK.
- SPT N values = 50/5.0" to 50/0.25".

5.3 Groundwater

Groundwater was not encountered at the time of Underhill's subsurface exploration. Fluctuations in the hydrostatic water table should be expected to occur over time, depending on variations in precipitation, surface runoff, pumping, flooding, evaporation, stream levels, and similar factors.

5.4 Laboratory Testing

Eight samples were retrieved from the subsurface exploration program for soil laboratory testing. Soil laboratory testing assigned by Underhill consisted of the following:

- Eight natural water content tests (ASTM D2216),
- Three Atterberg Limits tests (ASTM D4318), and
- Three gradation tests (ASTM D422/D1140).

The soil laboratory testing was performed to aid in the classification of the soils encountered in the subsurface exploration program, and to provide index test values for use in the development of design recommendations. Laboratory testing was performed by Underhill's subconsultant laboratory and reviewed and interpreted by Underhill.

Natural water content values of the laboratory-tested specimens are presented in the respective logs and summarized above in Section 5.2. A summary of the soil laboratory test results is included in Appendix B.

Soil laboratory index testing indicated the following for specimens retrieved from Stratum A:

- ASTM Classification: SILTY SAND (SM)
- AASHTO Classification: A-4 (silt-clay soils)
- Liquid Limit value: 26
- Plasticity Index (PI) value: 4
- Plasticity of the Whole Sample (PI multiplied by the Percent Passing the No. 40 Sieve): 3
- The natural water content of the specimen was near to 14 percent dry of its Plastic Limit value
- Moisture-related Volume Change Potential (shrink-swell) (NAVFAC DM-7): **Low**

Soil laboratory index testing indicated the following for specimens retrieved from Stratum B1:

- ASTM Classification: Sandy ELASTIC SILT (MH)
- AASHTO Classification: A-7-6 (clayey soils)
- Liquid Limit value: 71
- Plasticity Index (PI) value: 24
- Plasticity of the Whole Sample (PI multiplied by the Percent Passing the No. 40 Sieve): 21
- The natural water content of the specimen was about 21 percent dry of its Plastic Limit value, suggesting this material to be desiccated.
- Moisture-related Volume Change Potential (shrink-swell) (NAVFAC DM-7): **Medium**

Soil laboratory index testing indicated the following for specimens retrieved from Stratum B2:

- ASTM Classification: SILTY SAND (SM)
- AASHTO Classification: A-7-6 (clayey soils)
- Liquid Limit value: 49
- Plasticity Index (PI) value: 12
- Plasticity of the Whole Sample (PI multiplied by the Percent Passing the No. 40 Sieve): 11
- The natural water content of the specimen was about 23 percent dry of its Plastic Limit value, suggesting this material to be desiccated.
- Moisture-related Volume Change Potential (shrink-swell) (NAVFAC DM-7): **Low**

6.0 Geotechnical Recommendations

6.1 Earthwork

6.1.1 Stripping and Grading

The Contractor should remove the topsoil and the underlying loose/soft Stratum A soils to expose the competent residuum to receive compacted structural fill for structure support. Based on the average depth of topsoil and the loose Stratum A soils encountered during drilling, a stripping depth of 1.5 ft is recommended at most locations except for B-4, where at least 2.5 ft of stripping is recommended for preliminary planning purposes.

Considering the Final Floor Grade elevations supplied by the Client, subgrades should be undercut, at a minimum, to the following elevations:

Undercut Elevations (ft)	
Boring B-1 (14' dia. tank)	713
Boring B-2 (East building corner)	607.5
Boring B-3 (West building corner)	608
Boring B-4 (10' dia. tank)	606

Before any fill placement or additional undercutting below design subgrade level, the Geotechnical Engineer should evaluate the soils for suitability. Evaluation techniques may include probing with a penetrometer, observing proofrolling by a loaded dump truck, drilling hand augers, observing test pits, or a combination of these methods. The contractor should excavate areas deemed unsuitable by the Geotechnical Engineer and replace these areas with additional compacted structural fill.

Underhill recommends that undercut volumes be measured using cross sectioning survey methods. Other methods of calculating volumes of undercut, such as counting trucks, are less accurate and generally result in additional expense. If truck counts are used, Underhill recommends that the method of payment be in accordance with *Section 109 of the Virginia Department of Transportation (VDOT) Road and Bridge Specifications*.

Existing utilities are present on the site and may be encountered during excavation. Although not revealed by the subsurface exploration, excavation activities may encounter buried foundations and other associated debris. If these materials are encountered, existing structures should be completely removed from within the proposed structure areas. Existing utilities and drainage structures within the structure areas should be removed and replaced with new compacted structural fill.

6.1.2 Compacted Structural Fill

On-site soils free of deleterious materials may be re-used as compacted structural fill, provided that these materials are at a moisture content in the range suitable for compaction. Note that Stratum A soils contain varying amounts of root fragments; therefore, we anticipate only limited amounts of Stratum A materials to be suitable for re-use as compacted fill. The in situ natural water content value for Stratum B2 was between 13.2 to 14.2%. These values suggest that the residual soil are generally near the optimum moisture content needed to achieve compaction. However, depending on the weather conditions at the time of earthwork construction, portions of the on-site soils may be too wet

for suitable compaction. Therefore, project planning should schedule the earthwork construction for the drier seasons or consider the need for select fill material imported to the site for use as Compacted Structural Fill.

Off-site borrow material used as Compacted Structural Fill should meet the following criteria:

- ASTM Classification: **CL, ML, SC, SM, SP, SW, GC, GM, GP, or GW.**
- Plasticity Index value: **15 or less.**
- Maximum Dry Density (ASTM D698): minimum **100 PCF.**
- Maximum Particle Size: **3 inches.**
- Laboratory CBR value: minimum **6.**

Compacted Structural Fill should be placed in maximum 8-inch thick horizontal, loose lifts and compacted to at least **95 percent** of maximum dry density in accordance with ASTM D698, Standard Proctor. The contractor should bench compacted structural fill subgrades steeper than 4H:1V to allow placement of horizontal lifts.

Compacted structural fill should extend laterally at least 3 feet beyond the structure limits, and slope as needed to meet existing grades. Slopes constructed of Compacted Structural Fill should not be designed and built steeper than 2.5H:1V.

6.2 Foundations

6.2.3 Proposed Building and Raw Water Tanks

Shallow foundations consisting of strip footings or a perimeter turndown foundation are considered suitable for support of the proposed building and the adjacent 10-ft diameter raw water tank.

