ADDENDUM NUMBER 1

ISSUED Sept 1, 2010

to the CONTRACT DOCUMENTS for:

WASHINGTON COUNTY SERVICE AUTHORITY
MIDDLE FORK WTP UPGRADE TO 12 MGD

Prepared by: Olver - A CHA Company
1116 South Main Street
Blacksburg, VA 24060
Olver Project No.: 12367.13

The following revisions, additions, and clarifications are hereby made part of the Contract Documents and Technical Specifications for the above-referenced project and shall be taken into account in the preparation of all bids and the execution of all Work. Bidders shall acknowledge receipt of the addendum in the appropriate space on the Bid Form.

GENERAL REVISIONS AND CLARIFICATIONS:

Ad1-1 The requirements for affirmative steps to ensure that Small, Minority and Women's Businesses are utilized when possible is described in the contract documents. We encourage bidders to publicly advertise for interested Small, Minority and Women's businesses as a method of documenting good faith efforts by the bidder.

Ad1-2 Due to reproduction errors, the bid issue drawings may not perfectly scale

Ad1-3 There is a set of record drawing plans entitled "Middle Fork Holston River, Raw Water Intake Facility, Draper Aden Associates, 1999 available for inspection at Olver Incorporated's Blacksburg office.

Ad1-4 There are several sets of as-built plans available for inspection at Olver Incorporated's Blacksburg office and at Middle Fork water plant. These include:

- *Water Treatment Plant Sedimentation Basins, Draper Aden Associates, 1997*
- *Plans for Improvements and Additions, Waterworks Facilities, Goodson-Kinderhook Water Authority, Russel & Axon Engineers-Architects, 1975*

REVISIONS/CLARIFICATIONS TO TECHNICAL SPECIFICATIONS:

Ad1-5 **CHANGE** Section 06200 in the Table of Contents from "Finish Carpentry" to "Architectural Woodwork". The laboratory casework is specified in this section.

Ad1-6 Section 00410 - *Bid Form*, **REVISE** the schedule on page 6, Item g, columns D and E to read as follows:

"a. Siemens.
b. Acrison.
c. Merrick.
d. Or approved equal."

Ad1-7 Section 00410 - *Bid Form*, **REVISE** the schedule on page 6, Item e, columns D and E to read as follows:

a. Watson-Marlow/Bredel.
b. Verdeflex Pumps.
c. Blue-White Pumps
d. Or approved equal.

Ad1-8 Section 00410 - *Bid Form*, **REVISE** the schedule on page 7, Item k, columns D and E to read as follows:

a. Augusta Fiberglass.
b. Plas-Tanks Industries
c. Advance Fiberglass, Inc.
d. Diamond Fiberglass.
e. Southeastern Fiberglass.
f. Or approved equal."

Ad1-9 Section 01060, after Paragraph 3.1 **ADD** the **attached** Figures 1060-1 and 1060-2.

Ad1-10 Section 01062 - *Major Equipment and System Suppliers*, **REVISE** paragraph 1.4 A.5 to read as follows:

a. Watson-Marlow/Bredel.
b. Verdeflex Pumps.
c. Blue-White Pumps
d. Or approved equal.

Ad1-11 Section 01062 - *Major Equipment and System Suppliers*, **REVISE** paragraph 1.4 A.11 to read as follows:

a. Augusta Fiberglass.
b. Plas-Tanks Industries
c. Advance Fiberglass, Inc.
d. Diamond Fiberglass.
e. Southeastern Fiberglass.
f. Or approved equal."

Ad1-12 Section 02027 - **REMOVE** Paragraph 3.2.E.1. No on-site disposal of construction debris will be allowed.

Ad1-13 **ADD** the ***attached*** Section 02302 - *Cast-in-Place Piling: Auger Cast.*

Ad1-14 Section 03002 - Paragraph 1.4.A.2, **ADD** item l to read:

"1. Type of crystalline waterproofing admixture, confirmation that admixture manufacturer has reviewed and approved the use of waterproofing admixture in the waterproof concrete mixture, and has adjusted the mix design, if necessary, for the admixture to perform as intended."

Ad1-15 Section 03002, Paragraph 2.1.A, **ADD** item 6 as follows:

"6. Crystalline waterproofing admixture:
"a. Hydronil.
b. Aquafin.
c. Barrier-1."

Ad1-16 Section 03002, Paragraph 2.2.C, **INSERT** the following in between items 2.e and 3 and renumber remaining items:

"3. Crystalline waterproofing admixture: Silica-based crystalline forming admixture which produces a permanent insoluble crystalline matrix in the pore structure of hardened concrete. Product must meet NSF-61 certification requirements."

Ad1-17 Section 03002, Paragraph 2.3.A, **ADD** Item 4. to read:

"4. Add crystalline waterproofing admixture to concrete where indicated on the Drawings."

Ad1-18 Section 03002, Paragraph 2.3.E, **ADD** Item 8. to read as follows:

"8. For concrete with crystalline waterproofing admixture added, ready mix plant shall confirm mix design(s) with the admixture."

Ad1-19 **ADD** the ***attached*** Section 05400 - *Cold-Framed Metal Trusses.*

Ad1-20 Section 06610, REPLACE Paragraph 2.3.E.10 with the following text "Baffle walls shall extend to 8' above the tank floor. All portions of the baffle walls shall be designed for maximum deflection of L/180."

Ad1-21 Section 11025, **ADD** Paragraph 1.1.D to read: "D. The filter units are a major system in the water plant process. The filter unit supplier shall provide and coordinate all major components and appurtenances to the filters. All submittals on equipment and controls for the filter units shall be from the Filter Unit manufacturer."

Ad1-22 Section 11025, Paragraph 2.2.D.1, **CHANGE** the text that reads "The contractor shall furnish and install wash troughs in the new filter." to "The contractor shall install manufacturer supplied wash troughs in all the filters."

Ad1-23 Section 11025, Paragraph 2.2.D.1, **CHANGE** the text that reads: "An integral end plate, forming the other end of the trough, shall bolt to threaded anchors set in the back wall and be spaced away from the wall with ¼ inch fiberglass washers to allow thermal expansion of the trough shell" to "A mounting saddle shall be provided for the influent end of the troughs to allow for expansion and contraction. The flange end of the mounting saddle shall be bolted to the wall. The influent end of the trough shall be open to allow for penetration of the influent pipe."

Ad1-24 Section 11025, Paragraph 2.2.E, **ADD** sentence 9 as follows: "9. Air scour grids shall be provided for all filters except for Filter 4."

Ad1-25 Section 11025, **REPLACE** Paragraph 2.2.F.b. with the following text: "b. Individual Operator Interface Station shall be housed in stainless steel NEMA 4X enclosure."

Ad1-26 Section 11070, Paragraph 2.1.A. **REPLACE** Paragraph A with the following text "A. See Section 01062 - Major Equipment Suppliers."

Ad1-27 Section 11070, Paragraph 2.3.A.1.i. **CHANGE** the pump minimum discharge size from 6-inch to 4-inch.

Ad1-28 Section 11072, 2.4.J **ADD** sentence 8 as follows: "8. Anti-vortex baffles shall be provided to ensure correct flow patterns in the suction can."

Ad1-29 Section 11240, Paragraph 2.6.D.6 **ADD** new sentence at the end of the paragraph to read "g. Pump shall utilize LCD display to detail any alarms or alarm status."

Ad1-30 Section 11240, **REMOVE** Paragraph 2.12.A.2.

Ad1-31 Section 11240, **REMOVE** Paragraph 2.12.B.

Ad1-32 Section 11240, **REPLACE** the table labeled "Pump Data Sheet 11240, Chemical Metering Pumps, Peristaltic", with the ***attached***:

Ad1-33 Section 11565, Paragraph 2.4.A.3 **REMOVE** the sentence that reads "However the turbine manufacturer shall only be provided the pressure sustaining valve and pressure relief valves shown on the Drawings and otherwise specified in the contract documents."

Ad1-34 Section 11924, **REPLACE** paragraph 2.3.A with the following text:

"A. Scales:

1. A quantity of 3 chemical scales of the below indicated capacity shall be provided and shall be of the digital readout/electronic load cell type. Scale platform shall be sized to accept a either a 330 gallon chemical tote or a 3' diameter tank, as indicated. Four (4) adjustable hold down lugs shall be provided on the platform to increase lateral stability and to allow the use of hold down straps for securing the vessel to the platform. Platform scale coating system shall be a minimum dry thickness of 80 mils and be resistant to

moisture, chemicals, abrasion, impact and UV light. Scale shall be of the single load cell design. Weight shall be transferred via a pivoted platform to a single, NTEP approved load cell of the shear beam strain gauge type. Flexible cable shall connect load cell to indicator to allow easy remote installation of the readout.

2. The remote mounted LCD indicator shall carry CE marking and shall be housed in a NEMA 4X, UL approved enclosure. All operations shall be keypad operated & menu driven in order to avoid compromising the NEMA 4X seal at anytime. The alphanumeric LCD readout shall have backlighting for readability in low light conditions. A 6 digit numerical display shall give operator the ability to monitor chemical by weight (lb or kg) or volume (gallons or liters). A bar graph display shall read 0-100% for the net contents. A dual mode TARE key shall allow user to enter the tare weight of the vessel or enter the net weight of the chemical depending on application needs. A diagnostics menu shall allow recalibration without the need to apply field test weights. A user adjustable filter function shall stabilize display in the event of vibration from pumps or mixers in the immediate vicinity of the scale.

3. Indicator shall output net weight via a 4-20mA signal and full scale output shall be user adjustable via the keypad. Indicator shall have four adjustable set points to display low or high level conditions on the indicator. Adequate cable to reach the indicator as shown on the drawings shall be provided.

4. Scale shall carry a Full Five (5) Year Factory Warranty. "Limited" Warranties shall be considered unacceptable. Full scale accuracy shall be better than 1/4 of 1%. Scale shall be CHEM SCALE with TUF-COAT coating, IBC Tote Bin Scale or IBC Day Tank scale with Wizard 4000 digital indicator, or equal. Provide one indicator per building, minimum. Mount the fluoride scale indicator outside of the fluoride room.

5. Provide the following scales:

    a. Sodium Permanganate (SC-9): 60"x60", 4000 lb, Tote Bin Scale.

    b. Sodium Chlorite (SC-10): 60"x60", 4000 lb, Tote Bin Scale.

    c. Hydrolfluorosilicic Acid (SC-11), 40"x40",2000 lb, Day Tank Scale."

Ad1-35 Section 11924, **DELETE** Paragraph 2.3.D. No 30-day supply of process chemicals will be required.

Ad1-36 Section 11927, after Paragraph 2.2.C.4 **ADD** sentence 5 as follows: "5. Provide ANSI/AWWA flanged piping connections"

Ad1-37 Section 11930, **CHANGE** Paragraph 2.2.F.3 to indicate a 1.35 safety factor.

Ad1-38 Section 11930, **CHANGE** Paragraph 2.4.B.2 to indicate a minimum of 18,000 lbs

Ad1-39 Section 11930, **CHANGE** Paragraph 2.4.B.3 to indicate a minimum of 5000 scfm

Ad1-40 Section 11930, **CHANGE** Paragraph 2.4.C.1 to indicate a minimum of 5000 scfm of air flow.

Ad1-41 Section 11930, **CHANGE** Paragraph 2.4.C.3 to indicate a minimum of 40 HP.

Ad1-42 Section 11930, REMOVE all of paragraph 3.1.B.2 and **REPLACE** it with the following text:

"2. Upon completion of installation of the scrubber system, the Contractor shall be responsible for performing an acceptance test to verify the satisfactory operation of the system and the design performance requirements of the specification. As a minimum the test shall include but not be limited to the following:

a) The test shall be witnessed by the Owner.

b) Air flow and pressure shall be measured and recorded.

c) System component operation shall be tested by separately energizing each individual chlorine leak detector utilizing a sodium hypochlorite solution close to the sensor.

d) Manufacturer to provide certification of acceptable levels of chlorine removal based on testing the quality of a sample of the media delivered to the Owner's installation. Certified tests of chlorine removal for similar media of similar shall be provided."

Ad1-43 Section 11948, Paragraph 1.1.A **ADD** sentence 2 to read "2. New rapid mix motors and speed reducers M-102 and M-103 as part of bid alternate A."

Ad1-44 Section 11948, **CHANGE** Paragraph 1.3.A to read "A. Provide three (3) identical open tank top mounted gear reduced, slow speed mixers for mixing in 16'-6"x16'-6"x16'-6" concrete tanks with a liquid depth of 14'-10". Provide one additional motor and speed reducer as a spare."

Ad1-45 Section 11948, **ADD** Paragraph 1.3.C to read "C. Flocculation basin mixer supplier shall provide motors and required speed reducer as part of Bid Alternate A to replace the existing Sharpe motors and gear reducers on the flash mixers (M-102 and M-103). Existing motor and reducer is Sharpe Model 10N42-15, Serial No 34597-2. Replace with same model, or equal. Tip speed on the rapid mixer shall remain in the same range as the existing"

Ad1-46 Section 13210, after Paragraph 1.4.F, **ADD** the following text: "G. Certification that all materials utilized are optimal for chemical being stored."

Ad1-47 Section 13210, after Paragraph 2.2.B.1, **ADD** the following text: "2. Tanks shall be restrained against seismic forces, the restraint system shall tie into the fiberglass beams located below the tanks.

Ad1-48 Section 13210, Paragraph 2.2.D.1, **CHANGE** the resin type from "SLPE with Oxidation Resistant System" to "XLPE with Oxidation Resistant System."

Ad1-49 Section 15060, *Pipe and Pipe Fittings: Basic Requirements* - paragraph 3.2.B.1.a.1.f), **ADD** the following acceptable manufacturer of Double Contained Piping Systems:

"(4) Guardian."

Ad1-50 Section 15060, after Paragraph 3.10.J.2.a **ADD** text as follows:

"2) Exterior below Grade Piping
a. Schedule 80 PVC with Carrier Tubing
b. All piping to be run with tubing which is meant to be removed if plugged
c. Provide one length of tubing for entire exterior contained run, no fittings or tubing connections underground will be allowed.
d. Tubing shall be clear polypropylene with a minimum working pressure of 87 psi, Prolite or equal.
e. Containment pipe size shall be minimum 2" larger in diameter than tubing called for, minimum size 4".
f. Install containment piping as required for System 7."

Ad1-51 Section 15100, **REPLACE** the valve schedule with the **ATTACHED** valve schedule

Ad1-52 **ADD** the ***attached*** Section 15102 - *Plug Valves*.

Ad1-53 Section 015114, **REPLACE** Paragraph 2.9 with the following text:

"2.9 Mud Valves:

A. Mud Valves (Cast Iron or CI):

1. Mud Valve shall be of the heavy duty flanged type designed to provide a positive seal under both seating and unseating head conditions. The valves shall be non-rising stem style as detailed on the schedule or the plans. The frame, plug and yoke shall be cast iron (A126B) The valve operating stem and lift nut shall be bronze (B421) The seat ring shall be bronze (B62) with an accurately machined tapered seating face. The plug seat shall be a seamless molded, tapered resilient ring of BUNA-N designed to accurately mate with the seat ring for a positive seal.

2. Where required the manufacturer shall provide valve operating stems, Floor Stands and Stem Guides as specified in the valve schedule or plans.

3. The Mud Valves are to be coated using TNEMEC Pota Pox two part epoxy, NSF approved coating.

4. Provide and install wall mounted handwheel actuator as required by the manufacturer for all mud valves requiring.

5. Install valve flush with the bottom of the tank or sump. Install valve by bolting to tapped, flanged end connection of drain pipe.

6. Valve shall be by Mueller, Troy Valve, Trumbull, or equal.

B. Mud Valves (Stainless Steel or SS):

1. Mud valves shall be stainless steel with resilient seats as described herein. Valves shall be the rising stem type and be a heavy duty design.

2. The body flange, yoke, guides and gate shall be cast of Type 316 stainless steel. After machining, all castings shall be passivated in accordance with ASTM A-380. Valves including components welded from stainless steel are not acceptable.

3. The resilient seat shall be of SBR rubber and mechanically retained. Fasteners shall be stainless steel.

4. The valve stem shall be one piece with an integral thrust collar and be cast or machined from type 316 stainless steel.

5. The valve shall be capable of withstanding a minimum input torque of 490 foot pounds, without damage to the valve. The valve shall not leak more than one quart per hour, when the valve is closed to a stem torque of 35 foot pounds.

6. The stem shall be coupled to the extension stem with a stainless steel machined coupling or a cast stainless 2" square operating nut and retained with a 1/4" stainless steel spring pin. No welded components of stainless are permitted for this connection or to the valve stem.

7. The stem shall have a permanently bonded coating to prevent galling with other stainless components. The coating shall be safe for potable water use and capable of enduring a minimum of 15,000 open-close cycles without galling or excessive wear.

8. The base flange shall be drilled per ANSI 125# standard and have a minimum thickness of ¾".

9. The extension stem shall be type 316 stainless steel, of either schedule 40 pipe or solid round bar.

10. Install valve flush with the bottom of the tank or sump. Install valve by bolting to tapped, flanged end connection of drain pipe.

11. Valve shall be by Trumbull, Troy Valve, or equal.

C. Position Indication (if required in the valve schedule):

1. The position of the mud valves, from fully open to fully closed, shall be visible at ground level, by means of either a position indicator or an indicating-type floor stand, as shown on the drawings. Where a floor is not

directly over the valve and extension stem, position indicators or floor stands shall be supported by a cast stainless wall bracket mounted to the side wall.

2. Wall brackets shall contain a plate designed to support either the position indicator or wall mounted floor stand.

3. The position indicator shall be installed in a cast iron floor adapter. The adapter shall have internal opposing flats to match the flat sides of the position indicator, to prevent rotation of the housing during operation. The adapter shall be provided with a bronze bushing to support and center the extension stem. The bronze bushing shall be retained in the cast iron floor adapter by 2 stainless steel screws and drilled to an inside diameter 1/16" larger than the outside diameter of the extension stem.

4. The position indicator shall be of the planetary gear design. The sun gear, planet gear, ring gears and scale plate will be constructed of non-corrosive Delrin. Fasteners shall be stainless steel. Housings of carbon steel or aluminum will not be accepted. The top scale plate shall have recessed markings representing the number of turns, contain the word "Closed", and a directional arrow. The "open" line shall be marked on a transparent polycarbonate window, which can be field adjusted for the number of turns of each valve size. The position of the adjustable "open" window shall be secured to the top surface of the scale plate by the outside diameter of three stainless button head cap screws."

Ad1-54 Section 15114, Paragraph 2.11.F.2.d **CHANGE** the Cla-Val model number to 3650-07.

Ad1-55 Section 15114, after Paragraph 2.11.F, **ADD** the following paragraph:

"G. The main valve will be ductile iron and have 316 stainless steel anti-cavitation trim internals. This trim will consist of a one piece stainless steel stationary seat that has radial slots where the water passes from the valve inlet. It will also have a 316 disc guide that has angular radial slots which break the flow as it exits the valve. There shall be an X101 visual valve position indicator to monitor valve position at any time. The main valve cover will have stainless steel fasteners. In parallel to the CRL-33 will be a normally isolated manually adjusted CRL for set up with a no power condition."

Ad1-56 **DELETE** Section 16472 and **REPLACE** with ***attached*** revised Section 16472.

Ad1-57 **ADD** new specification Section 16474.

Ad1-58 **DELETE** Section 17120 and **REPLACE** with ***attached*** revised Section 17120.

Ad1-59 **DELETE** Section 17125 and **REPLACE** with ***attached*** revised Section 17125.

Ad1-60 Section 17240, Paragraph 2.5: In subparagraph 2.5.A first sentence, **REVISE** "...Wonderware InTouch..." to read "...Allen-Bradley Factory Talk...".

Ad1-61 **DELETE** Section 17950 and **REPLACE** with ***attached*** revised Section 17950.

Ad1-62 Appendix, **ADD** the attached geotechnical report to the Appendix

REVISIONS/CLARIFICATIONS TO DRAWINGS:

Ad1-63 Sheet C101, **ADD** the following text to the bottom of the notes section: "7. There is a potable water line running from the northeast corner of the sedimentation basins to the plant building, serving both the plant building and sedimentation basins. There are two water meters on the line, located near the northeast corner of the sedimentation basins, with the source water line located in a tee between them. These water meters are to be relocated as shown on the yard piping plan."

Ad1-64 **REPLACE** Drawing C104 with ***attached.***

Ad1-65 Sheet C106, NOTES, **CHANGE** the notes to indicate note number 2 starting in front of the words "Connect new 16-inch DR to 12-inch...." **CHANGE** the remaining notes 2 and 3 to notes 3 and 4.

Ad1-66 Sheet S003, **ADD** the attached Elevated Concrete Slab Schedule to S003.

Ad1-67 Sheet S103, Plan S103.2, Note 1; **CHANGE** finished floor elevation to "1799.75'".

Ad1-68 Sheet S103, Detail S103.4; **CHANGE** finished floor elevation to "1799.00'".

Ad1-69 Sheet S103, Detail S103.5; **CHANGE** elevations in five locations to be 1' higher than shown in the Bid Issue.

Ad1-70 S204, **CHANGE** the slab designated "S3" between column lines 2 and 3 to "S2".

Ad1-71 S205, **CHANGE** the two slabs designated "S1" at the southwest corner of the building to "S2".

Ad1-72 S205, **CHANGE** the two slabs designated "S3" at the west end of the building to "S2".

Ad1-73 S207 - ADD a section cut through the north wall of the existing filters (backwash gullet end) referenced to Section S505.6/S207.

Ad1-74 S207, **NOTE:** The leader line that has no text associated with it on column line 1, between column lines C.1 and D should have a cmu wall designation symbol indicating that the cmu wall is 6" thick reinforced vertically with #4@48".

Ad1-75 S207 - **ADD** a leader pointing to the center walkway area with text reading "ALL SLABS AND WALLS THAT ARE PART OF THE FILTER INFLUENT CHANNEL SHALL BE CONSTRUCTED WITH CONCRETE MIX THAT HAS WATERPROOFING ADMIXTURE INCLUDED."

Ad1-76 S208 - **NOTE:** The leader with no text associated with it at the west end of the building nearest the "MATCH LINE" should have a cmu wall designation symbol indicating that the cmu wall is 8" thick reinforced vertically with #4@24".

Ad1-77 S208, **NOTE:** The leader with no text associated with it at the west end of the building between column lines D and D.6 should have a cmu wall designation symbol indicating that the cmu wall is 8" thick reinforced vertically with #4@24".

Ad1-78 S208, **NOTE:** The leader line with no text associated with it on column line 1, between column lines E.2 and F should have a cmu wall designation symbol indicating that the cmu wall is 6" thick reinforced vertically with #4@48".

Ad1-79 S208, **NOTE:** The leader line on column line F, between column lines 2 and 3 should have a cmu wall designation symbol indicating that the cmu wall is 6" thick reinforced vertically with #4@48".

Ad1-80 S208, **ADD** a leader pointing to the center walkway area with text reading "ALL SLABS AND WALLS THAT ARE PART OF THE FILTER INFLUENT CHANNEL SHALL BE CONSTRUCTED WITH CONCRETE MIX THAT HAS WATERPROOFING ADMIXTURE INCLUDED".

Ad1-81 S209, **ADD** a section cut number S505.7/S209 through the gate opening of adsorption clarifier #4.

Ad1-82 S209, **ADD** a leader pointing to the center walkway area with text reading "ALL SLABS AND WALLS THAT ARE PART OF THE FILTER INFLUENT CHANNEL SHALL BE CONSTRUCTED WITH CONCRETE MIX THAT HAS WATERPROOFING ADMIXTURE INCLUDED".

Ad1-83 S209, **CHANGE** the two slabs designated "S3" at the north end of the building to "S5" and **ROTATE** the span direction 90-degrees.

Ad1-84 Sheet S401, Plan S401.2; **REVISE** plan as shown on the ***attached*** sketch.

Ad1-85 Sheet S402.5, Detail S402.5; **REVISE** as shown on the ***attached*** sketch.

Ad1-86 Detail S501.2, **DELETE** leader and associated text reading "VR AS REQ'D, SEE ARCH".

Ad1-87 Detail S501.9, **DELETE** leader and associated text reading "VR AS REQ'D, SEE ARCH".

Ad1-88 S501 - REPLACE detail S501.10 with the attached.

Ad1-89 S501, Detail S501.11, **ADD** 9'-9" dimension from the filter bottom slab up to the top of the 6" wall at the right end of the filter.

Ad1-90 S504, Details S504.3 and S504.4, **ADD** a leader pointing to the three concrete filter influent walls and bottom slab of the filter influent channel with text reading "USE WATERPROOF CONC MIX".

Ad1-91 S504, Detail S504.6, **ADD** a leader pointing to the concrete wall and bottom slab of the filter influent channel with text reading "USE WATERPROOF CONC MIX".

Ad1-92 S504, Detail S504.10, **ADD** a leader pointing to the concrete wall and bottom slab of the filter influent channel with text reading "USE WATERPROOF CONC MIX".

Ad1-93 S504, Detail S504.11, **ADD** a leader pointing to the concrete wall and bottom slab of the filter influent channel with text reading "USE WATERPROOF CONC MIX".

Ad1-94 S504, Detail S504.12, **ADD** a leader pointing to the concrete wall and bottom slab of the filter influent channel with text reading "USE WATERPROOF CONC MIX".

Ad1-95 S505 - **RENUMBER** Section S505.3/S207 at the left side of the sheet to S505.3/S208

Ad1-96 S505 - **ADD** attached detail S505.6/S207.

Ad1-97 **ADD** new Drawing M003, ***attached***.

Ad1-98 Sheet M006, **ADD** Trap Primer Detail as shown on the attached drawing.

Ad1-99 **ADD** new Drawing M007, ***attached***.

Ad1-100 **ADD** new Drawing M008, ***attached***.

Ad1-101 Sheet M102, **REVISE** M102.1 as indicated on the **attached** figure.

Ad1-102 Sheet M104, **ADD** leader and note to valve V-117 in the flocculator effluent channel that reads "Provide meter box style cover and access hatch in grating and mounting plate for indicating nut on valve".

Ad1-103 Sheet M104, **CHANGE** the flocculation section callout from M106.1/M104 to M105.1/M104.

Ad1-104 Sheet M104, **CHANGE** the rapid mix section callout from M107.1/M104 to M106.1/M104.

Ad1-105 Detail M105.1, **REVERSE** the section to indicate the new mixer on the right hand side of the page, and the 12" DR overflow piping on the left hand side of the page.

Ad1-106 Detail M107.1, **CHANGE** the valve label that reads "V-034" to "V-054".

Ad1-107 Detail M107.1, **CHANGE** the label that reads "Turbine", to read "Turbine Generator (typ of 2)."

Ad1-108 Sheet M203, **CHANGE** the note in the lower left that indicates Perforated Hinged FRP baffle from "typ of 12" to "typ of 9".

Ad1-109 Sheet M203, **CHANGE** the note that reads "PVC Channel wall See specification" to "PVC Channel Wall".

Ad1-110 Sheet M203, CHANGE the note that reads "5' Diameter Pump Out Manhole with 36-inch locking cover (typ of 2)" to "5' Diameter Pump Out Manhole with 36-inch, watertight,

locking manhole cover with the words "Potable Water" stamped on the top, East Jordan Iron Works model 2230 with special security bolts (typ of 2)

Ad1-111 Detail M205.2, **CHANGE** all references to ¾" PVC to ½" PVC.

Ad1-112 Detail M205.2 REPLACE the note that reads "Use ¾" PVC or SS Two way channel joiner..." with "Solvent weld a 3.5"x3.5" extruded PVC angle to the full length of the joint and on each side of all sheet joints. Weld the angle with the center of the joint in the center of the angle to integrally connect the two sheets."

Ad1-113 Detail M205.2, **ADD** the following notes to the bottom of the detail to read "1. Provide PVC with materials meeting ASTM D1784-07 Class 12454-B. No plasticizers or fillers may be utilized. PVC sheet available from Professional Plastics or U.S. Plastic Corps. 2. Each individual PVC sheet shall have a minimum of 4 bolted connections as described in the detail."

Ad1-114 Sheet M207, ADD note 2 to read: "2. Run 4-inch DR piping along edge of the north filter walls next to effluent piping, above the FFE, to accept drain flow from the turbidimeters and any other instruments. Pipe to terminate above the slab near the below floor drain near Filter 4"

Ad1-115 Sheet M208, ADD note 3 to read: "3. Run 4-inch DR piping underneath all the instruments mounted along the west wall of filter 5, and along the south filter walls and next to effluent piping, above the FFE to accept drain flow from the turbidimeters and any other instruments. Pipe to terminate at below floor drain near Filter 8"

Ad1-116 Sheet M208, **CHANGE** the label "Fluoride Scale SC-10" to "Fluoride Scale SC-11" for the fluoride day tank scale.

Ad1-117 Sheet M208, **CHANGE** the location of the Weight indicator to the exterior of the Fluoride room.

Ad1-118 Sheet M209, **ADD** 30-inch manways in the walls of all four AC clarifier bays, 3' east of each of the flush drains.

Ad1-119 Sheet M209, **CHANGE** the valve on AC-3 called out as V-236 to V-235.

Ad1-120 Sheet M209, **CHANGE** the 18" BWD connection immediately to the right of the note that says "TO LAGOON" to a TEE connection only. No Cross or Elbow up as shown will be required.

Ad1-121 Sheet M213, **REMOVE** valves V-203 and V-201. **CHANGE** the label of V-204 to V-201.

Ad1-122 Sheet M213, **ADD** a note with leaders pointing to V-201 and V-202 with the text: "Relocate existing butterfly valves from existing blower installation."

Ad1-123 Sheet M213, **ADD** a note with leaders to the suction piping of B-201 and the discharge piping of B-202 and B-201 with the following text: "Run 10-inch LPA along ceiling".

Ad1-124 Sheet M213, **CHANGE** the note that reads "New double door check valve" to "Install existing double door check valve (typ of 2)".

Ad1-125 Detail M214.2 ADD note 1 at the bottom of this detail to read "1. Provide backpressure/antisiphon valve at all chemical feed locations within 3' of chemical entry point into process water."

Ad1-126 Detail M215.1, **ADD** two 30-inch manways with an invert elevation of 1804.00, 3' to the right of each of the flush drains.

Ad1-127 Detail M215.1, ADD a note pointing to the tee at the top of the BWD coming out of AC-3 to read "Bolt 4-inch vent with two elbows to top of blind flange similar to vent on valve vaults with ¼" ring flange and screen. Apply to top of all four BWD lines from clarifiers."

Ad1-128 Detail M215.2, **CHANGE** the media screen elevation callout from 1806.42 to 1807.43.

Ad1-129 Detail M216.2, ADD note 1 at the bottom of this detail to read "1. Provide backpressure/antisiphon valve prior to feed at Filter 4, Filter 8 and on the main headers feeding Filters 1-3 and Filters 5-7."

Ad1-130 Detail M216.1 **CHANGE** the size of the Cla-Val Pressure relief valve from 12" to 10".

Ad1-131 Detail M216.1, **CHANGE** the label of the valve called out as V-232 to V-231. **CHANGE** the valve called out as V-234 to V-232.

Ad1-132 Detail M217.1 **CHANGE** the top of the gullet walls, located on the left side of filter 3, and the right side of Filter 7 to reach an elevation above the troughs at 1811.75

Ad1-133 Detail M218.1, **REMOVE** the centerline elevation 1802.08 from the raw water influent header.

Ad1-134 Detail M218.1, **CHANGE** the centerline of the air header from 1800.37' to 1800.73'.

Ad1-135 Sheet M401, Plan M401.1, **CHANGE** the location of the mud valve in the PACl sump to be similar to the valve in the NaOH sump.

Ad1-136 Sheet M407, **EXTEND** 4" CDR line from the central drain line in the chemical feed room to the chlorinator room, with termination in an FD-1.

Ad1-137 E003 - **REVISE** Control Panel CP-8 as shown on the attached drawing.

Ad1-138 E011 - ADD new drawing E011 **attached.**

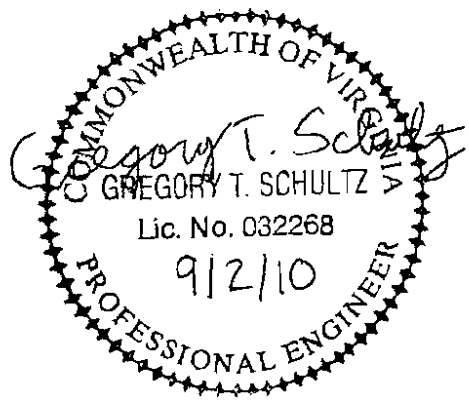
Ad1-139 E105 - ADD new drawing E105 **attached.**

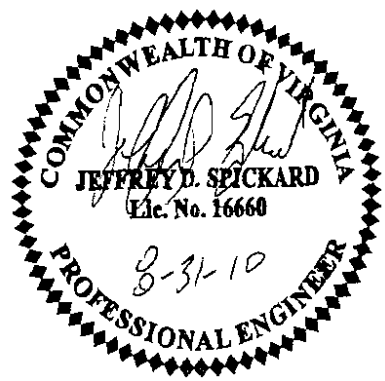
Ad1-140 E301 - ADD new drawing E301 **attached.**

Ad1-141 A revised bid form will be issued in subsequent addenda.

END OF ADDENDUM

Douglas B. Hudgins, P.E.
Project Manager





SECTION 02302 - Addendum 1

CAST-IN-PLACE PILING: AUGER CAST

PART 1 — GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cast-in-place piling.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 03002 - *Concrete*.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. A615, Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement Including Supplementary Requirements S1.
      b. C31, Making and Curing Concrete Test Specimens in The Field.
      c. C33, Specification for Concrete Aggregates.
      d. C39, Test for Compressive Strength of Cylindrical Concrete Specimens.
      e. C150, Specification for Portland Cement.
      f. C494, Specification for Chemical Admixtures for Concrete.
      g. D1143, Testing Piles Under Axial Compressive Load.
   2. American Welding Society (AWS):
      a. D1.4, Structural Welding Code - Reinforcing Steel.
   3. Corps of Engineers Specifications:
      a. CRD C-79, Method of Test for Flow of Grout Mixtures.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Record of three of Contractor's past installation of required type of pile under similar soil conditions.
   3. Concrete mix design for pile mortar.

B. Pile report.

1.4 SITE CONDITIONS

A. Do not begin pile installation until the earthwork in the area where piles are to be installed has been completed as shown on the plans and indicated in these Specifications.

PART 2 — PRODUCTS

2.1 PILE CAPACITY

A. Allowable working downward load carrying capacity of all piles shall be 28 tons.

2.2 PILE TYPE

A. Install 16 IN DIA cast in place piles by rotating a continuous, helical flight, hollow shaft auger into the subsoil.

B. Inject mortar under pressure through auger shaft as auger is withdrawn using earth filled auger to retain shape of hole and to act as a packer. Positive or removing pressure shall thus be exerted on the withdrawing auger as well as lateral pressure on soil surrounding the mortar filled hole.