Footings should be founded in competent residuum of Strata B2 and C; or on new Compacted Structural Fill. A design bearing pressure of **3,000 PSF** (net allowable soil bearing pressure) is recommended for the footing design. Note the recommended bearing pressure may be increased by 33 percent for wind and seismic loads only when used in conjunction with load combinations defined in IBC Section 1605.3.2, Alternate Basic Load Combinations for use with allowable stress design or other applicable code exceptions.

For conventional strip footings and turndowns, minimum footing widths of 16 inches and 12 inches, respectively, should be maintained for shear considerations. This bearing pressure provides a factor of safety of at least 3.0 against general shear failure. Compacted structural fill should meet the requirements outlined in Section 6.1.2 for Compacted Structural Fill.

Settlements of shallow spread footings founded as described above are not expected to exceed 1 inch. Differential settlements between similarly loaded footings are not expected to exceed ½ inch.

6.2.4 Proposed Finished Water Tank

A shallow foundation consisting of a ringwall is considered suitable for the 14-ft diameter finished water tank. Subgrades for the finished water tank should consist of competent residuum or new Compacted Structural Fill following the undercut of the loose Stratum A materials. An allowable contact pressure of of **2,000 PSF** (net allowable soil bearing pressure) is anticipated for the finished water tank. A factor of safety of 3.0 should be considered against general shear failure for this condition. Total settlement at the center of the finished water tank is not anticipated to exceed 1 inch with an angular distortion of about 0.006 inch/inch between the center and the edge of the tank.

Correlations of the Plasticity Index of the Whole Sample to Volume Change Potential (NAVFAC DM-7) indicates that the on-site soils have a **Low to Medium Potential for Shrink-Swell**. Therefore, the bottom of foundation grades for structures should be set at least 2 feet below surrounding grades for frost protection.

6.2.5 Seismic Site Class and Site Coefficients

The proposed water tanks were evaluated as a Category IV structures. We evaluated the Seismic Site Class and Seismic Site Coefficients for this project following AWWA D100 guidelines (i.e. ASCE 7-10 Standard). Based on our review of the subsurface conditions, the structural design may use the following seismic criteria:

- Seismic Site Class: **D**, Stiff Soil, Risk Category IV (e.g. essential facilities)
- Site Coefficient, Fa: **1.6**
- Site Coefficient, Fv: **2.4**

The Site Class was evaluated based on Standard Penetration Test N values with borings terminating in very dense disintegrated rock.

6.3 Floor Slabs

The proposed building floor slabs should be supported in Strata B2 or C materials, or on Compacted Structural Fill as described in Section 6.1.2. Slabs on grade supported on these materials should be designed considering a modulus of subgrade reaction value, **k = 125 pci**. The Contractor should re-compact slab subgrades immediately before placing moisture barrier materials to repair any disturbance that may occur due to construction. Since the floor is anticipated as slab-on-grade, utility excavations should be backfilled with compacted structural fill as defined in Section 6.1.2.

A 4-inch crushed stone or washed gravel capillary moisture barrier should underlie the slabs on grade. Moisture barrier material should consist of VDOT No. 57 crushed stone. The Contractor should compact the stone in place with at least two passes of suitable vibratory compaction equipment.

7.0 Construction Considerations

7.1 Site Grading and Earthwork

The on-site soils are susceptible to moisture changes, will be easily disturbed, and difficult to compact under wet weather conditions. Drying and reworking of the soils are likely to be difficult and may not be possible during wet winter months. During periods of extended wet weather, project planning should consider that these soils cannot be effectively dried and should consider the need for importing select fill materials. Therefore, it will be important that the earthwork phases of this project be performed during the warmer, drier times of the year to limit the potential for disturbance of on-site soils and reduce the amount of fill imported to the site.

Traffic on stripped or undercut subgrades should be limited to reduce disturbance of underlying soils. The Contractor should provide site drainage to maintain subgrades free of water and to avoid saturation and disturbance of the subgrade soils before placing compacted structural fill or moisture barrier material. This will be important during all phases of the construction work. The Contractor should be responsible for reworking of subgrades and compacted structural fill that were initially considered suitable but were later disturbed by equipment and/or weather.

Note earthwork activities may encounter groundwater during excavation to grade, especially during times of heavy precipitation. Therefore, the Contractor may need to provide temporary dewatering such as trenching and/or pumping from sumps to control the surface and/or groundwater.

7.2 Shallow Foundations

The Contractor should place foundation concrete as soon as possible after excavation to limit the potential for moisture changes at the foundation level. Foundation concrete should be cast neat against the sides of the excavation. If footings are formed, the sides of the footings should be backfilled with compacted on-site soils to final grade to reduce the potential for water collecting beneath the footings. Final grades should provide positive drainage away from the structure so that water does not accumulate around the foundation.

The Contractor should exercise care during excavation for foundations so that as little disturbance as possible occurs at the foundation level. The Contractor should carefully clean loose or soft soils from the bottom of the excavation before placing concrete. Underhill's Engineer should observe actual foundation subgrades during construction to evaluate whether subgrade soils meet the requirements as recommended in this report.

Foundation subgrades needing undercut may be concreted at the elevation of undercut, backfilled with Controlled Low Strength Material (CLSM), locally known as "flowable fill;" or backfilled to the original design subgrade elevation with compacted structural fill as described in Section 6.1.2. Compacted structural fill should extend at least 12 inches laterally beyond the footing in all directions. Concreting should take place the same day as excavation of footings.

7.3 Engineering Services During Construction

The engineering recommendations provided in this report are based on the information obtained from the subsurface exploration and laboratory testing. However, conditions on the site may vary between the discrete locations observed at the time of the subsurface exploration. The nature and extent of variations between borings may not become evident until during construction. To account for this variability, Underhill should provide professional observation and testing of subsurface conditions revealed during construction as an extension of our design phase engineering services. These services will also help in evaluating the Contractor's conformance with the plans and specifications.

8.0 General Specification Recommendations

The Project Construction Documents should include an allowance to account for possible additional costs that may be required to construct the foundations and earthwork as recommended in this report. Costs may be incurred for a variety of reasons including variation of soil between borings, greater than anticipated unsuitable soils, need for borrow fill material, wet on-site soils, obstructions, rock excavation, temporary dewatering, etc. Add/deduct unit prices in the construction contract are recommended so adjustments can be made for the actual work performed for the following:

- Scarifying and drying wet and/or loose subgrade soils.
- Undercutting unsuitable soils and replacement with compacted structural fill.

The project documents should indicate the Contractor's responsibility for providing adequate site drainage during construction. Inadequate drainage can lead to disturbance of soils by construction traffic and increased volume of undercut. The project documents should also delegate the Contractor responsible for reworking of subgrades and compacted fill initially considered suitable, but later disturbed by equipment and/or weather.