C. Exercise care to withdraw auger slowly and inject sufficient material to ensure a continuous column of mortar of diameter specified.

2.3 MATERIALS

A. Portland Cement: Conform to ASTM C150 and shall be Type I. Fly ash shall not be used.

B. Water: Potable, clean, free of oils, acids and organic matter.

C. Aggregate: Conform to ASTM C33 well graded from fine to coarse. Aggregates to be natural not manufactured.

D. Admixtures: Conform to ASTM C494 Types A through E only.

E. Proportion and mix mortar so as to produce a mortar capable of maintaining solids in suspension without appreciable water gain, yet which may be pumped without difficulty and which will penetrate and fill any voids in subgrade material. Proportion the materials to produce a hardened mortar in the cast in place piles with a minimum 28-day compressive strength of 4000 psi.

F. Prior to beginning installation of piles, submit the proposed mortar mix design to Engineer for review. Mix design to contain the following information:
   1. Sieve analysis and source of aggregates.
   2. Test for aggregate organic impurities.
   3. Proportioning of all materials.
   4. Type of cement along with mill certificate for the cement.
   5. Manufacturer and type of proposed admixtures.
   6. Field or laboratory test results used for mix conformation.

PART 3 – EXECUTION

3.1 INSPECTION

A. Do not include in bid price the cost of inspection services indicated herein to be performed by the OWNER's Laboratory.

3.2 LINES AND LEVELS

A. Complete necessary excavation and furnish lines and levels required to install piles at their indicated locations.

3.3 PILE CUT-OFF ELEVATIONS

A. Obtain cut off elevations from foundation plans and details.

3.4 MIXING AND PUMPING OF MORTAR

A. Provide adequate mixing and pumping equipment for preparation and handling of mortar. Provide a screen between mixer and pump or between mixer and agitator. Remove all soil, rust, loose mortar or other foreign material from mixing drums, stirring mechanisms, and from other portions of equipment in contact with mortar before materials are introduced.

B. Accurately measure all materials by weight as they are fed to the mixer.

C. Provide quantity of water such as to produce a mortar having a consistency of not less than 21 seconds when tested with a flow cone in accordance with Corps of Engineers Specification

CRD C-79. Time of mixing not to be less than one minute. If agitated continuously, mortar may be held in mixer or agitator for a period not exceeding 2 HRS at temperatures below 70°F and for a period not exceeding 1½ HRS at higher temperatures. If there is a lapse in operation of mortar injection, recirculate mortar through pump, or through mixer drum or agitator and pump.

3.5 PILE INSTALLATION

A. Provide auguring or mortar injection equipment with a mortar pressure gage in clear view of equipment operator. Coordinate rate of mortar injection and rate of auger withdrawal from soil so as to maintain at all times a positive pressure on this gage, which will in turn, indicate the existence of a removing pressure on bottom of auger flight.

B. Withdraw auger at an even rate consistent with mortar injection rate producing a pile of continuous required uniform cross section. Uneven or jerky removal of auger flight will be sufficient basis for requesting that the pile or piles in question be test loaded at Contractor's expense. Provide auguring equipment having no less than a four-part line for withdrawing auger.

C. Provide a plug in bottom end of auger flight. Plug to be removed by pressure of grout injection.

D. Jetting with water not to be used as an aid to auguring for pile installation.

E. Remove soil due to auguring operation from around the top of the pile hole to prevent the soil from re-entering the hole and contaminating the concrete.

F. Allow Engineer to witness the installation of each pile. If drilling conditions differ from those originally encountered and described in the Geotechnical Study, revise final tip elevation or elevations as directed by the Engineer.

G. Cure top surfaces of all piles for a minimum of 7 days. Begin curing immediately after pile installation is complete. Do not allow temperature of top of piles to fall below 50°F during the curing period.

H. Do not place pile mortar against frozen ground. Top of pile to be of diameter specified. Mushrooming of top of piles is not allowed. Remove excess mortar as required if this situation occurs.

3.6 OBSTRUCTIONS

A. Should any obstruction including but not limited to boulders, rocks, rubble, fill, existing foundations or timbers be encountered which prevent placing pile to depth required or cause pile to drift horizontally or vertically from required location, cease auguring, fill hole with mortar and take corrective action as directed by Engineer.

3.7 PILE LOCATIONS AND TOLERANCES

A. Provide piles that are straight and true with diameter as specified for full length of pile.

B. Install piles vertical at locations shown on Drawings.
   1. Maximum horizontal deviation of any pile from its required location not to exceed 3 IN.
   2. Pile centerline not to deviate more than 2 IN in 10 FT of pile length from vertical.
   3. Contractor to pay for cost of foundation revision and/or for additional installed piles due to piles being installed beyond indicated tolerance limits.

3.8 PILE

A. Top of piles at cut off elevation to be free of defects and be level with a full cross section of the diameter specified.

3.9 CONCRETE TESTS FOR INSTALLED PILING

A. Notify Owner's Laboratory a minimum of 72 hours before piling installation. Confirm piling schedule by 5:00 p.m. the day prior to installation.

B. Owner's Laboratory to make three 6 IN diameter by 12 IN high concrete test cylinders each morning and each afternoon for each drill rig operating. Cylinders will be in accordance with ASTM C31.

1. One cylinder will be tested at 7 days and two cylinders at 28 days. Testing will be in accordance with ASTM C39.
2. Test results, indicating piling they represent, will be sent to Engineer.

3.10 DAMAGED PILES

A. Replace damaged piles as directed by Engineer at no additional expense to Owner.

B. Damaged piles include but are not necessarily limited to piles which are cracked, spalled, contain voids or foreign material, are fractured, are of a cross-sectional area less than required, are of a compressive strength less than specified or contain any other defect as determined by Engineer that would weaken the pile.

C. Should any pile as determined by Engineer be damaged during or after installation, be too short to reach required tip elevation or otherwise not conform to this Specification Section, install another pile in its place at location indicated by Engineer. Revise foundation as directed by Engineer as required by new location of pile. Additional pile and foundation to be at Contractor's expense.

3.11 PILE REPORT

A. Provide Engineer with a copy of a pile report for all installed piles providing the following information:

1. Pile location and number.
2. Date installed.
3. Length of pile (tip to cut-off).
4. Pile tip elevation.
5. Description of piles that were rejected (pile number, location, reason for rejection).
6. Quantity of concrete placed in each pile.

END OF SECTION

SECTION 05400

COLD-FRAMED METAL TRUSSES

TABLE OF CONTENTS

SECTION 05400

COLD-FRAMED METAL TRUSSES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Engineered light gauge metal trusses.

B. Cold-formed steel framing accessories.

1.2 REFERENCES

A. AISI (American Iron and Steel Institute) - Specification for the Design of Cold-Formed Steel Structural Members, August 19, 1986 Edition with December 11, 1989 Addendum.

B. ASTM A 370 - Standard Test Methods and Definitions for Mechanical testing of Steel Products.

C. ASTM A 500 - Standard Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in rounds and Shapes.

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

1.3 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Design system components in accordance with AISI reference.
   2. Conform to requirements of Virginia Uniform Statewide Building Code.
   3. Maximum Allowable Deflection: $1/360^{th}$ of span, under total design loads.
   4. Maximum Allowable Deflection: $1/600^{th}$ of span, under live design loads.

B. Performance Requirements: Truss system, with framing components and accessories, shall provide a complete horizontal framing system, ready for deck installation, meeting specified Design Requirements.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 – *Shop Drawings, Product Data & Samples; Operation & Maintenance Manuals; and Miscellaneous Submittals.*
   2. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Materials certification.
      c. Manufacturer's installation instructions.
      d. Manufacturer's recommendations for temporary bracing.
      e. Warranty.
   3. Product Data: Descriptive literature for each item of cold-formed metal framing and each accessory specified in this section.
   4. Shop Drawings: Truss Fabricator's drawings and/or details that:
   5. Indicate special components and installations not fully detailed in product data.
   6. Indicate in the layout placement drawings the number, types, location, and spacings of trusses and other framing members.
   7. Indicate details of truss loading, reactions, uplifts, support locations, material sizes and gauges, permanent truss web bracing, and splices as required for a complete installation.

B. Quality Assurance Submittals:
   1. Printed installation instructions for each item of cold-formed metal framing and each accessory specified in this section.
   2. Design Data: Results of design analysis, bearing the seal and signature of a professional engineer registered in the State in which project is located.

C. Written recommendations for handling and storage: Observe written recommendations.

1.5 QUALITY ASSURANCE

A. Pre-installation Meetings:
   1. Confer at job site prior to scheduled beginning of construction activities of this section to review requirements of this section.
   2. Attendees: Representatives of the following:
      a. Truss Fabricator, if requested by installer of products of this section.
      b. Installer of the products of this section.
      c. Other entities directly affecting, or affected by, construction activities of this section, including but not limited to the following:
         1) Installer of truss support framing.
         2) Installer of mechanical systems.
         3) Installer of electrical systems.
   3. Review potential interface conflicts; coordinate layout and support provisions.

B. Regular job progress and coordination meetings, as required.

1.6 DELIVERY, STORAGE, AND HANDLING OF STEEL TRUSSES

A. Packing, Shipping, Handling and Unloading: Handle and lift shop assembled units in accordance with truss manufacturer's written recommendations to prevent damage or distortion.

B. Storage and Protection: Store shop assembled units in accordance with manufacturer's written recommendations to prevent damage, distortion and moisture buildup.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer shall be a company regularly engaged in the design, fabrication and supply of cold formed metal trusses with a minimum of 10 years of experience.

2.2 COMPONENTS

A. Load Bearing Members: Mechanical properties of components shall be determined by testing conforming to ASTM A370 - Standard Test Methods and Definitions for Mechanical Testing of Steel Products. Members shall be cold-formed to indicated sizes, profiles, and thickness of steel conforming to ASTM A653, minimum G60 coating, and ASTM A500 as follows:
   1. Chord materials - Minimum yield strength 55,000 KSI.
   2. Web materials - Minimum yield strength 45,000 KSI.
   3. Shapes: Indicated on shop drawings.
   4. Size: Indicated on shop drawings.
   5. Gauge: Indicated on shop drawings.

B. Fasteners Used in Fabricating Trusses: All web to chord connections shall be made with the appropriate screw fastener as recommended by manufacturer. For connecting higher-stress members welding is acceptable as long as welded connections are considered in the analysis and sizing of members.

2.3 FABRICATION

A. Light Gauge Steel Trusses:
   1. Shop fabricate from cold formed steel components in accordance with shop drawings, using jigging systems to ensure consistent component placement and alignment of components, and to maintain specified tolerances as shown in Section 2.4 below
   2. Field fabrication of trusses is strictly prohibited unless performed by manufacturer's authorized fabricator using the fabricators shop assemblers and proper jigging systems.

B. Shop fabrication of other cold formed steel framing components into assemblies prior to erection is permitted; fabricate assemblies in accordance with shop drawings.

2.4 SOURCE QUALITY CONTROL

A. Material Tolerances: Steel for cold-formed chord components
   1. Nominal 22 ga. members:
      a. Minimum bare metal thickness: 0.0284 inch.
      b. Maximum design thickness: 0.0299 inch.
   2. Nominal 20 ga. members:
      a. Minimum bare metal thickness: 0.0329 inch.
      b. Maximum design thickness: 0.0346 inch.
   3. Nominal 18 ga. members:
      a. Minimum bare metal thickness: 0.0428 inch.
      b. Maximum design thickness: 0.0451 inch.
   4. Nominal 16 ga. members:
      a. Minimum bare metal thickness: 0.0538 inch.
      b. Maximum design thickness: 0.0566 inch.

B. Material Tolerances: Steel for cold-formed web components
   1. Nominal 20 ga. members:
      a. Minimum bare metal thickness: 0.033 inch.
      b. Maximum design thickness: 0.035 inch.
   2. Nominal 18 ga. members:
      a. Minimum bare metal thickness: 0.047 inch.
      b. Maximum design thickness: 0.049 inch.
   3. Nominal 16 ga. members:
      a. Minimum bare metal thickness: 0.063 inch.
      b. Maximum design thickness: 0.065 inch.

C. Materials Tolerances: Truss Assemblies: Fabricate to tolerances of maximum variation from plumb, level, or true to line as indicated below:
   1. Trusses up to 30 ft. long = max ½ in. variation from design length.
   2. Trusses over 30 ft. long = max ¾ in. variation from design length.
   3. Trusses up to 5 ft. high = max ¼ in. variation from design height.
   4. Trusses over 5 ft. high = max ½ in. variation from design height.

D. Material Certification - Provide material certification in the submittal processes indicating conformance with this Section 2.4.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
   1. Verify that bearing surfaces and substrates are ready to receive steel trusses.
   2. Verify that rough-in utilities and/or chases that will interface with the steel trusses or truss bracing are in correct locations and do not interfere with truss placement.

B. Installer's Examination:

1. Have installer of this section inspect conditions under which construction activities of this section are to be performed, then submit written notification if such conditions are unacceptable to installer.
2. Installer shall transmit two copies of installer's report to Architect of Engineer-of-Record within 24 hours of inspection.
3. Beginning construction activities of this section before unacceptable conditions have been corrected is prohibited.
4. Beginning construction activities of this section indicates installer's acceptance of conditions.

3.2 INSTALLATION

A. Field Fastening: Use correct fasteners.

B. Metal Trusses:

1. Install metal trusses in accordance with manufacturer's written instructions and shop drawing submittal. Place components at spacings indicated on shop drawings. Install truss installation (erection) bracing. Truss installation (erection) bracing shall hold trusses straight and plumb and in safe condition until decking and permanent truss bracing has been fastened, forming a structurally sound framing system. All sub-contractors shall employ proper construction procedures to insure adequate distribution of temporary construction loads so that the carrying capacity of any single truss or group of trusses is not exceeded.
2. Install required roof and system permanent bracing and bridging as indicated by the drawings and notes of the Architect of Engineer-of-Record. See manufacturer's shop drawings for any additional bracing requirements. All truss installation (erection) bracing and permanent bracing and bridging shall be installed before the application of any loads.
3. The field removal, cutting or alteration of any truss chord, web or bracing members is not allowed without prior written approval of the manufacturer's Engineer-of-Record.
4. Damaged chords, webs and complete trusses shall be repaired or replaced as directed and approved in writing by the Engineer-of-Record and manufacturer prior to installation or application of the repair or replacement.

END OF SECTION

PUMP DATA SHEET 11240-Addendum 1
CHEMICAL METERING PUMPS (PERISTALTIC)

Chemical and Concentration	No. of Pumps	Tag Nos.	Pump Capacity (gph)	Minimum Speed (rpm)	Maximum Speed (rpm)	Minimum Pressure Rating (psi)	Watson Marlow Bredel Model	Tubing Bore Size (mm)	Minimum Tubing Wall Thickness	Tubing Material	Max Power (VA)	Voltage	Phase
Sodium Hydroxide 25%	2		1.5 to 15.6	6.3	66	60	520 REM/DUN Loadsure	9.6	3.2	Marprene	135	120	1
Hydrofluosilicic Acid 23%	2		0.9 to 2.3	14	38	60	520 REM/DUN Loadsure	6.4	2.4	PTFE or Fluorel	135	120	1
Sodium Permanganate (20%)	2		0.07 to 3.2	1.2	54	60	520 REM/DUN Loadsure	4.8	3.2	Marprene	135	120	1
Polymer (0.5%)	2		0.38 to 73.5	0.63	116 10 typical	60	520 REM/DUN Loadsure	12.7	3.2	Marprene	250	120	1
Polyaluminum Chloride (100%)	3		3.1 to 81.3	4.7	124 50 typical	60	620 DUN/RE Loadsure	12.7	3.2	Marprene	250	120	1

Notes:

1. Each chemical shall be provided with a calibration column with a capacity of at least 60 seconds of drawdown at maximum pump output, as shown on the plans.
2. Each pump shall have a revolution counter.
3. Manufacturer shall confirm tubing size and material is compatible with intended flowrate and chemical.
4. Provide 200 feet of spare tubing for each chemical listed.

Tag	Description	Location	Size	Valve Type	End Type	Operator	Pressure Rating (psi)	Notes
V-014	Cla-Val Control Valve	Control Valve Vault/Energy Recovery	18	Pressure Sustaining	Flanged	Hydraulic	150	Location varies based on Base Bid/Bid Alternate
V-015	South Fork Isolation from Turbines	Yard	24	Butterfly	MJ	Nut	150	
V-016	MF Connection to Low Pressure	Yard	20	Butterfly	MJ	Nut	150	Bid Alternate B
V-018	MF Isolation from Bypass	Yard	20	Butterfly	MJ	Nut	150	
V-019	Booster PS Suction Line Isolation	Yard	18	Butterfly	MJ	Nut	150	
V-020	Booster PS FM Line Isolation	Yard	18	Butterfly	MJ	Nut	150	
V-021	Sedimentation Basin Isolation	Yard	36	Butterfly	MJ	Handwheel	150	
V-022	CCT #1 Drain	Yard	8	Butterfly	MJ	Nut	150	
V-023	CCT #2 Drain	Yard	8	Butterfly	MJ	Nut	150	
V-024	Chemical Unloading Drain	Yard	8	Plug	MJ	Nut	150	
V-025	CCT Overflow Flap Valve	Endwall 1	24	Flap	Flanged	N/A	N/A	Rodney Hunt Series FV-AC or equal
V-026	Filter Overflow Flap Valve	Endwall 1	18	Flap	Flanged	N/A	N/A	Rodney Hunt Series FV-AC or equal
V-027	Drain Flap Valve	Endwall 1	4	Duckbill Check	Flanged	N/A	N/A	Tideflex Series 35 or equal
V-028	Sed Basin Overflow Flap Valve	Endwall 1	16	Flap	Flanged	N/A	N/A	Rodney Hunt Series FV-AC or equal
V-050	Turbine TR-6 Isolation	Energy Recovery Buildng	12	Butterfly	Flanged	Hydraulic	150	By Turbine Mfg (Bid Alt B)
V-051	Turbine TR-10 Isolation	Energy Recovery Buildng	16	Butterfly	Flanged	Hydraulic	150	By Turbine Mfg (Bid Alt B)
V-052	Turbine TR-6 Discharge Isolation	Energy Recovery Buildng	12	Butterfly	Flanged	Handwheel	150	Bid Alternate B
V-053	Turbine TR-10 Discharge Isolation	Energy Recovery Buildng	16	Butterfly	Flanged	Handwheel	150	Bid Alternate B
V-054	Pressure Relief Isolation	Energy Recovery Buildng	10	Butterfly	Flanged	Handwheel	150	Bid Alternate B
V-055	Pressure Relief Isolation	Energy Recovery Buildng	10	Butterfly	Flanged	Handwheel	150	Bid Alternate B
V-056	Pressure Relief	Energy Recovery Buildng	10	Cla-Val	Flanged	Hydraulic	150	Bid Alternate B
V-057	Control Valve Isolation 1	Energy Recovery Buildng	18	Butterfly	Flanged	Handwheel	150	Bid Alternate B
V-058	Control Valve Isolation 2	Energy Recovery Buildng	18	Butterfly	Flanged	Handwheel	150	Bid Alternate B
V-110	Sump Pump Clearing Valve	Raw Water PS	4	Plug	Flanged	Nut	150	Bid Alternate A
V-111	Mix Valve #1	Raw Water PS	4	Plug	Flanged	Nut	150	Bid Alternate A
V-112	Mix Valve #2	Raw Water PS	4	Plug	Flanged	Nut	150	Bid Alternate A
V-113	Lagoon Discharge Valve	Raw Water PS	4	Plug	Flanged	Nut	150	Bid Alternate A
V-114	Floc Basin No. 4 Drain	Floc Basin No. 4	12	Mud Valve (CI)	Flanged	Indicating Handwheel	150	
V-115	Floc Basin No. 5 Drain	Floc Basin No. 5	12	Mud Valve (CI)	Flanged	Indicating Nut	150	
V-116	Floc Basin No. 6 Drain	Floc Basin No. 6	12	Mud Valve (CI)	Flanged	Indicating Nut	150	
V-117	Floc Effluent Channel Drain	Floc Effluent Channel	12	Mud Valve (CI)	Flanged	Indicating Nut	150	
V-130	P-108 Check	Inter Booster PS	16	Check	Flanged	Air Cushioned	150	
V-131	P-108 Isolation	Inter Booster PS	16	Butterfly	Flanged	Handwheel	150	
V-132	P-107 Check	Inter Booster PS	16	Check	Flanged	Air Cushioned	150	
V-133	P-107 Isolation	Inter Booster PS	16	Butterfly	Flanged	Handwheel	150	
V-134	P-106 Check	Inter Booster PS	16	Check	Flanged	Air Cushioned	150	
V-135	P-106 Isolation	Inter Booster PS	16	Butterfly	Flanged	Handwheel	150	
V-138	P-108 Suction Isolation	Inter Booster PS	20	Butterfly	Flanged	Handwheel	150	

Tag	Description	Location	Size	Valve Type	End Type	Operator	Pressure Rating (psi)	Notes
V-139	P-107 Suction Isolation	Inter Booster PS	20	Butterfly	Flanged	Handwheel	150	
V-140	P-106 Suction Isolation	Inter Booster PS	20	Butterfly	Flanged	Handwheel	150	
V-205	CCT #1 Entrance	CCT Pipe Gallery	42	Butterfly	Flanged	Handwheel	50	
V-206	CCT Separation Valve	CCT Pipe Gallery	42	Butterfly	Flanged	Handwheel	50	
V-207	CCT #1 Exit Valve	CCT Pipe Gallery	42	Butterfly	Flanged	Handwheel	50	
V-211	AC-1 Inlet Valve	AC Pipe Gallery	16	Butterfly	Flanged	Electric (Modulating)	50	
V-212	AC-1 Isolation Valve	AC Pipe Gallery	16	Butterfly	Flanged	Handwheel	50	
V-213	AC-1 Flush Valve	AC 1&2 Flush Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-214	AC-1 Drain Valve	AC 1&2 Flush Gallery	4	Butterfly	Flanged	Handwheel	50	
V-215	AC-2 Inlet Valve	AC Pipe Gallery	16	Butterfly	Flanged	Electric (Modulating)	50	
V-216	AC-2 Isolation Valve	AC Pipe Gallery	16	Butterfly	Flanged	Handwheel	50	
V-217	AC-2 Flush Valve	AC 1&2 Flush Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-218	AC-2 Drain Valve	AC 1&2 Flush Gallery	4	Butterfly	Flanged	Handwheel	50	
V-219	AC-3 Inlet Valve	AC Pipe Gallery	16	Butterfly	Flanged	Electric (Modulating)	50	
V-220	AC-3 Isolation Valve	AC Pipe Gallery	16	Butterfly	Flanged	Handwheel	50	
V-221	AC-3 Flush Valve	AC-3 Flush Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-222	AC-3 Drain Valve	AC-3 Flush Gallery	4	Butterfly	Flanged	Handwheel	50	
V-223	AC Pressure Relief Valve	AC Pipe Gallery	10	Cla-Val	Flanged	Hydraulic	50	
V-224	Relief Valve Isolation	AC Pipe Gallery	10	Butterfly	Flanged	Handwheel	50	
V-231	AC-1 Air Inlet Valve	AC Pipe Gallery	10	Butterfly	Flanged	Electric (Open/Close)	20	
V-232	AC-1 Air Check Valve	AC Pipe Gallery	10	Butterfly	Flanged	Electric (Open/Close)	20	
V-235	AC-3 Air Inlet Valve	AC Pipe Gallery	10	Butterfly	Flanged	Electric (Open/Close)	20	
V-241	Filter #1 Influent A	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended SS Neck	50	
V-242	Filter #1 Influent B	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended SS Neck	50	
V-243	Filter #1 Effluent	Filter 1-4 Pipe Gallery	8	Butterfly	Flanged	Electric (Modulating)	50	Reinstall existing valve
V-244	Filter #1 to Waste	Filter 1-4 Pipe Gallery	8	Butterfly	Flanged	Electric (Open/Close)	50	Adjust to stop at normal filter flowrate
V-245	Filter #1 Backwash Supply	Filter 1-4 Pipe Gallery	16	Butterfly	Flanged	Electric (Open/Close)	50	Reinstall existing valve
V-246	Filter #1 Backwash Drain	Filter 1-4 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	Reinstall existing valve
V-247	Filter #2 Influent A	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended SS Neck	50	
V-248	Filter #2 Influent B	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended SS Neck	50	
V-249	Filter #2 Effluent	Filter 1-4 Pipe Gallery	8	Butterfly	Flanged	Electric (Modulating)	50	Reinstall existing valve
V-250	Filter #2 to Waste	Filter 1-4 Pipe Gallery	8	Butterfly	Flanged	Electric (Open/Close)	50	Adjust to stop at normal filter flowrate
V-251	Filter #2 Backwash Supply	Filter 1-4 Pipe Gallery	16	Butterfly	Flanged	Electric (Open/Close)	50	Reinstall existing valve
V-252	Filter #2 Backwash Drain	Filter 1-4 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	Reinstall existing valve
V-253	Filter #3 Influent A	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended SS Neck	50	

Tag	Description	Location	Size	Valve Type	End Type	Operator	Pressure Rating (psi)	Notes
V-254	Filter #3 Influent B	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended SS Neck	50	
V-255	Filter #3 Effluent	Filter 1-4 Pipe Gallery	8	Butterfly	Flanged	Electric (Modulating)	50	Reinstall existing valve
V-256	Filter #3 to Waste	Filter 1-4 Pipe Gallery	8	Butterfly	Flanged	Electric (Open/Close)	50	Adjust to stop at normal filter flowrate
V-257	Filter #3 Backwash Supply	Filter 1-4 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	Reinstall existing valve
V-258	Filter #3 Backwash Drain	Filter 1-4 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	Reinstall existing valve
V-259	Filter #4 Influent A	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended SS Neck	50	
V-260	Filter #4 Influent B	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended SS Neck	50	
V-261	Filter #4 Effluent	Filter 1-4 Pipe Gallery	8	Butterfly	Flanged	Electric (Modulating)	50	Reinstall existing valve
V-262	Filter #4 to Waste	Filter 1-4 Pipe Gallery	8	Butterfly	Flanged	Electric (Open/Close)	50	Reinstall existing valve
V-263	Filter #4 Backwash Supply	Filter 1-4 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	Reinstall existing valve
V-264	Filter #4 Backwash Drain	Filter 1-4 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	Reinstall existing valve
V-265	Filter #5 Influent A	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended SS Neck	50	
V-266	Filter #5 Influent B	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended SS Neck	50	
V-267	Filter #5 Effluent	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Modulating)	50	
V-268	Filter #5 to Waste	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Open/Close)	50	Adjust to stop at normal filter flowrate
V-269	Filter #5 Backwash Supply	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-270	Filter #5 Backwash Drain	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-271	Filter #6 Influent A	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50	
V-272	Filter #6 Influent B	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50	
V-273	Filter #6 Effluent	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Modulating)	50	
V-274	Filter #6 to Waste	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Open/Close)	50	Adjust to stop at normal filter flowrate
V-275	Filter #6 Backwash Supply	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-276	Filter #6 Backwash Drain	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-277	Filter #7 Influent A	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended SS Neck	50	
V-278	Filter #7 Influent B	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended SS Neck	50	
V-279	Filter #7 Effluent	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Modulating)	50	
V-280	Filter #7 to Waste	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Open/Close)	50	Adjust to stop at normal filter flowrate
V-281	Filter #7 Backwash Supply	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-282	Filter #7 Backwash Drain	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	

Tag	Description	Location	Size	Valve Type	End Type	Operator	Pressure Rating (psi)	Notes
V-283	Filter #8 Influent A	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended SS Neck	50	
V-284	Filter #8 Influent B	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended SS Neck	50	
V-285	Filter #8 Effluent	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Modulating)	50	
V-286	Filter #8 to Waste	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Open/Close)	50	Adjust to stop at normal filter flowrate
V-287	Filter #8 Backwash Supply	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-288	Filter #8 Backwash Drain	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-291	Filter #1 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close)	20	
V-292	Filter #2 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close)	20	
V-293	Filter #3 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close)	20	
V-294	Filter #4 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close)	20	
V-295	Filter #5 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close)	20	
V-296	Filter #6 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close)	20	
V-297	Filter #7 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close)	20	
V-298	Filter #8 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close)	20	
V-401	Caustic Bulk Storage	Caustic Bulk Storage	4"	Mud Valve (SS)	Flanged	Nut/Rising Stem	N/A	
V-402	PACL Bulk Storage	PACL Bulk Storage	4"	Mud Valve (SS)	Flanged	Nut/Rising Stem	N/A	
V-403	PACL Bulk Storage	PACL Bulk Storage	4"	Mud Valve (SS)	Flanged	Nut/Rising Stem	N/A	
V-404	Fluoride Bulk Storage	Fluoride Bulk Storage	4"	Mud Valve (SS)	Flanged	Nut/Rising Stem	N/A	
V-405	PACL Day Tank Drain	PACL Day Tank	4"	Mud Valve (SS)	Flanged	Nut/Rising Stem	N/A	
V-406	Caustic Day Tank Drain	Caustic Day Tank Drain	4"	Mud Valve (SS)	Flanged	Nut/Rising Stem	N/A	
V-407	Spare Day Tank Drain	Spare Day Tank Drain	4"	Mud Valve (SS)	Flanged	Nut/Rising Stem	N/A	
V-408	Spare Tote Drain	Spare Tote Drain	4"	Mud Valve (SS)	Flanged	Nut/Rising Stem	N/A	
V-409	Sodium Permanganate Tote Drain	Permanganate Tote Drain	4"	Mud Valve (SS)	Flanged	Nut/Rising Stem	N/A	

SECTION 15102

PLUG VALVES

TABLE OF CONTENTS

SECTION 15102

PLUG VALVES

1.1 SUMMARY

A. Section Includes:
1. Plug valves.

B. Related Sections include but are not necessarily limited to:
1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 1 - General Requirements.
3. Section 15100 - *Valves: Basic Requirements.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. American National Standards Institute (ANSI):
a. A21.11, Rubber - Gasket Joints for Ductile - Iron and Gray - Iron Pressure Pipe and Fittings.
b. B16.1, Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
2. American Society for Testing and Materials (ASTM):
a. A126, Gray Iron Castings for Valves, Flanges and Pipe Fittings.
b. A536, Standard Specification for Ductile Iron Castings.
3. American Water Works Association (AWWA):
a. C606, Grooved and Shouldered Joints.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Section 15100 - *Valves: Basic Requirements.*

B. Operation and Maintenance Manuals:
1. See Section 15100 - *Valves: Basic Requirements.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed under the specific valve types are acceptable.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 NON-LUBRICATED ECCENTRIC PLUG VALVES

A. Acceptable Manufacturer:
1. DeZurik Series 100.
2. Milliken Series 600.
3. Victaulic Series 365.
4. Clow Series 5400.

B. Materials:
1. Body: Cast-iron ASTM A126, Class B.
2. Plug: Ductile iron, ASTM A536 65-45-12.
3. Plug facing: Grease and/or petroleum-resistant Neoprene or Buna-N compound.
4. Shaft bearing bushings: Permanently lubricated stainless steel or bronze.
5. Valve seats: Welded-in overlay of 90 percent nickel (minimum 1/8 IN thick).
6. Stem seal: Nitrile butadiene packing or Buna-N dual U-cups.

2.3 ACCESSORIES

A. Refer to Drawings and valve schedule for type of actuator. Furnish actuator integral with valve.

B. Refer to Section 15100 - *Valves: Basic Requirements* for actuator requirements.

2.4 FABRICATION

A. See Section 15100 - *Valves: Basic Requirements.*

B. Valves specified as having an extended neck shall include an extended shaft and neck of the specified length, as measured from the start of a standard neck. All materials subjected to process water shall be stainless steel.

PART 3 – EXECUTION

3.1 INSTALLATION

A. See Section 15100 - *Valves: Basic Requirements.*

B. Install valves with valve stem horizontal, plug seat on inlet side and with plug rotating up into the open position for valves in horizontal lines.

C. Install valve with actuator above pipe or plug centerline.

END OF SECTION

SECTION 16472

VARIABLE FREQUENCY DRIVES AND SOLID STATE REDUCED VOLTAGE STARTERS

TABLE OF CONTENTS

SECTION 16472

VARIABLE FREQUENCY DRIVES AND SOLID STATE REDUCED VOLTAGE STARTERS

PART 1 – GENERAL

1.1 DESCRIPTION

A. General
   1. Furnish all labor, materials, tools, equipment, and services for all variable frequency drive (VFD) equipment, and solid state reduced voltage starters (SSRV) as indicated, in accordance with provisions of the Contract Documents.
   2. Completely coordinate with work of all other trades.
   3. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work.
   4. See Section 16010 - *Electrical General Requirements* for general electrical requirements.

1.2 SUBMITTALS

A. Shop Drawings
   1. Supply descriptive product information.
   2. Complete master wiring diagrams, elementary control schematics including interconnection and coordination with other electrical control devices operating in conjunction with the VFD.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Acceptable Manufacturers:
   1. Benshaw.

B. Motors: Verify all motor sizes and specifications from approved mechanical, process, and instrumentation shop drawings, contract drawings, and Contract Documents.
   1. It is the responsibility of the Contractor to fully coordinate the variable frequency drive equipment with the motors and associated equipment to provide a totally integrated, operational system.

C. The variable frequency drives shall have a main circuit breaker and shall consist of a 480-volt adjustable frequency inverter with integral control, sequence logic, and self-diagnostics as specified hereinafter. The drives shall be of "pulse width modulated inverter" (PWM) type employing IGBT power semi-conductor technology.
   1. The VFD shall limit harmonic distortion reflected onto the system to a voltage and current distortion level as defined by IEEE 519 for general system application.

D. The variable frequency drives shall be rated constant torque, 480 volt, 3-phase, 60 HZ. The VFDs shall be a microprocessor-based static adjustable frequency controller designed to provide continuous-speed adjustment of 3-phase motors. The adjustable frequency output voltage shall provide constant volts per hertz excitation to the motor terminals up to 60 HZ. The VFDs shall provide energy-efficient, low-loss speed control in the range from 4 to 60 HZ.

E. VFDs shall be provided with input surge protection.

F. Discrete interface to each VFD shall be 24 VDC, including status and alarm contact outputs and control inputs. Speed control input signal and speed output signal shall be 4-20 mAdc.