This report may be made available to prospective bidders for informational purposes. The project specifications are recommended contain the following statement:

> *Underhill Engineering, LLC has prepared this geotechnical engineering report for this project. This report is for informational purposes only and is not part of the contract documents. The opinions expressed represent the Geotechnical Engineer's interpretation of the subsurface conditions, tests, and the results of analyses conducted. Should the data contained in this report not be adequate for the Contractor's purposes, the Contractor may make, before bidding, independent exploration, tests and analyses. This report may be examined by bidders at the office of the Owner, or copies may be obtained from the Owner at nominal charge.*

Additional data and reports prepared by others that could have an impact upon the Contractor's bid should also be made available to prospective bidders for informational purposes.

9.0 Limitations

The analyses and recommendations submitted in this report study are based on the information revealed by the subsurface exploration. This report attempts to provide for normal contingencies, but the possibility remains that unexpected conditions may be encountered during construction.

Underhill has prepared this study to aid in the evaluation of the site. It is intended for use concerning this specific project and should not be used for other purposes. The recommendations provided within are based on information on the site and proposed construction as described in this report. Changes regarding existing conditions or changes in loads, locations, or grades should be brought to Underhill's attention so that recommendations can be modified as needed. Underhill would appreciate an opportunity to review the plans and specifications as they pertain to the recommendations contained in this report, and to submit comments to you based on this review.

Underhill has endeavored to complete the services identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this report, or other instrument of service.

References

Conley, James F. (1989) Stratigraphy and Structure Across the Blue Ridge and Inner Piedmont in Central Virginia: Culpeper to Charlottesville, Virginia. American Geophysical Union, Washington, DC.

Evans, Nick H. and Rader, E.K. (1993) Geologic Map of Virginia, Virginia Division of Mineral Resources, Charlottesville, Virginia.

Sinha, A.K. and Bartholomew, M.J. (1984) Evolution of the Grenville Terrane in the Central Virginia Appalachians. Special Paper 194. Geological Society of America, Boulder, CO.

Figures

FIGURE 1

Image from Google Earth

No Scale

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FIGURE 2: LOCATION PLAN

Project 19055
Cherry Hill Water Treatment Facility
Culpeper County, Virginia

LEGEND

APPROXIMATE TEST BORING LOCATION

Scale: No scale

Note: Base image from Google Earth

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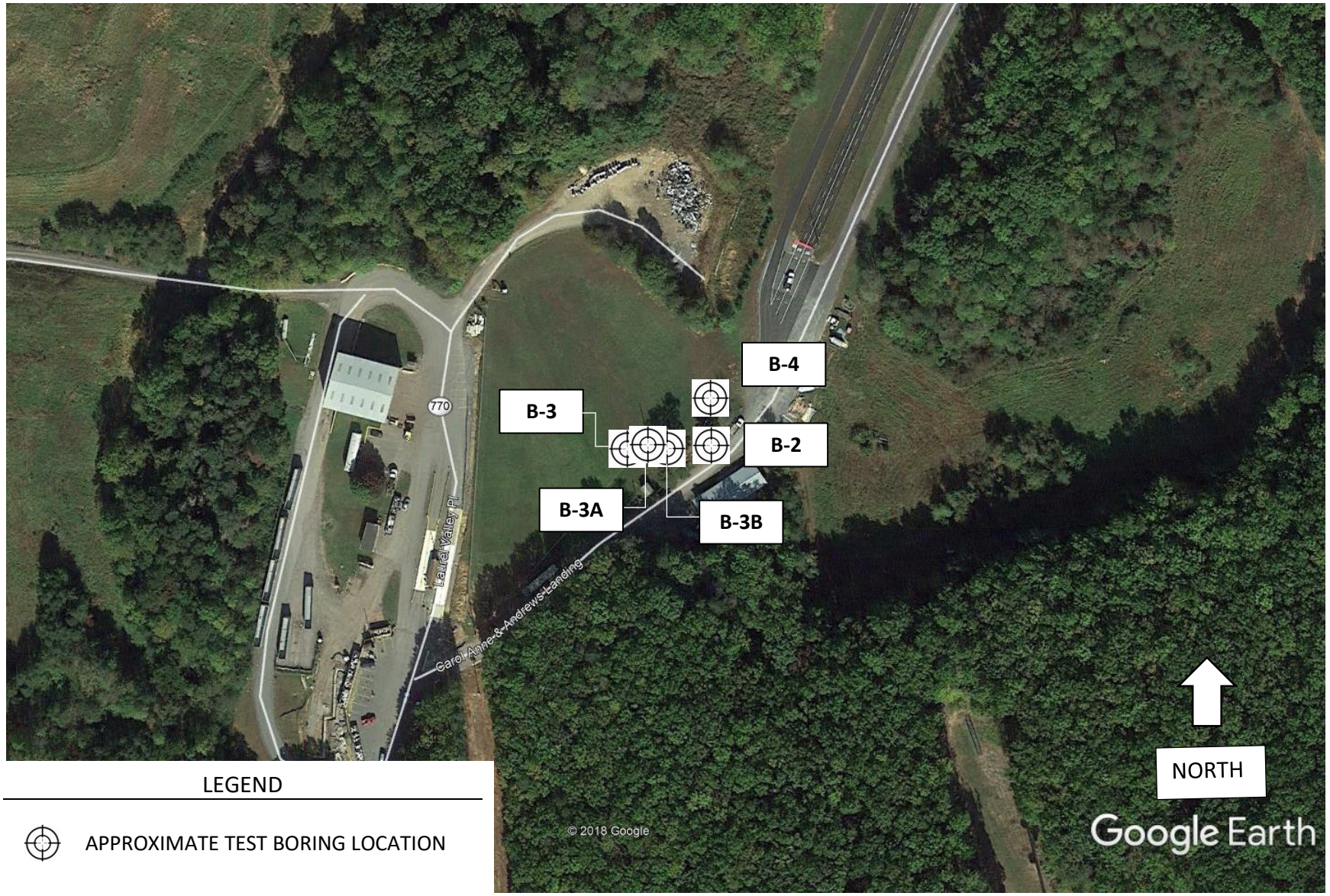
FIGURE 3: LOCATION PLAN

Project 19055
Cherry Hill Water Treatment Facility
Culpeper County, Virginia



LEGEND

APPROXIMATE TEST BORING LOCATION

Scale: No scale

Note: Base image from Google Earth

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Subsurface Exploration Data

Key to Logging and Soil Classification (2 Sheets)

Test Boring Logs, B-1 through B-4 (7 Sheets)

Note: Elevations at the test boring locations were obtained from the boring stakes placed by WW Associates. The elevations and locations should be considered no more accurate than the means and methods used to obtain them.