G. Provide the following Variable Frequency Drives:

Tag	HP	Enclosure	Service	Type	Interrupting Rating at 480V
VFD-1	40	NEMA 1 Separately mtd.	Intermediate Pump 1	18 Pulse	50,000 Amps
VFD-2	40	NEMA 1 Separately mtd.	Intermediate Pump 2	18 Pulse	50,000 Amps
VFD-3	40	NEMA 1 Separately mtd.	Intermediate Pump 3	18 Pulse	50,000 Amps
VFD-4	10	NEMA 1 grouped line-up	Flash Mixer 1	6 Pulse	30,000 Amps
VFD-5	10	NEMA 1 grouped line-up	Flash Mixer 2	6 Pulse	30,000 Amps
VFD-6	3	NEMA 1 grouped line-up	Flocculator 1	6 Pulse	30,000 Amps
VFD-7	3	NEMA 1 grouped line-up	Flocculator 2	6 Pulse	30,000 Amps
VFD-8	3	NEMA 1 grouped line-up	Flocculator 3	6 Pulse	30,000 Amps
VFD-9	3	NEMA 1 grouped line-up	Flocculator 4	6 Pulse	30,000 Amps
VFD-10	3	NEMA 1 grouped line-up	Flocculator 5	6 Pulse	30,000 Amps
VFD-11	3	NEMA 1 grouped line-up	Flocculator 6	6 Pulse	30,000 Amps
VFD-12	10	NEMA 1 grouped line-up	Spare	6 Pulse	30,000 Amps

2.2 PERFORMANCE REQUIREMENTS

A. Service Factor: 1.0 continuous, 110% current for 1 minute.

B. VFD shall have a full load current greater than the motor nameplate current.

C. Guaranteed Minimum Efficiency, including all auxiliary equipment such as cooling fans, etc. and harmonic distortion mitigation devices: 96%.

D. Output Frequency: .5-120 Hz.

E. Resolution: 0.01 Hz.

F. Accuracy: 0.01%.

G. Audible VFD Noise: Not greater than 85dBA at 1 meter at full load.

H. Power Loss Ride-through: Less than 1 cycle.

2.3 ENVIRONMENTAL REQUIREMENTS

A. Temperature: 0 - 40°C (32°F to 104°F).

B. Relative Humidity: Up to 95%, non-condensing.

C. Input Power: 480V AC, 3Ph, +/- 10% 50-60 Hz, +/- 3Hz.

2.4 ENCLOSURE

A. The VFD(s) cabinets shall be NEMA 1 with fans and filters. The VFD(s) and any required accessories or auxiliary items shall fit within the space shown on the Plans. Any costs associated with furnishing equipment that exceeds the available space shall be borne by the Contractor.

2.5 DISCONNECTING DEVICE

A. Each VFD shall be provided with an input circuit breaker rated with an interrupting rating as scheduled. The breaker shall be provided with a shunt trip.

2.6 CONVERTER

A. The converter shall limit Voltage and Current distortion produced by the VFD to within the limits cited in IEEE 519-1992, Table 10-3. A preliminary Harmonic Distortion Analysis shall be provided with the bid to indicate conformance. The analysis shall be based on the 1-line

diagram as shown in the Plans, and assume all units operating simultaneously at full speed, full load. Tie breakers if present, shall be modeled as open. The point of common coupling for current distortion measurements and modeling shall be the line side of each VFD circuit breaker.

B. 18-pulse VFDs shall include an integral phase shifting transformer and three paralleled 3 phase full wave type converter bridges.

C. The VFD system shall also include a 7.5% impedance AC reactor.

D. The 18 pulse transformer shall use copper windings.

E. The VFD system shall consist of a 6 pulse VFD chassis with a UL recognized diode section providing an additional 12 diodes. The 18 pulse system shall be modular in that upon failure of any of the additional 12 pulse diodes or 18 pulse transformer, the VFD shall be able of being operated as a 6 pulse unit.

F. The VFD system shall be provided with input fuses.

2.7 INVERTER

A. The inverter section shall utilize IGBT devices.

B. Output waveform to contain not more than 5% current harmonics.

C. Able to withstand full-speed, full load short circuits without component damage.

2.8 CONTROL LOGIC

A. Space vector controlled modulation to minimize motor noise.

B. Protective circuitry to shutdown VFD without damage in the event of an overload.

C. 32-bit digital signal processor.

D. Multiple motor profiles.

E. Multiple accel and decel patterns, 0.1 - 6,000 seconds:
1. Linear for constant torque.
2. Squared for variable torque loads.
3. User defined.
4. Auto boost to optimize V/Hz curve at low speeds.

F. Multiple stall prevention modes.

G. Proportional, integral, and derivative control.

H. The VFD shall have wired to a user terminal strip:
1. 1 Form C run contact.
2. 1 Form C fault contact.
3. Hand mode indication.
4. Auto mode indication.
5. Bypass mode indication.

2.9 OPERATIONAL FEATURES

A. Programmable fixed carrier frequency. Automatic derating shall not be allowed.

B. 0-10VDC, -10V to 10Vdc or 4-20mA input, direct or reverse acting.

C. Diagnostics and fault log histories. Display the following, in English:

1. Overvoltage
2. Low voltage.
3. Overcurrent.
4. Ground fault.
5. Overtemperature.
6. Blown DC bus fuse.
7. Overload.
8. Motor overload.
9. External trip.

D. 1 Form "C" fault relay output, rated 1A, 250 VAC.

E. 4 form "A" software programmable output relays, rated 1A, 250 VAC.

F. User selectable (up to 10 attempts) Auto Restart.

G. Restart into a spinning load.

H. The VFD shall have a power on time meter.

I. The VFD shall have a time between faults meter.

J. The VFD shall have a run time meter.

K. The VFD shall have a software selectable parameter to select parameters that have been changed from default. This function shall be used in troubleshooting the VFD and only show parameters that have been changed from default settings.

L. The VFD shall have an autotuning function to tune to the motors parameters. Volts / Hz drives will not be accepted.

M. The VFD shall be provided with an intelligent keypad which can upload and download parameters. The keypad shall be transferable and be able to move parameters from one VFD to another.

2.10 DOOR MOUNTED CONTROLS

A. 32-character backlit LCD display. LED displays are not acceptable.

B. Plain English programming.

C. VFD - Off - Bypass Selector switch.

D. Green "Running" light.

E. Red "Bypass" light.

F. Amber "Stand By" light.

G. Temperature monitor.
1. Temperature monitor/control shall be Minco Model CT124, 8 channel, to display the output of six TRDs (two per phase).
2. Monitor/control shall stop the motor if high temperature is detected in the motor.
3. Reset from the stopped condition shall be manual.

H. High pressure alarm light.

I. High pressure alarm reset push button switch.

J. Low wetwell level alarm light.

K. Low wetwell level alarm reset push button switch.

2.11 BYPASS CIRCUIT

A. Each 18-pulse VFD shall be provided with a three contactor bypass circuit. The VFD shall be provided with a bypass contactor and a VFD output contactor. The output contactor and bypass contactor shall be mechanically and electrically interlocked. A third contactor shall be provided to provide isolation to the VFD input when in bypass mode.

B. An OL relay shall be provided to protect the motor when in bypass mode.

C. The VFD system shall contain a reduced voltage solid state starter for bypass mode. The solid state starter shall be a microprocessor based starter and have integral bypass contactors to remove heat from the system after the motor is up to speed.

2.12 WINDOWS BASED SOFTWARE

A. The VFD system shall be provided with a windows based software package. The software will allow uploading and downloading parameters, monitoring digital and analog inputs, providing a real time event recorder and be able to print parameter reports in an Excel format.

2.13 REMOTE OPERTOR'S CONTROL STATION

A. Provide a remote operator's control station for each of the 6 pulse drives.

B. Operator's remote control station shall be rated NEMA 4X for handrail mounting near the controlled motor.

C. Operator's station shall have start/stop pushbuttons, speed control potentiometer, and speed feedback indicator.

D. The supplier shall recommend a manufacturer and part number of a suitable cable to extend from the VFD to the control station.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install as indicated and in accordance with manufacturer's recommendations and instructions.

B. Provide services of factory-trained technician for inspection, programming, startup, and certification of completed installation. Provide minimum eight (8) hours on site for startup and additional four (4) hours on site for operator training in two separate sessions of two hours each.

END SECTION

SECTION 16474

MOTOR CONTROL CENTERS, CONTROL EQUIPMENT, AND SEPARATELY MOUNTED DEVICES

TABLE OF CONTENTS

SECTION 16474

MOTOR CONTROL CENTERS, CONTROL EQUIPMENT, AND SEPARATELY MOUNTED DEVICES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Motor control centers, separately mounted motor starters (including those supplied with equipment), manual motor starters, separately mounted circuit breakers and control equipment.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 16010 - *Electrical: Basic Requirements.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. C62.41, Guide for Surge Voltages in Low Voltage AC Power Circuits.
   2. Canadian Standards Association (CSA).
   3. Institute of Electrical and Electronics Engineers (IEEE).
   4. National Electrical Manufacturers Association (NEMA):
      a. ICS 2, Industrial Control Devices, Controllers, and Assemblies.
      b. 250, Enclosures for Electrical Equipment (1000 Volt Maximum).
   5. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   6. Underwriters Laboratories, Inc (UL):
      a. 845, Electric Motor Control Centers.

B. Miscellaneous:
   1. Verify motor horsepower loads, other equipment loads, and controls from approved shop drawings and notify Engineer of any discrepancies.
   2. Verify the required instrumentation and control wiring for a complete system and notify Engineer of any discrepancies.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 and 16010.
   2. MCC elevation drawings and complete description of units in the MCC.
   3. Typical MCC unit wiring diagrams.
   4. Typical wiring diagrams for all control equipment.

B. Operation and Maintenance Manuals:
   1. See Section 01340.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Motor control centers:
      a. General Electric.
      b. Westinghouse.

c. Square D.
d. Cutler Hammer.
e. Benshaw.

2. Separately mounted motor starters:
   a. General Electric.
   b. Westinghouse.
   c. Square D.
   d. Cutler Hammer.
   e. Benshaw.
3. Control relays:
   a. General Electric.
   b. Square D.
   c. Cutler Hammer.
4. Mechanical timers:
   a. Tork.
5. Timing relays:
   a. Agastat.
   b. General Electric.
   c. Square D.
   d. Cutler Hammer.
6. Enclosures:
   a. Hoffman.
7. Manual motor starters:
   a. General Electric.
   b. Westinghouse.
   c. Square D.
   d. Cutler Hammer.
8. Separately mounted circuit breakers:
   a. General Electric.
   b. Square D.
   c. Westinghouse.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 COMPONENTS

A. Motor Control Centers:
   1. Design:
      a. Service voltage: 480 V, 3 PH, 3 W, 60 HZ, unless otherwise indicated on the Drawings.
      b. Main horizontal bus: 800 A.
         1) Unless otherwise indicated on the Drawings.
      c. Vertical bus: 300 A.
         1) Unless otherwise indicated on the Drawings.
      d. Short circuit withstand rating: 22,000 AIC symmetrical.
         1) Unless otherwise indicated on the Drawings.
      e. Provide main horizontal bus in each structure; full capacity, full-length, with provisions for extension.
         1) Bus bars:
            a) Plated copper.
            b) Rectangular cross section.
            c) Support in each structure by means of bus supports.
      f. Provide each structure with full length vertical bus to distribute incoming power to each circuit breaker and starter in structure:
         1) Starters NEMA size 5 and larger and certain other components may be cable connected to the main bus with the approval of the Engineer.
         2) Vertical bus shall be extended to spaces provided for future equipment.
      g. Provide ground bus:
         1) Continuous.

2) ¼ IN x 2 IN copper.
3) Solidly grounded to each structure.
4) Locate near bottom of structure.
5) Provide for lug connection of equipment ground wires.

h. Provide guides for supporting and aligning starters.

2. Construction:
   a. NEMA Class I, Type B.
   b. NEMA 1, free standing.
   c. Unit structures:
      1) Totally enclosed.
      2) Joined together to form one assembly:
         a) Each unit structure will be nominal 20 IN wide, 20 IN deep, and 90 IN high, unless otherwise indicated on the Drawings.
   d. Fabricate of not less than 14 GA steel with 16 GA steel doors in standardized units.
   e. Provide each structure with two horizontal wiring spaces.
      1) One at top.
      2) One at bottom.
      3) Spaces will line up with adjacent units to form convenient wiring raceway entire length of control center.
   f. Provide each structure with one vertical wireway for unit wiring.
      1) With cable tie supports to hold wiring in place.
      2) With a separate door.
   g. Bottom shall have ample unrestricted space for conduit entry.
   h. Doors:
      1) Formed round corners and rolled edges.
      2) Gasketed.
      3) Minimum of two heavy-duty hinges or continuous piano hinge.
      4) Held closed by means of captive fasteners.
   i. Fabricate doors to be a part of the structure and not part of the starter.
   j. Cubicles:
      1) Totally enclosed.
      2) Effectively baffled to isolate any ionized gases which may occur within unit starter.
   k. Assemblies effectively ventilated, to allow relocation of starters and other components:
      1) Within the assembly and with the same load.
      2) Without having to compensate for changes in location.
3. Combination full voltage magnetic starters mounted in MCC:
   a. Circuit breaker:
      1) Motor circuit protector (MCP) type.
   b. Contactor NEMA rated.
   c. Line plug-in, pull-out, lock-out type.
      1) Except starters NEMA size 5 and larger.
         a) Fixed mounted with the approval of the Engineer.
      2) Provide guides in structure for supporting and aligning unit starter during removal or replacement.
      3) Plug-in units:
         a) Silver-plated.
         b) Pressure type line disconnecting stabs.
         c) High-strength copper alloy.
      4) Lock-out latch to padlock unit in "pull-out" position and at same time isolate stubs and entire unit from bus. Hold each unit in place by means of quick-captive fasteners.
   d. Operating handle shall clearly indicate whether circuit breaker is ON, OFF, or TRIPPED.
      1) Provide means to lock each circuit breaker handle in OFF position with cover closed by means of up to three padlocks.
      2) Interlock so that circuit breaker must be in OFF position before door can be opened:
         a) Provide defeater mechanism for use by authorized personnel.

e. Provide starter unit with ambient compensated, external manually resettable, three bimetallic type overload relays. Coordinate size with actual motor full load current.
   1) For motors with power factor correction capacitors, size heater elements to compensate for the capacitors effect on load current.
f. Provide heavy-duty devices:
   1) Oil tight selector switches.
   2) Oil tight push-buttons.
   3) Oil tight pilot lights:
      a) Push-to-test type.
   4) Other devices as indicated on the Drawings.
   5) Devices will be accessible with the door closed.
g. Provide each starter with two extra field reversible N.O. auxiliary contacts for future use.
h. Provide each starter with bus voltage to 120 V control power transformer:
   1) 480 V primary, 120 V secondary.
   2) Fused on primary and secondary sides.
   3) Rated for 140 percent of required load.
   4) For all motor starters.
i. Provide six-digit readout elapsed time meter.
   1) Where indicated on Drawings.
j. Starter units will have the same fault current withstand rating as the main bus fault current withstand rating.
k. Provide each starter with the following status signals, wired to terminal boards:
   1) Motor run contact (N.O.).
   2) Motor stop contact (N.C.).
   3) Auxiliary overload relay contact (N.O.).

B. Main and Feeder Circuit Breakers in MCC and Separately Mounted:
1. Molded case thermal magnetic or solid state trip type, with minimum interrupting rating equal to the main bus fault current rating:
2. Circuit breaker frame sizes 150 A and less:
   a. Non-interchangeable, non-adjustable thermal magnetic trip units.
3. Circuit breaker frame sizes 225 A and higher:
   a. Interchangeable and adjustable thermal magnetic trip units.
4. Circuit breaker frame sizes 600 A and greater:
   a. Solid state trip units, unless otherwise noted on the Drawings.
   b. Current sensor or rating plug.
   c. Adjustable current setting: Minimum range 70 to 100 percent of current sensor or rating plug.
   d. Adjustable instantaneous pickup: Minimum range 3 to 8 times.
   e. On circuit breakers 1000 A and larger provide ground fault protector.
      1) Adjustable pick-up.
      2) Adjustable delay.
5. Provide main circuit breaker with service entrance label.
6. All circuit breakers to be provided with padlocking provision in the OFF position for up to three padlocks.
7. Circuit breakers rated 1000 A or above: 100 percent rated.

C. Provide ambient compensated devices.

D. Manual Starters with Thermal Element:
1. Quick-make, quick-break toggle mechanism.
2. Trip free.
3. Clearly indicate ON, OFF, and TRIPPED position.
4. NEMA 12 enclosure unless otherwise indicated on the Drawings.

E. Separately Mounted Starters:
1. Circuit breaker shall be motor circuit protector (MCP) type.
2. Contactor shall be NEMA rated.

a. One-half size and IEC sized starters not permitted.

3. Operating handle shall clearly indicate whether circuit breaker is ON, OFF, or TRIPPED.
   a. Provide means to lock each circuit breaker handle in OFF position with cover closed by means of up to three padlocks.
   b. Interlock so that circuit breaker must be in OFF position before door can be opened. Provide defeater mechanism for use by authorized personnel.
4. Provide starter unit with ambient compensated, external manually resettable, three bimetallic type overload relays. Coordinate size with actual motor full load current.
   a. For motors with power factor correction capacitors size heater elements to compensate for the capacitors effect on load current.
5. Provide heavy-duty Oil tight selector switches, push-buttons, push-to-test pilot lights, or other devices as indicated on the Drawings. These devices will be accessible with the door closed.
6. Provide each starter with two extra field reversible NO auxiliary contacts for future use.
7. Provide each starter with 480120 V control power transformer fused on secondary side and rated for 140 percent of required load.
8. Provide six-digit readout elapsed time meter where indicated on Drawings.
9. Starter units will have the same fault current withstand rating as the MCC main bus fault current withstand rating from which they are fed.
10. Provide each starter with the following status signals, wired to terminal boards.
    a. Motor run contact (N.O.).
    b. Motor stop contact (N.C.).
    c. Auxiliary overload relay contact (N.O.).