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KEY TO LOGGING AND SOIL CLASSIFICATION

Particle Size and Proportion

Descriptions are assigned to each soil sample or stratum based on estimates of the particle size of each component of the soil and the percentage of each component in the soil.

Particle Size Descriptive Terms		Proportion Descriptive Terms		
Soil Component	Particle Size	Component	Term	Percentage
Boulder	> 12 inches	Major	Uppercase Letters	> 50%
Cobble	3 - 12 inches		(e.g., SAND, SILT)	
Gravel-Coarse	¾ - 3 inch			
-Fine	#4 - ¾ inch	Secondary	Adjective	20% - 50%
Sand-Coarse	#10 - #4		(e.g., sandy, clayey)	
-Medium	#40 - #10			
-Fine	#200 - #10	Minor	With	15% - 20%
Silt (non-cohesive)	< #200		Trace	< 15%
Clay (cohesive)	< #200		Contains	presence of

Density or Consistency

The Standard Penetration Test values (N-values) are used when soil test borings are performed, to describe the density of coarse-grained soils (gravel, sand) or the consistency of fine-grained soils (silt, clay). Sandy silts of low plasticity may be assigned a density instead of a consistency.

DENSITY		CONSISTENCY	
Term	N-value	Term	N-Value
Very Loose	0-4	Very Soft	0-2
Loose	5-10	Soft	3-4
Medium Dense	11-30	Medium Stiff	5-8
Dense	31-50	Stiff	9-16
Very Dense	>51	Very Stiff	17-32
		Hard	>33

Notes:

1. The N-value is the number of blows of a 140-lb. hammer (falling 30 inches) required to drive a standard split-spoon sampler (2.0 in. O.D., 1-3/8 in. I.D.) 12 inches into the soil after properly seating the sampler six inches.
2. When encountered, gravel may increase the N-value of the SPT and may not accurately represent the in-situ density or consistency of the soil sampled.

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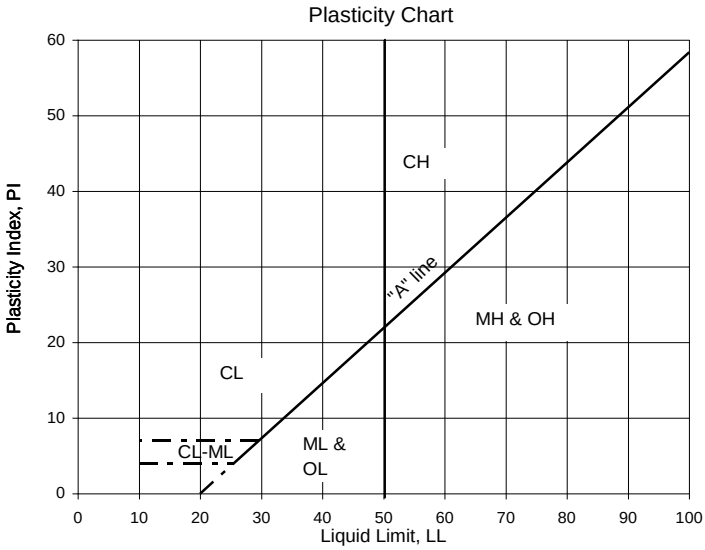
UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

Major Divisions			Group Symbols	Typical Names	Laboratory Classification Criteria		
Coarse-grained soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 Sieve), coarse-grained soils are classified as follows: Less than 5 per cent GW, GP, SW, SP More than 12 per cent GM, GC, SM, SC 5 to 12 per cent Borderline cases requiring dual symbols	$C_u=D_{60}/D_{10}$ greater than 4; $C_c=(D_{30})^2/(D_{10}x\ D_{60})$ between 1 and 3	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are border-line cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits below "A" line or PI greater than 7	
	Sands (More than half of coarse fraction is smaller than No.4 sieve size)	Clean sands (little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines		$C_u=D_{60}/D_{10}$ greater than 6; $C_c=(D_{30})^2/(D_{10}x\ D_{60})$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures		Atterberg limits above "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are border-line cases requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line or PI greater than 7	
Fine-grained soils (More than half material is smaller than No. 200 sieve	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity			
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity			
	Highly organic soils		Pt	Peat and other highly organic soils			

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Project: Cherry Hill Water Treatment Facility
Culpeper County, Virginia

Boring No. **B-1**

Project No. 19055

Drilling Contractor: SRM Drilling

Drill Rig Type: Diedrich D50

Foreman: S. Martin

Method: 2-1/4" HSA

Logged By: S. Ray

Started: 10/24/19

Finished: 10/24/19

Location: 14-ft ϕ tank

GS ELEV: 714.6'

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	10/24/19	---	Dry	---	---
Completion	10/24/19	9:27 AM	Dry	---	---
Casing Pulled	10/24/19	9:33 AM	Dry	---	5.5'

Depth (feet)	Sample Type	Stratum	Blow Counts (blows/foot)	**Soil Group Name:** modifier, color, moisture, density/consistency, grain size, other descriptors **Rock Description:** modifier, color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions	USCS	Remarks
				Forest litter, root mat, and topsoil		
0.0-1.5	◪	A	4+8+15	0.2 Fine to coarse SILTY SAND, contains mica and root fragments, dry - tan, W = 8.3%	SM	ALLUVIUM / COLLUVIUM
2.0-3.5	◪	C	19+36+ 50/5.0"	2.5 DISINTEGRATED ROCK, dry - white and tan		Relict structure
4.0-5.5	◪		50/3.75"			Rig chatter @ 4.5'
						RESIDUUM
7.0-8.5	◪		50/3.0"			Auger and sampler refusal @ 8.5'
8.5	◪		50/0.25"			
				Test Boring Terminated @ 8.5 FT		

Key:

Boring Log: Sheet 1 of 1

◪ Standard Penetration Split Spoon Sampler (SPT)

☒ Bulk/ Bag Sample

WOH Weight of Hammer

▼ Stabilized Groundwater

▽ Groundwater at time of drilling

NOTES: 1. Boring elevations obtained from boring stakes placed by WW Associates
2. Boring backfilled upon completion

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Project: Cherry Hill Water Treatment Facility
Culpeper County, Virginia

Boring No. **B-1A**

Project No. 19055

Drilling Contractor: SRM Drilling

Drill Rig Type: Diedrich D50

Foreman: S. Martin

Method: 2-1/4" HSA

Logged By: S. Ray

Started: 10/24/19

Finished: 10/24/19

Location: 14-ft ϕ tank

GS ELEV: 714.6'

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	10/24/19	---	Dry	---	---
Completion	10/24/19	10:15 AM	Dry	---	---
Casing Pulled	10/24/19	10:31 AM	Dry	---	---
W.O.W.	11/05/19	3:02 PM	Dry	**---**	---

Depth (feet)	Sample Type	Stratum	Blow Counts (blows/foot)	**Soil Group Name:** modifier, color, moisture, density/consistency, grain size, other descriptors **Rock Description:** modifier, color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions	USCS	Remarks
0.0-1.5 2.0-3.5 4.0-5.5 7.0-8.5				See Boring B-1 for Strata Description		Auger probe to 9 ft Rig chatter @ 8.5'
9.0-10.5 10.9-11.0	◪ ◪	C	50/4.25" 50/1.0"	9.0 DISINTEGRATED ROCK, dry - white & tan		Auger refusal @ 10.9'
				Test Boring Terminated @ 11.0 FT		Sampler refusal @ 11 ft

Key:

Boring Log: Sheet 1 of 1

◪ Standard Penetration Split Spoon Sampler (SPT)

☒ Bulk/ Bag Sample

WOH Weight of Hammer

▼ Stabilized Groundwater

▽ Groundwater at time of drilling

NOTES: 1. Boring elevations obtained from boring stakes placed by WW Associates
2. Boring backfilled upon completion

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Project: Cherry Hill Water Treatment Facility
Culpeper County, Virginia

Boring No. **B-2**

Project No. 19055

Drilling Contractor: SRM Drilling

Drill Rig Type: Diedrich D50

Foreman: S. Martin

Method: 2-1/4" HSA

Logged By: S. Ray

Started: 10/24/19

Finished: 10/24/19

Location: Building corner

GS ELEV: 609.3'

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	10/24/19	---	Dry	---	---
Completion	10/24/19	11:51 AM	Dry	---	---
Casing Pulled	10/24/19	12:02 PM	Dry	---	11.4'

Depth (feet)	Sample Type	Stratum	Blow Counts (blows/foot)		**Soil Group Name:** modifier, color, moisture, density/consistency, grain size, other descriptors **Rock Description:** modifier, color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions	USCS	Remarks
					Root mat and topsoil		
0.0-1.5	◪	A	4+4+5	0.5	Fine to medium SILTY SAND with root fragments, moist - brown	SM	ALLUVIUM / COLLUVIUM
		B1		1.0	Fine to coarse sandy ELASTIC SILT with quartz fragments, contains mica, moist - red-brown	MH	Relict structure
2.0-3.5	◪		7+11+12	2.0	Fine to medium SILTY SAND, contains mica, moist - tan and gray	SM	W = 13.7%
4.0-5.5	◪		10+13+15				W = 13.2%
				do,	tan, gray, and red		RESIDUUM
7.0-8.5	◪	B2	11+15+17	do,	contains pyrrhotite		
9.0-10.5	◪		14+19+23				
13.5-15.0	◪		17+12+14				
					Test Boring Terminated @ 15.0 FT		

Key:

Boring Log: Sheet 1 of 1

◪ Standard Penetration Split Spoon Sampler (SPT)

☒ Bulk/ Bag Sample

WOH Weight of Hammer

▼ Stabilized Groundwater

▽ Groundwater at time of drilling

NOTES: 1. Boring elevations obtained from boring stakes placed by WW Associates
2. Boring backfilled upon completion

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Project: Cherry Hill Water Treatment Facility
Culpeper County, Virginia

Boring No. **B-3**

Project No. 19055

Drilling Contractor: SRM Drilling

Drill Rig Type: Diedrich D50

Foreman: S. Martin

Method: 2-1/4" HSA

Logged By: S. Ray

Started: 10/24/19

Finished: 10/24/19

Location: Building corner

GS ELEV: 609.12"

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	10/24/19	---	Dry	---	---
Completion	10/24/19	12:29 PM	Dry	---	---
Casing Pulled	10/24/19	12:30 PM	Dry	---	---

Depth (feet)	Sample Type	Stratum	Blow Counts (blows/foot)	Soil Group Name: modifier, color, moisture, density/consistency, grain size, other descriptors Rock Description: modifier, color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions	USCS	Remarks
				Topsoil		
0.0-1.5	◪	A	1+6+11	0.3 ELASTIC SILT with sand, contains mica and root fragments, moist - red, W = 15.0%	MH	ALLUVIUM / COLLUVIUM
		B2		0.8 Fine to medium SILTY SAND, contains mica, moist - brown, white, and gray	SM	Relict structure RESIDUUM
2.0-3.5	◪	C	12+14+ 50/4.5"	2.5 DISINTEGRATED ROCK, contains mica, moist - brown, white, and gray		Rig chatter @ 3.0' Auger deflecting on rock
4.0-4.4	◪		50/5.0"			
				Test Boring Terminated @ 4.4 FT		

Key:

Boring Log: Sheet 1 of 1

◪ Standard Penetration Split Spoon Sampler (SPT)

☒ Bulk/ Bag Sample

WOH Weight of Hammer

▼ Stabilized Groundwater

▽ Groundwater at time of drilling

NOTES: 1. Boring elevations obtained from boring stakes placed by WW Associates
2. Boring backfilled upon completion

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Project: Cherry Hill Water Treatment Facility Culpeper County, Virginia		**Boring No.**	**B-3A**
		Project No. 19055	
Drilling Contractor: SRM Drilling		**Drill Rig Type**: Diedrich D50	
Foreman: S. Martin		**Method:** 2-1/4" HSA	

Logged By: S. Ray	**Groundwater Observations**					
Started: 10/24/19		**Date**	**Time**	**Depth**	**Casing**	**Caved**
Finished: 10/24/19	**Encountered**	10/24/19	---	Dry	---	---
Location: Building corner	**Completion**	10/24/19	12:36 PM	Dry	---	---
GS ELEV: 609.12"	**Casing Pulled**	10/24/19	12:36 PM	Dry	---	---

Depth (feet)	Sample Type	Stratum	Blow Counts (blows/foot)	**Soil Group Name:** modifier, color, moisture, density/consistency, grain size, other descriptors **Rock Description:** modifier, color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions	USCS	Remarks
0.0-1.5				See Boring B-3 for Strata Description		Auger probe to 1 ft
				Test Boring Terminated @ 1.0 FT		Auger Refusal @ 1 ft

Key:

Boring Log: Sheet 1 of 1

- Standard Penetration Split Spoon Sampler (SPT)
- Bulk/ Bag Sample
- WOH Weight of Hammer
- Stabilized Groundwater
- Groundwater at time of drilling