F. Selector Switches, Indicating Lights, and Push-buttons:
1. Heavy-duty oil tight water tight for unclassified or wet areas.
2. NEMA 4 for outdoor applications or panels specified WP.
3. NEMA 4X for corrosive areas.
4. NEMA 7 and 9 for Class I, Division I Groups C and D; and Class II, Division I, Groups E, F, and G hazardous locations.
5. Selector switches shall have standard gloved operator.
6. Push-buttons shall have standard flush operator.
7. Provide switch positions and contacts:
   a. As specified on Contract Drawings or as necessary for proper control.
8. Switch contacts shall be NEMA A600 rated.
9. Full voltage indicating lights, unless specified otherwise.
10. Provide 100 percent replacement lamps for indicating lights.
11. Provide 10 percent replacement caps for indicating lights.

G. Alarm Horns:
1. Siren type.
2. Sheet metal housing.
   a. Primer and finish coat of paint shall be suitable for use in corrosive areas.
3. Adjustable mounting bracket.
4. For use on 120 V AC.
5. Universal motor.
6. Nominal 106 dB at 10 FT from source.
7. Federal Signal Model "A" or approved equal.

H. Control Relays:
1. Provide industrial control relays as specified on the Drawings and as required for proper operation and control of supplied equipment.
2. All control relays shall have 120 V coils capable of operating on line voltage fluctuations of "10 percent unless specified otherwise.
3. Relays shall be provided with NEMA A600 rated contacts, and shall be capable of supporting a minimum of eight contacts.
4. Provide relays with all N.O. contacts unless otherwise specified.
   a. Contacts shall be field reversible.
5. Provide contacts for all required control plus two spares.

I. Remote Operator Stations:
   1. NEMA 12 for unclassified areas unless specified otherwise.
   2. NEMA 4 for wet areas, outdoors or equipment specified WP, and control panel enclosures not covered under Division 11.
   3. NEMA 4X for corrosive areas.
   4. NEMA 7 and 9 for Class I, Division I, Groups C and D; and Class II, Division I, Groups E, F, and G hazardous locations.
   5. Construction and installation shall be in accordance with NEC Article 373.
   6. Provide barrier-type terminal strips for termination of all control and 120 V power field wiring plus 20 percent spare for all control panels.
   7. Control panel construction:
      a. 14 GA steel.
      b. Continuously welded seams.
      c. Manufacturer's standard gray.

J. Time Delay Relays:
   1. Provide time delay relays with delayed pickup or release as specified on Drawings.
   2. All time delay relays shall operate at 115 V AC "10 percent.
   3. Heavy duty, solid state construction.
   4. Contact rating: 10 amps.
   5. Provide external adjust dial with 0-30 second range unless specified otherwise.
   6. Operating temperature ranges: -18 to +50EC.
   7. Repeat accuracy: "3 percent plus "10ms over specified voltage range.
   8. Provide all required contacts plus two N.O. spares.
   9. Provide auxiliary relays as required to perform functions specified on Drawings.

K. Terminal Strips:
   1. 600 V.
   2. Full size.
   3. Rated for 10 A continuous current.

L. Electro mechanical Timers:
   1. Time switches:
      a. Duty cycle type.
      b. Capable of programming at 15-minute intervals of the day.
      c. Schedule tabs provided:
         1) Easily set by hand without tools to obtain or change the desired schedule.
   2. The unit:
      a. Powered by a self-starting, enclosed, 120 V, 60 HZ, synchronous motor capable of continuous and accurate operation.
   3. The switch mechanism:
      a. Self-contained unit rated at not less than 20 A, 120 V, single pole, double throw.
      b. Readily replaceable in the field.
   4. An omitting device:
      a. Furnished as an integral part of the time switch:
         1) To enable the switching operation to be skipped for any preselected day or days of the week.
   5. Verify that the timer is compatible with all associated control relays, and furnish schematics showing all connections.
   6. Provide detailed instructions:
      a. Setting and changing the timing intervals.
      b. As part of the operation and maintenance manuals.
   7. The electro mechanical timer and associated relay configuration may be replaced by a programmable controller.

M. Enclosures and Control Panels:
   1. NEMA 12 for unclassified areas.
   2. NEMA 4 for outdoor or wet areas.
      a. Except MCC's which shall be NEMA 3R non-walk-in type.

3. NEMA 4X for corrosive areas.
4. NEMA 7 for Class I hazardous locations.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install as indicated and in accordance with manufacturer's recommendations and instructions.

B. Mount MCC on 4 IN high concrete pad:
   1. Install two 4 IN wide channel sills flush in pads to support and maintain alignment of the MCC.
   2. Align front of MCC with top edge of pad chamfer.

C. Mount other equipment as scheduled in Section 16010.

3.2 FIELD QUALITY CONTROL

A. Field test and verify operation of the equipment.

END OF SECTION

SECTION 17120

PROGRAMMABLE LOGIC CONTROLLERS

TABLE OF CONTENTS

SECTION 17120

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all programmable logic controllers, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050 - *Tools, Supplies, and Spare Parts*. In addition, the following specific spare parts items shall be provided:

1. Two CPU modules for PLC equipment furnished under this Contract.
2. Two each type of input/output module for PLC equipment furnished under this Contract.
3. Two each type and size of PLC and equipment power supply furnished under this Contract.

PART 2 – PRODUCTS

2.1 PROGRAMMABLE LOGIC CONTROLLERS - GENERAL

A. The instrumentation subcontractor shall furnish programmable controllers (PLCs) as specified herein and as shown on the Drawings. PLCs shall be provided complete with rack, power supply, I/O cards, special function cards, instructions, memory, input/output capacity, and appurtenances to provide all features and functions as described herein. PLC I/O cards may be supplied by third party vendors if approved by the PLC manufacturer and the Engineer. No substitutions will be permitted.

B. All components of the PLC system shall be of the same manufacturer; who shall have fully tested units similar to those being furnished in an industrial environment with associated electrical noise. The PLC system shall have been tested to meet the requirements of NEMA Standard ICS 2-230 (Arc Test) and IEEE C37.90.1 (SWC). The processing unit shall perform the operations functionally described herein based on the program stored in memory and the status of the inputs and outputs.

C. Programmable controllers shall be designed to operate in an industrial environment. The PLC shall operate in an ambient temperature range of 0 to 60 degrees centigrade and a relative humidity of 5-95 percent, non-condensing. The PLC shall operate on supply voltages of 90-132 VAC at 47-63 Hz or 24 VDC if provided with a battery backup system. An integral fuse shall be provided on the power supply for short circuit protection and shall be front panel accessible. Integral overcurrent and undervoltage protection shall be provided on the power supply.

D. The minimum PLC rack size for rack-based PLCs shall be 7 slots, not to include main processor or power supply slots.

E. System configuration shall be as shown on Drawings E001, E002, and E003. Only a single type of processor shall be supplied for all PLCs. Memory and processor shall be adequate for all control functions specified. PLCs shall be Allen-Bradley Control Logix.

2.2 PROCESSORS

A. The processor and its associated memory shall be enclosed in a modular enclosure. A multiple-position selector switch or equivalent shall be used to select processor operating mode. LED-type indicating lights shall be provided to indicate processor, memory, and

battery status. Errors in memory shall be recognized and shall activate the memory error indicating lights. The PLC processor shall monitor the internal operation of the PLC for failure and provide an alarm output. Memory shall consist of battery-backed RAM that shall retain the control program indefinitely as long as AC power is supplied. Lithium batteries shall maintain processor RAM memory for at least one year in the event of power loss. Visual indication shall be provided if battery charge is insufficient to maintain the program in RAM memory for at least two weeks.

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

C. Additional co-processors or modules may be required to meet the minimum instruction set.

2.3 COMMUNICATIONS

A. PLC communications shall be provided as specified in Section 17180 - Local Area Network and as shown on Drawings E001, E002, and E003.

B. In addition to a communications port for the data highway network, communication ports shall be provided for any other devices required (i.e., operator interface unit) plus an additional communication port for connection to a notebook computer.

2.4 INPUT/OUTPUT SUBSYSTEMS

A. Input/output hardware shall be plug-in modules in associated I/O rack assemblies. Each unit shall handle the required number of process inputs and outputs plus a minimum of 10 percent active pre-wired spares for each I/O type furnished, plus a minimum of 20 percent spare I/O module space for the addition of future circuit cards or modules.

B. Discrete inputs shall be 24 VDC signals from dry field contacts. Discrete outputs shall be 24 VDC outputs sourced from the PLC, or dry relay contacts (2A minimum) as required. Refer to Section 17060 - *Signal Coordination* Requirements for further details of discrete signal type and voltage requirements. The PLC shall provide momentary and latched outputs as required to interface with motor controls and external devices. Interposing relays shall be provided where required to interface with field equipment. Interposing relays shall be as specified in Section 17550. Electrical isolation shall be provided where required. Maximum density for discrete I/O modules shall be 32 per input module and 16 per output module.

C. Analog input circuits shall be isolated, minimum 12-bit resolution type. Analog input hardware shall be provided as required for all types of analog inputs being transmitted to the PLC. In general, analog input modules shall be capable of receiving 4-20 mA signals. Where required, RTD input modules shall have a minimum resolution of 0.15°C and be capable of accepting signals from 100-ohm Platinum RTD's. Analog outputs shall be

coordinated with the receivers but shall generally be isolated 24 VDC 4-20 mA outputs powered from the PLC. Each input/output circuit shall have optical isolation to protect the equipment against high voltage transients. Optical isolation shall be rated at not less than 1500 V RMS. Lightning/surge protection shall be provided as specified in Section 17560 - *Transient Voltage Surge Suppression Devices*. Maximum density for analog I/O modules shall be 8 per module.

D. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms that can be disconnected to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals. The process interface modules shall be provided with screw-type terminal blocks with barriers between adjacent terminals for connection of field inputs. Terminals shall be suitable for accepting up to and including No. 14 AWG wire. All DC output circuits to the field shall include fuses, either integral or at the terminal strip. Output failure mode shall be selectable so that upon station or communication system failure all outputs shall be placed either in the non-conducting mode, or remain as were prior to failure. Light-emitting diodes shall be provided for status indication for each input and output point.

E. External power supplies shall be provided with the PLC as required to meet specified installed I/O power requirements plus spares. Power supplies shall be modular units, shall be fully redundant and shall alarm the PLC upon failure. Power supplies shall have a line regulation of 0.05% and meet the environmental and power requirements specified herein for the PLC.

2.5 INPUT/OUTPUT CIRCUIT ARRANGEMENT

A. Signal and control circuitry to individual input/output boards shall be arranged such that board failure shall not disable more than one half of the control loops within any group of controlled equipment (e.g., one pump out of a group of three pumps, two pumps out of four, etc.). Where possible, individual control loops and equipment shall be assigned to individual boards such that failure of the board will disable only one loop or piece of equipment.

2.6 PROGRAMMING SOFTWARE

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

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

C. All configuration and programming software necessary and the individual PLC control programs shall be provided on a portable notebook computer for connection to the PLC processor via a communications port. The notebook computer with PLC control programs installed shall be provided by the Contractor. All necessary hardware required to allow the notebook computer to perform PLC configuration and programming shall be provided.

D. The configuration and programming software shall support communication over the network specified in Section 17180 - *Local Area Network* to implement its functions remotely from an operator workstation. All configuration and programming software necessary to implement this functionality shall be provided on the SCADA operator workstations. All necessary hardware required to have the operator workstation perform PLC configuration and programming shall be provided.

PART 3 – EXECUTION

3.1 REQUIREMENTS FOR MANUFACTURER-SUPPLIED PLCS

A. PLCs that are supplied for equipment local control panels by individual equipment manufacturers or suppliers shall, where so indicated on the Control System Block Diagram, be integrated into the plant control system. The manufacturer-supplied PLC shall be furnished, installed and programmed by the manufacturer. The PLC shall continuously monitor and control the associated system and at the same time shall provide all the required alarms, indications of system parameters, equipment status, etc. to the main control system at the plant.

B. Where required as described above, each manufacturer-supplied PLC shall be connected to the Ethernet data highway network for access from the plant control system SCADA computers, as specified in Section 17530, and shall contain a managed Ethernet switch identical to those provided for the rest of the data-highway-connected PLCs. Each equipment manufacturer shall provide all monitoring and control data to be transferred between the PLC and the plant control system in contiguous blocks of PLC registers to facilitate block read and write commands for efficient scanning by the control system SCADA computers. These contiguous registers shall be arranged in a single data transfer area, which shall be divided into eight distinct areas with an emphasis on flexibility and future expansion. The distinct areas shall be arranged by data type (analog or discrete), transfer direction (server to PLC or PLC to server), and, where applicable, implementation schedule (current or future). Where required, peer-to-peer communication between PLCs shall likewise be accomplished using separate blocks of contiguous registers. Where individual equipment PLCs are not required to be connected to the plant control system via the data highway network, they shall provide the individual hardwired signals as specified in the Contract Documents. Data and commands for connection to the control system are described in the Drawings, the individual equipment specification sections, and in Section 17950 - *Functional Control Descriptions*.

C. The operator interface for control of each individual system shall be performed by local operator interface units as specified in Section 17125 or individual pilot devices on the equipment local control panel, as specified in the associated equipment specification section. Additional operator interface functions shall be provided through the plant control system as specified in the respective equipment specifications and in Section 17950.

D. Where operator interface and control functions are required to be provided through the plant SCADA system, the individual system supplier shall be responsible for coordination with the instrumentation subcontractor to provide a complete and working equipment control system. The individual equipment supplier shall also be responsible for limiting the access of the plant control system to the equipment PLC code so as to prevent malfunctions of the equipment and any failure to continuously perform its intended functions. The equipment supplier shall also provide direction in the configuration of the SCADA software's security system by the instrumentation subcontractor to limit access to the control functions of the equipment control system to authorized personnel only. The equipment supplier shall coordinate testing of the completed system with the instrumentation subcontractor, which shall conform to the requirements of Section 17072 - *Field Testing*.

E. The Contractor, equipment supplier and instrumentation subcontractor shall coordinate testing and startup of the equipment provided by the equipment supplier with the plant SCADA system, including but not limited to the following tasks:
   1. Provide assistance with control system testing of inputs, outputs, and control strategies as needed.
   2. Provide support or interface work necessary to perform physical checkout and field testing to the final field devices. The schedule may require the instrumentation subcontractor and equipment manufacturer personnel to perform loop checks simultaneously, as directed by the Engineer.
   3. Coordinate and assist as needed to maintain I/O connectivity throughout the system.
   4. Ensure personnel safety while equipment is exercised via the plant control system.

5. Ensure that process, instrumentation, and control equipment are not damaged while equipment is exercised via the plant control system.
6. Provide temporary modifications to field devices and their terminations, if needed.
7. Providing labor and supervision which may include, but is not limited to: electricians, instrument technicians, manufacturer's representatives, and individual(s) knowledgeable about the process startup and operation.
8. Operation of process equipment for verification of each plant control system input and output.

3.2 REQUIREMENTS

A. Refer to Section 17000, Part 3.

END OF SECTION

SECTION 17125

PLC OPERATOR INTERFACE PANELS (OIP)

TABLE OF CONTENTS

SECTION 17125

PLC OPERATOR INTERFACE PANELS (OIP)

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all operator interface panels, with all spare parts, accessories, and appurtenances in all PLC cabinets as herein specified and as shown on the Drawings.

1.2 SUPPLIERS

A. The filter manufacturer shall provide eight operator interface panels programmed as required for filter monitoring and control.

B. The adsorption clarifier manufacturer shall provide three operator interface panels programmed as required for adsorption clarifier monitoring and control.

C. The systems integrator shall provide one unprogrammed spare operator interface panel.

PART 2 – PRODUCTS

2.1 OPERATOR INTERFACE PANEL - COLOR GRAPHIC TOUCH SCREEN

A. Operator Interface Panels shall be provided to view and control PLC parameters and to display alarm messages using a graphical user interface. The OIP shall provide the following features as a minimum.

1. Color active matrix touch screen.
2. 304 mm X 228 mm display size.
3. 1023 X 768 pixel resolution.
4. Ethernet communications.
5. 24 VDC power from a power supply in the associated PLC cabinet.
6. Allen-Bradley Factory Talk programming software.
7. NEMA 4X.
8. Conformal coating on circuit boards, copper side, and component side.
9. All Operator Interface Panels (11 total) shall be Allen-Bradley PanelView Plus 1500.

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. The OIU shall be configured to display all PLC I/O, set points, and parameters. All equipment failures shall be alarmed. PLC I/O values and operator-entered set points shall be displayed with associated units and service descriptions. Menus shall be provided to navigate between screens of different equipment items. Displays shall be arranged in a hierarchical structure with displays for specific equipment items grouped together. Additional functionality shall be as specified elsewhere in this Division.

B. All necessary configuration and programming software shall be provided on CD media and turned over to the Owner.

C. Refer to Section 17000 for additional requirements.

END OF SECTION

SECTION 17950

FUNCTIONAL CONTROL DESCRIPTIONS

TABLE OF CONTENTS

SECTION 17950

FUNCTIONAL CONTROL DESCRIPTIONS

PART 1 — GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all equipment as herein specified and as shown on the Drawings. The Contractor shall be responsible for furnishing complete functioning systems as described herein.

B. Together with the control system input/output drawings, the equipment specifications (including functional descriptions for local equipment control panels), and the Drawings, the functional control descriptions describe the required operation, monitoring, and control of the facilities included in this Contract.