NOTES: 1. Boring elevations obtained from boring stakes placed by WW Associates
2. Boring backfilled upon completion

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Project: Cherry Hill Water Treatment Facility
Culpeper County, Virginia

Boring No. **B-3B**

Project No. 19055

Drilling Contractor: SRM Drilling

Drill Rig Type: Diedrich D50

Foreman: S. Martin

Method: 2-1/4" HSA

Logged By: S. Ray

Started: 10/24/19

Finished: 10/24/19

Location: Building corner

GS ELEV: 609.12'

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	10/24/19	---	Dry	---	---
Completion	10/24/19	1:09 PM	Dry	---	---
Casing Pulled	10/24/19	1:18 PM	Dry	---	10.0'

Depth (feet)	Sample Type	Stratum	Blow Counts (blows/foot)	**Soil Group Name:** modifier, color, moisture, density/consistency, grain size, other descriptors **Rock Description:** modifier, color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions	USCS	Remarks
0.0-1.5				See Boring B-3 for Strata Description		Auger probe to 4 ft
2.0-3.5						
4.0-5.5	◪	B2	21+50/5.5"	4.0 Fine to medium SILTY SAND, contains mica, moist - brown, white, and gray	SM	Relict structure
		C		4.5 DISINTEGRATED ROCK, contains mica and pyrrhotite, dry - white, brown, and gray		
7.0-8.5	◪	B1	20+20+23	8.1 ELASTIC SILT with sand, contains mica, moist - red and orange	MH	W = 6.6% RESIDUUM
9.0-10.5	◪	C	37+50/4.75"	9.0 DISINTEGRATED ROCK, contains mica and pyrrhotite, moist - gray, tan, and orange		
13.5-15.0	◪	B2	17+15+14	13.5 Fine SILTY SAND, contains mica, moist - brown	SM	
				Test Boring Terminated @ 15.0 FT		

Key:

Boring Log: Sheet 1 of 1

◪ Standard Penetration Split Spoon Sampler (SPT)

☒ Bulk/ Bag Sample

WOH Weight of Hammer

▼ Stabilized Groundwater

▽ Groundwater at time of drilling

NOTES: 1. Boring elevations obtained from boring stakes placed by WW Associates
2. Boring backfilled upon completion

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Project: Cherry Hill Water Treatment Facility
Culpeper County, Virginia

Boring No. **B-4**

Project No. 19055

Drilling Contractor: SRM Drilling

Drill Rig Type: Diedrich D50

Foreman: S. Martin

Method: 2-1/4" HSA

Logged By: S. Ray

Started: 10/24/19

Finished: 10/24/19

Location: 10-ft ϕ tank

GS ELEV: 608.46'

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	10/24/19	---	Dry	---	---
Completion	10/24/19	2:26 PM	Dry	---	---
Casing Pulled	10/24/19	2:44 PM	Dry	---	---
W.O.W.	11/05/19	3:07 PM	17.3'	---	---

Depth (feet)	Sample Type	Stratum	Blow Counts (blows/foot)	Soil Group Name: modifier, color, moisture, density/consistency, grain size, other descriptors Rock Description: modifier, color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions	USCS	Remarks
				Topsoil		
0.0-1.5	◪	A	1+2+1	0.5 ELASTIC SILT with sand, contains mica, moist - red	MH	ALLUVIUM / COLLUVIUM
2.0-3.5	◪		4+6+11			W = 25.9%
		B1		2.6 Fine to coarse sandy ELASTIC SILT, contains mica, moist - red	MH	Relict structure
4.0-5.5	◪		8+13+20			W = 25.3%
				5.3 Fine to coarse SILTY SAND, contains mica, moist - white and red	SM	
7.0-8.5	◪		14+20+21	7.0 Fine to coarse WELL GRADED SAND with silt, moist - white and gray	SW-SM	
9.0-10.5	◪		7+8+11			W = 14.2%
		B2		10.0 Fine to medium SILTY SAND, contains mica, moist - white, tan, and red	SM	RESIDUUM
14.0-15.5	◪		4+6+6	do, contains pyrrhotite		
18.5-20.0	◪		4+6+7	do, white, tan, and black		
				Test Boring Terminated @ 20.0 FT		

Key:

Boring Log: Sheet 1 of 1

◪ Standard Penetration Split Spoon Sampler (SPT)

☒ Bulk/ Bag Sample

WOH Weight of Hammer

▼ Stabilized Groundwater

▽ Groundwater at time of drilling

NOTES: 1. Boring elevations obtained from boring stakes placed by WW Associates
2. Boring backfilled upon completion

Soil Laboratory Test Results

Summary of Soil Laboratory Tests (1 Sheet)
Sieve Analysis – ASTM D4318 (3 Sheets)

Summary of Soil Laboratory Tests			
Sample Location	B-1	B-2	B-4
Sample Type	JAR	JAR	JAR
Sample Depth (ft)	0.0-1.5	2.0-3.5	2.0-3.5
Stratum	A	B2	B1
Description, Symbol USCS (AASHTO)	SILTY SAND, SM (A-4)	SILTY SAND, SM (A-7-6)	Sandy ELASTIC SILT, MH (A-7-6)
Natural Water Content (%)	8.3	13.7	25.9
% Passing No. 40 Sieve	67.6	92.3	87.7
% Passing No. 200 Sieve	36.6	48.6	69.3
Liquid Limit	26	49	71
Plastic Limit	22	37	47
Plasticity Index	4	12	24

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GEOTECHNICAL ENGINEERING REPORT

Cherry Hill Rock Evaluation
Culpeper County, Virginia

Underhill Project No. 21093
February 4, 2022

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February 4, 2022

Mr. Jason A. Clark, PE
The County of Culpeper
PO Box 4119
Lynchburg, VA 24502

Geotechnical Data Report, Cherry Hill Rock Evaluation Culpeper County, Virginia (Underhill Engineering Project No. 21093)

Dear Mr. Clark:

Underhill Engineering, LLC (Underhill) is pleased to present this Geotechnical Data Report, summarizing the results of the mechanically advanced auger probe borings for the proposed Cherry Hill Waterline project. These services are provided in accordance with Underhill's Contract Addendum for Geotechnical Services dated December 7, 2021.

Site and Project Description

The project area is north of Sperryville Pike, between Stonehouse Mountain Road and 0.67 mile southwest of the intersection of Cherry Lane and Randle Lane, in Culpeper County, Virginia. The project includes two phases, consisting of Phase I (raw and finished water lines) and Phase II (raw water lines).

Phase I waterline route is between the well location east of the intersection of Cherry Hill Road (Route 638) and Woodland Church Road (Route 616) at TMP 30-52A and the New Cherry Hill Water Treatment Facility/Finished Water Storage Tank, northeast of Laurell Valley Place.

The Phase II route starts at the New Cherry Hill Water Treatment Facility, northeast of Laurel Valley Place. The line splits west of Laurel Valley Road with one section extending south to Sperryville Pike Road and terminating near TMP 29-62 with a valve and plug for future connection. The other portion of the line extends west, generally parallel to and north of Sperryville Pike Road, terminating on Stonehouse Mountain Road, northwest of its intersection with Clark Lane, also at a valve and plug for future connection.

The site of the proposed waterline routes varies considerably in terrain and topography. The topographic data in the 7/9/2020 plan sets provided by WW Associates indicates ground surface grades varying from EL 458 to EL 664 in Phase I and from EL 554 to EL 677 in Phase II.

The project includes new raw and treated water lines running between treatment facilities and out to new service areas. The Phase I 4-inch diameter finished water line installation consists of approximately 3,025 feet of open cut trench and 6,420 feet of directional drilling placement. The Phase II section of line placement consists of approximately 4,430 feet of open cut trench and 470 feet of directional drilling placement.

The above project description is based on information provided by WW Associates and Culpeper County.

Site Geology

Underhill's review of the available geologic data, including the state geologic map of Virginia, indicates that the project encounters three distinct geologic units throughout the proposed water line and associated structure layout.

An approximately 3,300-foot-wide protrusion of Proterozoic-age porphyoblastic biotite-plagioclase augen gneiss extends from 900 feet northwest of the Cherry Hill Road and Sperryville Pike intersection, the southern end of the dump and along the south side of Carol Anne and Andrews Landing. The protrusion encompasses the proposed buildings and structures and the intersection of Cherry Hill Road and Woodland Church Road. A small area of layered biotite granulite and gneiss lies beneath the northwestern portion of Hickory Mountain Lane, the entirety of the 29-147C1 parcel, and the southeastern portion of parcel 29-144. Both formations are part of the Blue Ridge Basement Complex.

The remainder of the both sites The Proterozoic-age Fauquier Formation consists of arkosic metasandstone containing quartz, plagioclase, potassium feldspar, and sericite. The Fauquier Formation is part of the Blue Ridge Anticlinorium.

Subsurface Exploration Results

The subsurface exploration program consisted of 15 mechanically advanced auger probe borings for the Phase I and Phase II water system lines. Note that Standard Penetration Test ((SPT) N values were not performed, and samples were not collected. Instead, the subsurface exploration was limited to auger probes to evaluate whether shallow rock was present at the respective auger probe locations. The approximate locations of the auger probe borings are shown in Figures 1 and 2, following the text of this letter report.

The boring locations were staked in the field by Underhill. Underhill obtained LAT/LNG coordinates at the boring locations, as indicated on the respective logs, and referencing Google Earth.

The elevations at the test boring locations were referenced to the January 2022 topographic site drawing by the Monteverde. A Boring Location Plan is included as Figure 2 following the text of this report. The locations and elevations should be considered no more accurate that the methods and means used to obtain them.

Underhill's subcontractor, Ayers & Ayers, Inc., drilled the auger probe borings on December 9, 2021, under the observation of Underhill's personnel. The auger probe locations are shown in Figures 1 and 2.

A summary of the subsurface exploration is provided in Exhibit A, following the text of this report. Fourteen of the fifteen auger probes reached the maximum depth of penetration, 6.0 feet below the surface. Auger probe B-102 refused at 4.5 feet below the surface.

Underhill has endeavoured to complete the services identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this report.

Thank you for the opportunity to provide our services. If you have any questions or require additional information, please do not hesitate to contact the undersigned.

Sincerely,

UNDERHILL ENGINEERING, LLC

Susan E. Ray, P.E., G.I.T.

Susan E. Ray, PE, GIT
Geotechnical Engineer

O. Christopher Webster, P.E.

O. Christopher Webster, PE, F ASCE
Principal

Figure:

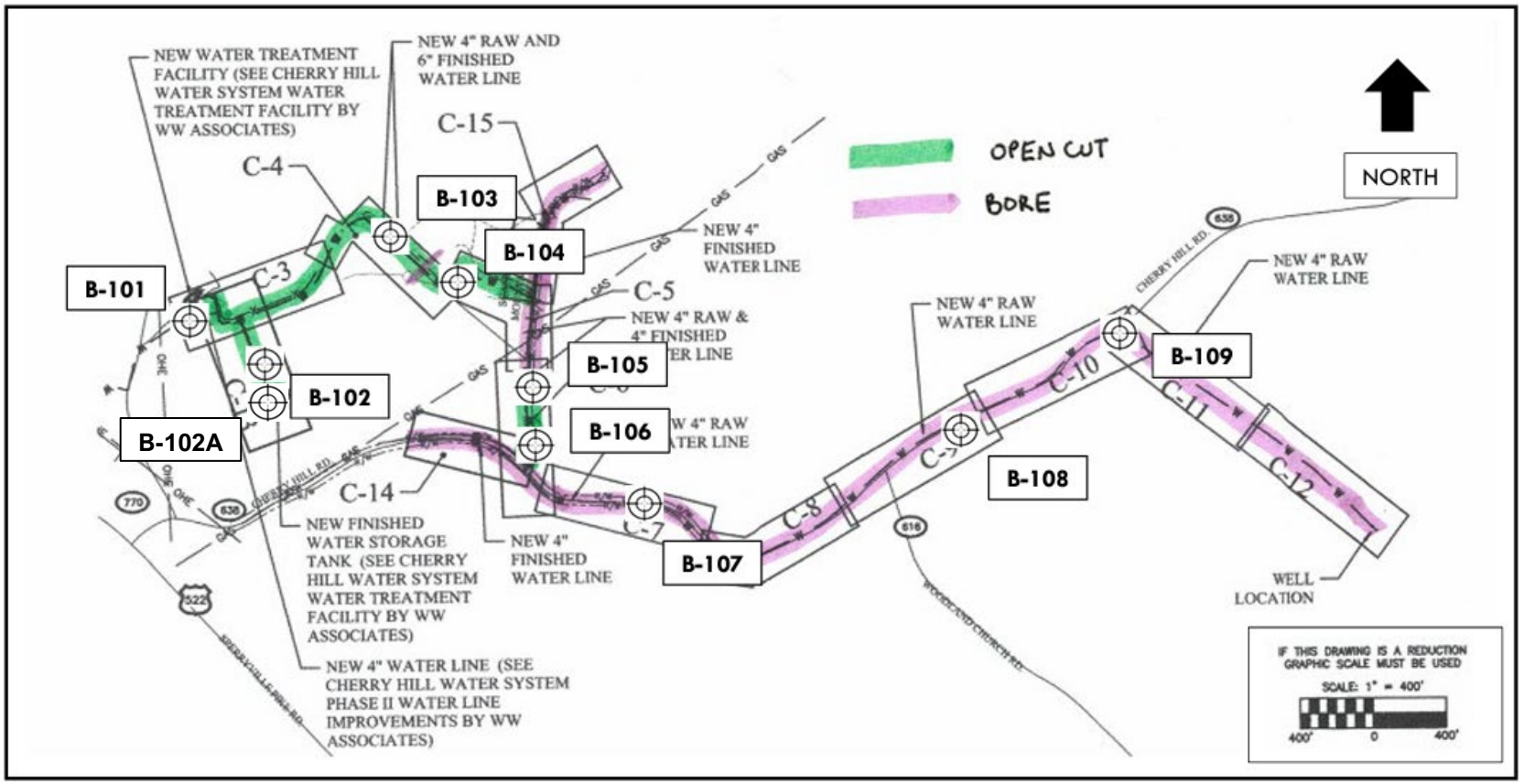
Figures 1 and 2: Auger Probe Location Plan