C. The functional descriptions contain requirements for furnishing and installing labor and materials that may not appear elsewhere in the contract documents.

D. All equipment and services required in equipment local control panels provided to implement the monitoring and control functions described herein or in the process input/output schedules shall be provided by the Contractor through individual equipment suppliers.

E. Unless specifically stated otherwise, all interconnected wiring between all instruments, panels, controls, and other devices listed in the functional descriptions as required providing all functions specified herein shall be furnished by the Electrical Contractor under Division 16. The Electrical Contractor shall provide all cable and conduit required to carry all signals listed in the process input/output schedules. Special cables that are required for interconnection between sensors or probes and transmitters or signal conditioners shall be furnished with the instrumentation devices by the equipment supplier.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Related sections include but are not necessarily limited to:
1. Section 11025 - *Filter Units.*
2. Section 11227 - *Adsorption Clarifiers.*
3. Section 11240 - *Chemical Transfer and Metering Pumps.*
4. Section 11930 - *Chlorine Vapor Scrubber System.*
5. Section 11921 - *Chemical Feed: Chlorine.*

PART 2 — FUNCTIONAL CONTROL DESCRIPTIONS — GENERAL

2.1 DEFINITIONS

A. RUNNING status signals shall be from auxiliary contacts provided with the motor control equipment (i.e., starter, VFD, SCR, etc.).

B. AUTO status signals shall be defined as HAND-OFF-AUTO switch in the AUTO position or process control system in AUTO (versus MANUAL).

C. FAIL status signals shall be defined as motor overload and/or any other shut down mode such as over torque, over temperature, low oil pressure, high vibration, etc.

D. READY status signal shall be defined as all conditions, including equipment control power, satisfied to permit remote control of the equipment.

2.2 CONVENTIONS

A. Operator workstation graphic display symbols and indicator lights on all MCCs, control panels, starter enclosures, etc. shall conform to the following color convention:

CONDITION	COLOR
Running/On/Open	Red
Auto/Ready	White
Stopped/Off/Closed	Green
Fail/Alarm	Amber
Generic Status	Blue or White

2.3 PROCESS CONTROL

A. Where set points, operating limits, and other control settings are provided by the functional descriptions, these settings shall be initial settings only and shall be used for assistance in the initial startup of the plant. All such settings shall be fully adjustable and, based on actual operating conditions; the instrumentation subcontractor shall make all necessary adjustments to provide smooth, stable operation at no additional cost to the Owner.

B. Provision shall be made in PLC logic to suppress nuisance alarms and control actions by the following means:

1. For alarms and control actions derived from analog input signals, use adjustable time delays and dead bands.
2. For alarms and control actions derived from discrete input signals, use adjustable time delays.
3. Initial settings for time delays shall be 10 seconds (range 0-120 seconds). Initial settings for dead bands shall be 5% of span (range 0-100%).
4. Equipment that is started or stopped manually by the operator shall start or stop immediately, with no time delay.

C. All set point control shall be by PID control algorithms. Where only proportional control is specified, tuning constants shall be used to reduce the Integral and Derivative functions to zero. All set points, sequence times, sequence orders, dead bands, PID tuning parameters, PLC delay timers, variable speed operating range limits, and similar control constants shall be accessible and alterable from the operator workstations.

D. Unless otherwise specified, all equipment shall automatically restart after a power failure utilizing adjustable start delay timers in PLC control logic. Unless otherwise specified, all PLC control strategies shall be based upon automatic restart after a power failure and shall return to a normal control mode upon restoration of power.

E. The PLC shall be capable of receiving initial run-time values for existing and proposed equipment. Initial run-time shall not automatically be assumed to be zero.

F. Equipment failure shall be generated through the PLC for any drive, motor, etc. for which a command has been issued, but for which the PLC is not receiving a confirming status signal (e.g., start command with no run feedback). The failure shall be logged.

G. Instrument failure shall be generated via the operator work stations for any instrument which is generating a signal which is less than 4 mA or greater than 20 mA.

H. A control program that controls multiple pieces of equipment shall not be prevented from running because not all of the equipment is in AUTO. If equipment within an equipment chain is required to be running for program operation and it is running in HAND or MANUAL, then the program shall run and control the other equipment that is in AUTO.

I. All PLC wait states (internal time delays, etc.) after an operator action shall be displayed on the operator workstation.

PART 3 – FUNCTIONAL CONTROL DESCRIPTIONS

3.1 GENERAL REQUIREMENTS

A. The contractor shall assign the responsibility of PLC programming for the adsorption clarifier controls to the manufacturer of the adsorption clarifier. This includes programming of PLC-4 and PLC-5, and the associated Operator Interface Panels.

B. The contractor shall assign the responsibility of PLC programming for the filter controls to the manufacturer of the filters. This includes programming of PLC-2 and PLC-3, and the associated Operator Interface Panels.

C. The contractor shall assign the responsibility for the plant SCADA system programming to the Systems Integrator. This includes PLC-1, PLC-6, PLC-7, PLC-8, PLC-9, and PLC-10, and the two SCADA computers. The Systems Integrator shall also be given the responsibility to coordinate his display, control, trending, and data logging with the adsorption clarifier manufacturer and the filter manufacturer.

D. Refer to drawings E001, E002, and E003. These drawings indicate discrete inputs, discrete outputs, analog inputs, and analog outputs connected to the PLC shown.
   1. Discrete inputs shall be displayed on the Operator Interface Computer (OIC) screens as status or alarm points, as applicable.
   2. Discrete outputs shall control equipment as described in part 3 of this specification.
   3. Real-time trends, historical trends, and digital value displays shall be configured in the OIC and displayed for analog signals. Flow signals shall be totalized and stored in retentive memory. Instantaneous values of pressure, loss-of-head, turbidity, flow, and levels shall be logged to the hard disk each 15 seconds.
   4. Analog outputs shall control equipment as described in part 3 of this specification.
   5. Pumps shall have HAND/OFF/AUTO switches configured on the OIC screens.
   6. Motor operated valves shall have HAND/OFF/AUTO switches and manual OPEN/CLOSE switches configured on the OIC screens. For modulating valves, provide a manual positioning control on the OIC screens, active when the switch is in HAND.
   7. Alarms that are generated by PLC control panels, equipment control panels, and Variable Frequency Drives shall be displayed at each OIC. Refer to approved shop drawings and wiring diagrams for the above equipment.
   8. Pump, filter, and adsorption clarifier run times shall be totalized.

3.2 MIDDLE FORK RAW WATER PUMPS

A. Pumps at the Middle Fork Raw Water Pump Station selected to run are manually started and speeds are manually set to the desired raw water flow.

B. Multiple pumps running simultaneously shall run at identical speeds.

3.3 SOUTH FORK RAW WATER PUMPS

A. Pumps at the South Fork Raw Water Pump Station selected to run are manually started and pump speeds are manually set to the desired raw water flow.

B. Multiple pumps running simultaneously shall run at identical speeds.

3.4 SOUTH FORK RAW WATER CONTROL VALVE

A. The South Fork raw water control valve is automatically positioned to maintain the inlet pressure to the control valve as required to keep the water level in the gravity inlet pipe near the highest elevation of the pipe.

B. The initial setpoint shall be 15 feet below the high point of the pipe.

3.5 RAW WATER FLASH MIXERS

A. Flash mixers are manually started and the speed is manually set.

B. Start/stop, speed control and speed indication is available from the computer, at the VFD, and on a control station located near the mixer.

3.6 FLOCCULATORS

A. Flocculators are manually started and the speed is manually set.

B. Start/stop, speed control and speed indication is available from the computer, at the VFD, and on a control station located near the flocculator.

3.7 SEDIMENTATION BASINS

A. The level in the sedimentation basin effluent channel is measured. Low and high level alarms allow the operator to manually adjust raw water flow if necessary.

3.8 INTERMEDIATE BOOSTER PUMP STATION

A. Booster pumps are variable speed operating on VFDs. In AUTO as selected at the VFD, speed is automatically controlled by the level in the filter influent channels. The level transmitter used for control can be selected.

B. Speed control is implemented with a PID controller configured in PLC software.

C. Pumps shall automatically stop if low level is detected in the sedimentation effluent trough. Manual reset is required to enable automatic pump operation.

D. Pumps shall automatically stop if low level is detected in the sedimentation effluent trough. Manual reset is required to enable automatic pump operation. Multiple pumps operating simultaneously shall run at identical speeds.

E. The pumps shall be capable of running in manual mode during bypass of the sedimentation basin. In this mode, the pumps shall not automatically stop on low level in the sedimentation effluent trough.

3.9 ADSORPTION CLARIFIERS

A. Normal Operation:

1. Water enters each tank through an influent flow control (modulating) valve. The inlet valves modulate to maintain a constant flow into the clarifier.
2. Clarifier flowrate shall be determined by splitting the flow to each clarifier equally. This will be done by monitoring the flows to each in service clarifier (whether in flush mode or not) and splitting the flow equally among them. If all clarifiers are registering no flow (as on initial startup), flow shall be divided based upon the total of all the in-service filter flows.
3. The maximum flow to any clarifier shall be 4.6 mgd, this shall be the peak flowrate allowed in the PLC. If flow rises above this condition, an alarm shall sound and flow through each clarifier shall be automatically reduced to 4.6 mgd by the inlet modulating valves. The resulting change in the filter influent channel shall automatically adjust the speed of the intermediate pumps to maintain the level in the filter influent channel at the level setpoint.
4. All clarifiers in operation are to maintain the same flowrate, unless one is in flush mode, see below.
5. The clarifiers shall operate in normal mode until either condition is reached:

a. Headloss across the clarifier media increases to the point that it is four feet above the clean bed headloss (adjustable)
b. A preset operation time limit has been reached (adjustable)
c. A selector switch shall provide override of the automatic flush initiation to allow manual flushing of each unit

6. If headloss increases to six feet above the clean bed headloss, the unit shall be taken out of service and an alarm shall sound.

B. Flush Cycle:

1. When a flush cycle is initiated, the PLC shall check to ensure that no other clarifiers or filters are in backwash mode. If any other units are in backwash mode, the influent valve shall close and all flow to the clarifiers shall be split equally among the remaining in service clarifiers.
2. The backwash valve shall open and the effluent gate shall close, causing the water in the trough to flow to waste;
3. The influent valve shall slowly close (0-300s, adjustable);
4. The air inlet valve shall open
5. One blower shall be turned on and the speed slowly ramped up to the preset maximum in a preset amount of time (0-300s, adjustable). During this step air is distributed to the bottom of the adsorption clarifier. This causes expansion and fluidization of the adsorption media; excess solids are scoured, forming a slurry.
6. After a preset time period (0-300s, adjustable), the influent valve shall reopen and flushing commences.
   a. In this mode, the water level rises until it breaks over the lip of the waste trough above the clarifier compartment, allowing the clarifier flush water to discharge to waste.
   b. In flush mode, there shall be an additional mode of influent operation. In this mode, the operators may choose to operate as normal with flow split equally among the clarifiers, or they may choose a preset "flush rate", and the influent modulating valve on the flushing clarifier will position to allow this preset "flush rate" to flow to the clarifier. The other clarifiers will equally split the remainder of the flow.
   c. The flush cycle continues for a preset duration (0-500s, adjustable),
   d. The influent valve is slowly stopped (0-300s, adjustable).
   e. The air continues for a preset interval (0-120s, adjustable) to re-level the media bed and dissipate any flow currents induced by the flush cycle.
   f. The blower is brought out of service.
   g. The air influent valve is closed.
   h. A short period (0-120 s adjustable) of no water or air flow permits the media to return to its normal depth against the retainer panels.
   i. The influent valve is opened and modulated to run at the normal influent rate;
   j. A rinse to waste cycle (60-360s, adjustable) is initiated
   k. After the rinse to waste cycle, the effluent valve is opened while the flushing valve is closed, putting the unit back into service and ending the flush cycle.

C. Adsorption Clarifiers Operator Interface Panels (3 total):

1. Panel shall provide the following functions (through the HMI Interface):
   a. Influent Valve Open/Close/Auto Switch and valve PID controller.
   b. Flush Valve Open/Close/Auto Switch.
   c. Clarifier Effluent Gate Open/Close/Auto Switch.
   d. Air Scour On/Off/Auto Switch.
      1) Turning air switch on will result in the air scour valve for that clarifier opening and the lead blower slowly coming up to preset filter air scour speed in approximately 3 minutes (adjustable). The blower will not go above this speed unless the preset adsorption clarifier speed is adjusted.
   e. Blower selector switch (Blower 1/Blower 2).
   f. Clarifier Loss of Head Display (always displayed when panel not in use).
   g. Clarifier Effluent Turbidity Display (always displayed when panel not in use).
   h. Comply with Section 1127 - Adsorption Clarifiers.

2. The touch screen color graphic operator interface panel shall be configured to display touch link graphic symbols for switches and controller face plates for operator input to control the clarifiers. Valve status and valve positions shall be shown as active graphic symbols. Digital values for head loss, flow, and turbidity shall be displayed.

3.10 FILTERS

A. Filter effluent flow is automatically controlled by the modulating effluent valve to maintain the operator entered setpoint. Effluent flow control is implemented by a PID controller configured in PLC software.

B. General:

1. All filters will be automated and integrated into two PLC systems, one for filters 1-4 and one for filters 1-5. .
2. Filter run time will be monitored and totalized by the PLC. A filter will be considered to be on-line if its influent valves are full open and its effluent valve is at least partially open.
3. Filters will be selected for operation by the operator at the computer. The quantity of filters required will be calculated by the operator or the PLC based on the plant flow setpoint.
4. The flow setpoints to the individual filters will be calculated either in the PLC as the quotient of the plant influent flow divided by the quantity of filters on-line or a set flow rate shall be maintained with any variation in flow rate handled by the overflows. The option to automatically adjust setpoints to compensate for filters in backwash shall be provided. The maximum filter effluent flow setpoint shall not exceed 1340 GPM under any circumstances.
5. The filter effluent flow valves shall be adjusted to maintain a constant water level in the filter influent channel, using an operator adjustable set point. When a filter is in backwash, filter operation may not keep up with the influent flow depending on how the filters are controlled and the level in this channel will rise. At that point, the booster pump station to the adsorption clarifiers will slow down, allowing water to rise in the sedimentation basin and the influent flow to the filters will be reduced.
6. All automated filter valves will have motorized actuators controlled by integral reversing starters. All valves will be power-to-open/power-to-close, two position service except the filter effluent valves which will be modulated by 4-20 mA signals. All valves will have full open/full closed limit switches monitored by the PLC.
7. Each filter effluent valve will be controlled by a PLC programmed PID algorithm with 4-20 mA output to modulate the respective valve to maintain setpoint.
8. All filter valves will further have programmed override to force closure on any of the following:
   a. Filter deselected for operation at computer.
   b. As required during backwash sequence.
9. Each filter will be equipped with an effluent flow meter, effluent turbidimeter, and loss of head transmitter, with all signals input to the PLC.
10. Filter status will be tabulated on a computer filter summary screen and schematically displayed on individual filter graphic screens. The graphics will also be displayed on the respective operator interface terminal (OIT) at each filter console.

C. Filter Backwash:

1. The filter automatic backwash sequence will be PLC controlled and may be initiated by one of the following events:
   a. Operator directed start.
   b. Elapsed time since last backwash (if enabled).
   c. High headloss (if enabled).
   d. High turbidity (if enabled).
2. The PLC shall provide an interlock that requires no other filter or adsorption clarifier is in backwash or flush mode prior to initiating a backwash. If the preset conditions above are reached while another filter is being backwashed or an adsorption clarifier is in flush

mode, an alarm will sound and the backwash will not be initiated though the filter may be left in service.

3. Prior to initiating backwash, operator consent to the backwash shall be obtained through the plant computer.

4. All filters will use the same preprogrammed sequence, but different setpoints between filters for blower speed and backwash flowrate may be entered by the operator. A backwash setup screen will be configured at the computer or respective OIT to provide operator entry of:
   a. All adjustable time and flow setpoints.
   b. Selectively enable or disable automatic backwash initiation by elapse time, headloss, or turbidity.
   c. Select automatic return to service after backwash individually for each filter.
5. Operator directed backwash initiation will be accomplished from either the computer or the respective OIT at the filter console. Backwash progress will be displayed by step number at both computer and OIT with the capability to hold, resume, and reset in any step.
6. The backwash sequence will be programmed in each PLC.
   a. When initiated, the following steps will be automatically performed.
      1) Capture date and hour, backwash totalizer reading, elapse run time, turbidity and headloss for filter backwash daily report.
      2) Close filter influent valve and confirm.
      3) Drain filter down to programmed level.
      4) Close effluent valve and confirm, zero the effluent flow setpoint.
      5) Open drain valve and confirm.
      6) Open air scour valve and confirm.
      7) Energize air scour blower and confirm run.
      8) Ramp air scour speed slowly up to preset maximum in preset amount of time (0-300s).
      9) Start backwash pump against closed influent valve for 0-30 s to eliminate air.
      10) Open Influent Valve.
      11) Ramp backwash flow setpoint to 500 gpm (adjustable), by modulating backwash pump control valve (adjustable from OIT) and hold until water level reaches preset (adjustable from OIT) setpoint. This is the concurrent backwash. The filter backwash pump shall only start when the control valve is closed and the pump is at deadhead.
      12) Close air scour valve and confirm.
      13) Deenergize air scour blower and confirm off.
      14) Ramp backwash flow operator setpoint initially set at 4,000 gpm over the course of approximately operator entered duration of 60s (adjustable) and hold for adjustable time (0-15 min adjustable). This is the water only backwash. The operator may change this flow setpoint for each individual filter, so that there is a potentially different backwash flow setpoint for every filter.
      15) Ramp backwash flow setpoint to 0 gpm.
      16) When backwash flow rate declines to 2,000 gpm, close drain valve and confirm.
      17) Open influent valve and confirm.
      18) Stop backwash pump when backwash flow rate declines to 0 gpm, confirm off.
      19) Hold until filter level rises to programmed refill level.
         a) If return to service is selected, enable the filter to waste sequence (steps 20-22).
         b) If return to service is de-selected, close all valves and hold.
      20) Capture the backwash totalizer reading and calculate volume used for daily report.
         a) Open the filter to waste valve and confirm.
         b) Hold for either a programmed time duration, or until a preset turbidity measurement is obtained, at operators option. If turbidity measurement is utilized, alarm will sound after preset amount of time.
         c) Close the filter to waste valve and totalize filter to waste volume.
         d) Enable the effluent valve and ramp the effluent flow setpoint to the calculated value.

e) Capture headloss and turbidity after filter to waste sequence for daily report.