Exhibit:

Exhibit A: Subsurface Exploration Results

cc: Mr. Paul Howard, Jr., Director of Environmental Services – The County of Culpeper

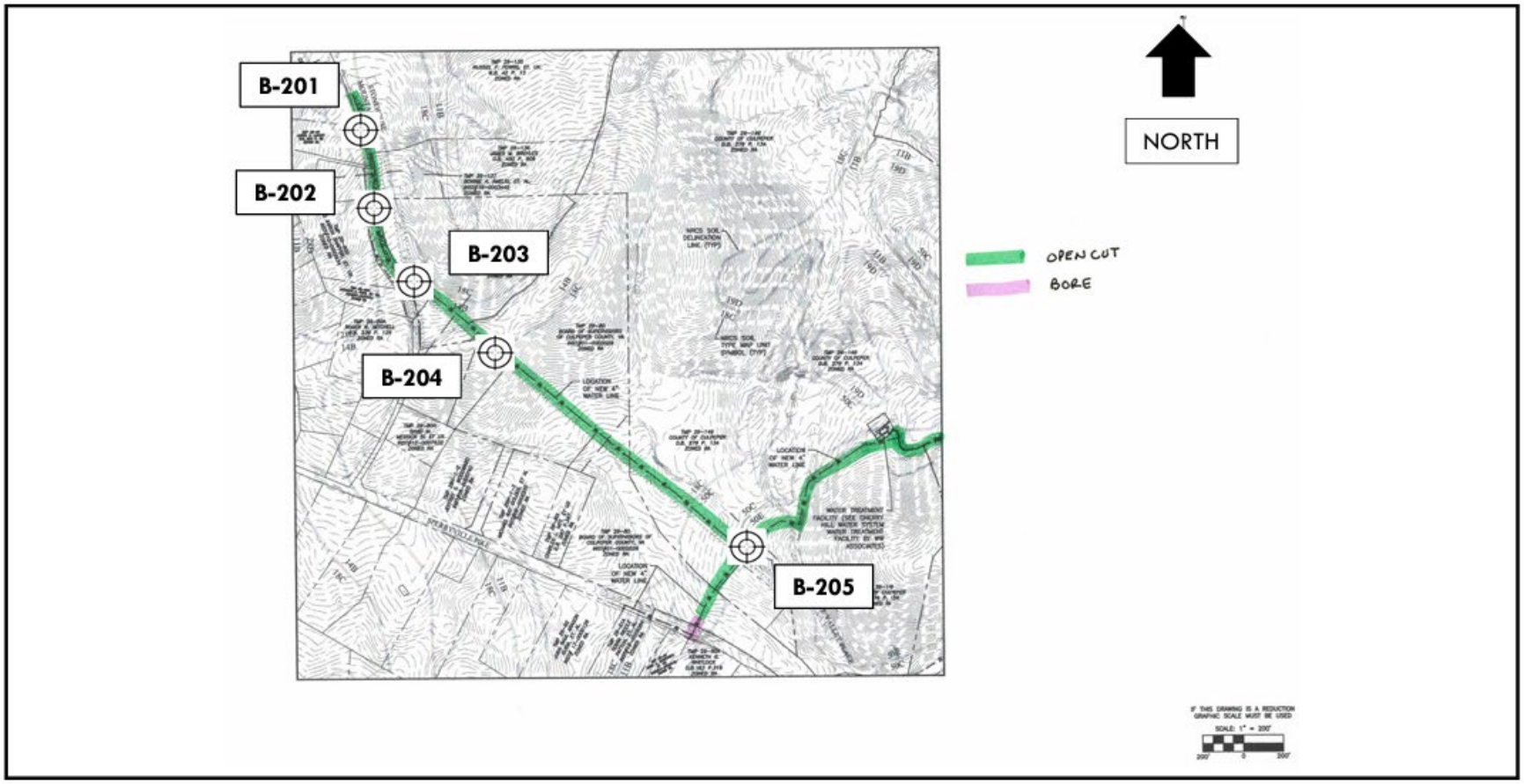
Figure 1: Auger Probe Location Plan, Waterline Phase 1



APPROXIMATE AUGER PROBE LOCATION

Base drawing provided by WW Associates

Figure 2: Auger Probe Location Plan, Waterline Phase II



APPROXIMATE AUGER PROBE LOCATION

Base drawing provided by WW Associates

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Exhibit A: Subsurface Exploration Results

Subsurface Exploration Results

Summary of Auger Probe Total Depths (1 sheet)

Summary of Auger Probe Total Depths			
Auger Probe Number	**Latitude**	**Longitude**	**Total Depth (feet)**
B-101	38.511865	-78.051901	6.0
B-102	38.511050	-78.050852	4.5
B-102A	38.511056	-78.050845	6.0
B-103	38.513195	-78.048653	6.0
B-104	38.512292	-78.046792	6.0
B-105	38.510094	-78.045693	6.0
B-106	38.509834	-78.045691	6.0
B-107	38.508800	-78.043531	6.0
B-108	38.509713	-78.038314	6.0
B-109	38.511086	-78.035229	6.0
B-201	38.516440	-78.060582	6.0
B-202	38.515175	-78.060334	6.0
B-203	38.514149	-78.059843	6.0
B-204	38.510460	-78.054269	6.0
B-205	38.509374	-78.055145	6.0