21) Filter to waste sequence (steps 20-22) shall be automatically run when placing any filter on line.

22) The progress of filter backwash duration will be monitored by the PLC and compared against a benchmark duration. Excessive backwash elapsed time will be alarmed as an automatic backwash failure individually for each filter. Any singular failure will not inhibit other filter backwash, however, the affected filter will be taken off-line and held for inspection. The benchmark and elapsed time will be concurrently displayed at the computer and OIT with the capability for operator alarm override if the backwash is attended.

23) In addition to automatic backwash the operator shall have the ability to perform a manual backwash from each respective console. The backwash pump and air scour blower shall have OIT Start/Stop pushbuttons which will allow the operator to manipulate the devices individually from the touch screen when in manual mode. The operator shall also have the ability to set the backwash flow rate and blower speed for manual backwash execution.

24) The backwash pump shall be interlocked to only start when the control valve is completely shut, and every backwash sequence shall return control valve to closed position. This is to protect the filter underdrain from blow-outs due to a short duration pressure surge.

D. Filter Operator Interface Panels (8 total):

1. Panel shall provide the following functions (through the HMI Interface):
   a. Influent Valve Open/Close/Auto Switch (for both influent valves).
   b. Filter Drain Valve Open/Close/Auto Switch.
   c. Filter Effluent Flow Control Valve Open/Close/Auto Switch.
   d. Filter-to Waste Valve Open/Close/Auto Switch.
   e. Air Scour On/Off/Auto Switch.
      1) Turning air switch on will result in blower slowly coming up to preset filter air scour speed in approximately 4 minutes. The blower will not go above this speed unless the preset filter speed is adjusted.
   f. Backwash Pump On/Off/Auto Switch.
      1) Turning pump switch on will result in pumped flow slowly coming to preset value over 5 minutes.
   g. Backwash Flow Control Valve On/Off/Auto Switch.
   h. Backwash Filter Isolation Valve On/Off/Auto Switch.
   i. Filter Loss of Head Display.
   j. Filter Effluent Turbidity Display.
   k. Effluent Flow Display, with indication of Filter to Waste or Filtered Water condition.
   l. Filter water level
   m. Backwash control valve positioner
   n. Comply with Section 11025 - *Filter Units*.

E. The touch screen color graphic operator interface panel shall be configured to display touch link graphic symbols for switches and controller face plates for operator input to control the filters. Valve status and valve positions shall be shown as active graphic symbols. Digital values for head loss, flow, and turbidity shall be displayed.

3.11 CHEMICAL ADDITION

A. Chemical pumps listed below shall be paced to the indicated process flow. The ratio of chemical flow to process flow is set by the operator at the OIC. Chemical delivery to the system is maintained at this ratio as the process flow varies.

B. Chemical flows are measured by rotometers equipped with flow transmitters.

C. Configure PLC software for pacing the chemical feeders as shown in the table below:

CHEMICAL	DOSING POINT	PACING FLOW SIGNAL
Fluoride	Front of CCT	Filtered Flow
Chlorine	Front of CCT	Filtered Flow
Chlorine	Filter Influent Channel	Filtered Flow
Chlorine	Static Mixer	Clarified Flow
Chlorine	Flocculation	Raw Water Flow
Chlorine	Rapid Mix	Raw Water Flow
Sodium Permanganate	Pre-Rapid Mix	Raw Water Flow
Caustic	Pre-Rapid Mix	Raw Water Flow
Polyaluminum Chloride (PACl or Coagulant)	Rapid Mix	Raw Water Flow
Polyaluminum Chloride (PACl or Coagulant)	Adsorption Clarifier	Clarified Flow
Chlorine Dioxide	Rapid Mix	Raw Water Flow
Sodium Chloride	Chlorine Dioxide Generator	Generator
Powdered Activated Carbon (PAC)	Rapid Mix	Raw Water Flow
Powdered Activated Carbon (PAC)	Static Mix	Clarified Flow
Polymer - 1	Flocculation	Raw Water Flow
Polymer - 1	Filters	Manual
Polymer - 2	Static Mixer	Clarified Flow

Filtered Flow = Sum of all active filter effluent flows.
Clarified Flow = Sum of all Clarifier flows
Raw Water = Sum of Middle and South Fork raw water flows

D. OPEN/CLOSE/AUTO selector switches shall provide control of the solenoid water valves for the chlorine injectors. In AUTO, the valves will open when the plant is filtering water and will close when the plant stops.

3.12 CHEMICAL TRANSFER TO DAY TANKS

A. The level in each chemical storage tank and day tank is measured.

B. When the day tank level drops to the low setpoint, the operator will be notified via the plant computer and the selected transfer pump will start and fill the day tank when directed by the plant operator.

1. If the day tank level transmitter fails and the transfer pump fails to stop, the level in the day tank will rise to the backup stop float switch at which point the transfer pump will stop and lock out. Manual reset when the level decreases below the float switch is required for continued operation of the transfer pump.
2. The operator may interrupt the pump operation at any point from the SCADA system.

3.13 FINISHED WATER PUMPS

A. With the HAND/OFF/AUTO selector switch located in the finished water pump VFD is in AUTO, the pumps selected to run will operate in lead, lag, standby sequence to maintain the level in the clearwell at the operator entered level setpoint.

B. Existing discharge check valve operation shall remain.

C. If low water level in the respective pump wetwell occurs, the pump will stop. Manual reset of this alarm is required.

3.14 CT CALCULATIONS

A. The level in each of the the chlorine contact tanks is measured. This level is automatically controlled to the operator entered setpoint by the variable speed finished water pumps.

B. Chlorine residual in the chlorine contact tank is measured by the finished water chlorine analyzer.

C. Finished water flow is measured.

D. The SCADA system calculates the CT parameter by multiplying the detention time in the chlorine contact tank and the chlorine residual downstream end of the tank. Detention time shall be determined by measuring the individual floor area of each of the chlorine contact tanks and the connecting channel. The tanks in operation shall be entered by the operator, and CT calculated based on utilized tanks. The result is stored each minute on the system drives and is displayed and trended at each computer.

END OF SECTION

GEOTECHNICAL STUDY

Middle Fork Water Treatment Plant
12 MGD Improvements
Abingdon, Virginia

Prepared for:

Washington County Service Authority
25122 Regal Drive
Abingdon, VA 24211

Prepared by:

THE LANE GROUP
124 Depot Avenue
P. O. Box 1340
Chilhowie, Virginia 24319
276.646.2520

Engineers–Architects–Planners–Environmental Specialists

COMMONWEALTH OF VIRGINIA
LESLIE C. SUTHERLAND
Lic. No. 22895
4/25/10
PROFESSIONAL ENGINEER

April 2010

TABLE OF CONTENTS

INTRODUCTION

The Washington County Service Authority plans to build additions to the Middle Fork Water Treatment Plant located at 18385 Jeb Stuart Highway in Abingdon, Virginia. Construction of the interim improvements are planned to begin in the Spring of 2010. Once the interim improvements are complete, a second expansion will increase the plant capacity to 12 million gallons per day (MGD). We completed a geotechnical study for the interim improvements and the report was dated November 2009. This report addresses the improvements to expand to a 12 MGD plant. The results of the study, presented in outline and tabular form, comprise this report.

Purpose of Study: Provide geotechnical engineering advice and recommendations for foundation design of the structures.

Elements of Study: Ten soil borings were completed during the explorations for the interim improvements. An additional 6 soil borings were completed during this phase of field work. Review of existing data, a site reconnaissance, and an analysis of the collected data were also performed.

SITE DESCRIPTION

Location: The existing plant site is located on the east side of Jeb Stuart Hwy (US 58) just south of the Middle Fork of the Holston River bridge about 3 miles east of Abingdon, Virginia.

Topography: The existing plant site sits about 10 to 20 ft above the low-lying flood plain of the Middle Fork of the Holston River. The structures are surrounded by grassy areas and paved parking. We understand that man-made fill was constructed to prepare the existing site. Surface drainage is considered good to excellent.

PROJECT DESCRIPTION

To reiterate, after construction of the interim improvements are complete, plans are to increase the plant capacity to 12 MGD. This work will further increase the size of the filter plant building. Additionally, a new intermediate booster pump station, a chemical feed building, and construction of additional flocculation basins are planned.

SUMMARY OF SUBSURFACE EXPLORATION

Test Borings – includes borings during field work for interim improvements and 12 MGD expansion			
No. of Borings: 16		**Range in Depth, ft:** 7.9 to 23.7	
Drilling Contractor: S&ME		**Crew:** Dave and Dana. Adam and Brian	
Drill Rig		**Support Vehicles**	
CME ATV		**Water Truck**	
Truck-mounted CME 55		**Front-end Loader**	
Other – Four-wheel ATV	x	**Other** - 1-ton truck	x
Drill Tools			
Hollow-Stem Auger	x		
NQ2" Rock bit & barrel		**NW Casing**	
Type of Borings & Drilling Quantities in ft		**Type of Sampling & Sampling Details**	
Auger Probe		**Standard Penetration Test:** 5-ft intervals or less	
Soil – Intermittent Sampling	227.0	**Extra Samples:**	
Soil - Continuous Sampling		**Shelby Tube:** None	
Boulders		**Bulk:** None	
NQ2" Rock			
NW Casing			

A representative of our firm directed the drill crew regarding boring locations and sampling requirements. He also examined the samples as they were recovered, prepared a field log of the borings, and adjusted the drilling program to fit the conditions encountered. Soil samples were placed in glass jars for temporary storage. **Boring logs and a sketch of the boring locations are in the Appendix.**

Standard Penetration Test - performed by driving a split-barrel sampler (2" O.D., 1.375" I.D.) 1 ft using 140-lb hammer, 30" fall; yields N-value or blow-count in blows per foot that provides relative indication of consistency and density.

SUBSURFACE DESCRIPTION

Strata descriptions are summarized in the tables below. For details of individual strata, please refer to the boring logs in the Appendix. Where possible, the strata descriptions are arranged in descending order. With discontinuous layers, a given layer may directly overlie more than one stratum; or the opposite, more than one layer may rest on a single stratum of broad lateral extent.

Descriptive Tables

Stratum: Brown, tan and red clay with some shale and sandstone fragments, some topsoil (Man-made Fill)		
Thickness ft: 3 to 10	**N-values:** 3 to 50	**Moisture:** Moist to wet
Occurrence: All borings except Borings 8 and 9		
Properties: Fill composition and consistency is variable. Fill varies from soft to very stiff based on N-values, but generally was observed as soft to medium; shear strength is judged low to moderate; compressibility is judged low to high.		

Stratum: Gray organic silt and clay with some brown sand, some gravels (Alluvium)		
Thickness ft: 6 to 10	**N-values:** 3 to 17	**Moisture:** Moist to saturated
Occurrence: Borings 1, 2, 8, 9, 10, 15 and 16		
Properties: Alluvial clay and silt vary from soft to firm consistency and alluvial sands range from very loose to medium in relative density based on N-values; we feel some of the N-values were elevated due to influence of gravel or rock fragments; shear strength is judged as low; compressibility is judged as high.		

Gray weathered to decomposed shale bedrock was encountered in the borings between the depths of 6 and 18 feet.

Groundwater

Water level readings were taken from the open bore holes for up to 24 hours after completion. Measured levels are shown on the boring logs in the Appendix. For clarity, groundwater depths noted in the report refer to depth below existing grade.

The groundwater data is considered a "snapshot." Groundwater levels may change significantly depending on weather conditions and may be influenced by the water level of the river.

GEOTECHNICAL DISCUSSION, OPINIONS, AND RECOMMENDATIONS

Discussion of the proposed structures will be made on an individual basis.

Future Plant Building Expansion

- **Structure:** In plan, the existing filter plant with interim improvements is approximately 105 ft x 36 feet. The proposed expansion will increase the overall size to about 150 ft x 85 feet. To make room for the expansion, several existing features will have to be removed or demolished. These include abandoned sediment basins south of the existing plant, an above ground 48-inch pipeline on the east side of the abandoned basins, a couple of underground tanks, and some water, electric, and chemical feed lines.

  The western 112 ft x 85 ft has a proposed finished floor elevation of 1788 ft, which matches the existing clear well floor elevation. Within this area, up to 10 ft of cut will be required on both the east and west sides of the existing basins (to be removed). The existing basins have a floor elevation of roughly 1793 feet. After demolition, an additional 5 ft of cut will be required within this area.

  The eastern 38 ft x 85 ft will contain adsorption clarifiers and does not have a clear-well floor level. The finished floor elevation for the adsorption clarifiers is 1798 ft (10 ft higher than the clear well floor). To prepare the area, from 2 to 6 ft of fill will be required.

- **Expected Structural Loads:** Generally, foundation loads are expected to be light. Increases in net load are expected to be less than 2000 psf.

- **Subsurface Conditions:** Several soil borings were completed in the eastern portion of the proposed expansion area. No borings were completed in the western portion due to the existing sediment basins and underground utilities in the area.

  Based on our borings, from 3 ft (Boring 13) to 10 ft (Boring 16) of man-made fill has been placed along the east side of the existing sediment basins and plant building. The consistency and the composition of the fill are both variable. The fill ranges from soft to firm and is generally moist to wet. Brown, tan, and red clay with some gravel and weathered shale fragments comprise the fill material.

Based on discussion with plant personnel, some swampy areas used to exist behind the existing plant. We believe we identified some of the swampy soils in Borings 1, 2, 15, and 16. In these borings, we encountered 4 to 10 ft of soft, wet, brown and gray organic clay and silt beneath the fill. We described this zone as alluvium in our Boring Logs.

Gray weathered to decomposed shale bedrock was encountered below the fill and/or alluvium. The weathered shale bedrock was encountered in the borings at depths ranging from 6 ft to 17 feet. These depths yield weathered shale bedrock surface elevations ranging from about 1788 ft to 1776 feet. Generally, the shale bedrock surface tends to be dropping in elevation as you move to the north.

- **Foundation Conditions: (Separate discussion for clearwell and clarifier portions of the expansion due to differences in floor elevation.)**

Clearwell level - Finished Floor Elevation, 1788 feet

1. Based on our borings, weathered shale was encountered near proposed subgrade (ele. 1786.5 ft) with the exception of Boring 2 where the shale layer was deeper. Although not confirmed, we presume that the majority if not all of the existing sediment basins (to be demolished) are founded on weathered to hard shale. Review of a subsurface investigation completed for the original plant design recommended bearing on weathered to hard shale.

2. The weathered shale layer is considered a suitable bearing stratum for the proposed structure; the soft fill and alluvium are considered unsuitable.

3. Where soft soil is encountered, we recommend undercutting and replacing with suitable fill material. Based on our borings, we expect any undercut to be limited to the north east corner of the clearwell-level expansion area (near Boring 2). Dewatering of the excavation may be required. As recommended for the interim improvements construction, we recommend using crushed stone as backfill for any undercut in the area. If groundwater is present, a free-draining aggregate such as VDOT No. 57 stone is proposed. The granular fill should be placed in lifts approximately 12 inches thick and compacted sufficiently to establish a firm stable lift. If groundwater is not present, dense-graded aggregate such as VDOT No. 21A stone is recommended. The dense-graded aggregate should be placed as controlled fill, described later.

4. For shallow foundations bearing on weathered shale bedrock or compacted granular fill, placed as controlled fill, an allowable soil pressure of 2000 psf is recommended for design.

5. When performing any undercut, extreme care will be required to protect from undermining the existing buildings. Based on a review of a geotechnical study completed for the original plant (dated 1973), the existing plant may bear on shale bedrock, but this condition has not been confirmed. The use of sheet piles, staged excavation, and/or other measures may be needed to provide adequate support. As a precaution, we recommend survey monitoring points be established on the existing buildings so that periodic checks for movement can be made.

Clarifier level - Finished Floor Elevation, 1798 feet

1. Based on the variable conditions of the existing fill and the organic soils encountered, it is our opinion that the existing soil conditions are unsuitable to support the proposed fill and the proposed structure using a shallow foundation. We considered undercut and replacement as a remedial solution, but the higher floor elevation makes this alternative less practical. The depth of undercut could approach 19 ft (Boring 15) and would likely average in excess of 10 feet. After the undercut was backfilled, an additional 2 to 6 ft of fill would still be required to reach proposed subgrade.

2. We recommend this portion of the structure be supported by cast-in-place piles bearing on the decomposed shale bedrock. We recommend a pressure-injected pile such as those constructed by Technical Foundations Incorporated. Richmond, Virginia. A pressure-injected pile is installed by drilling to the selected stratum with a large-diameter (12- to 24- inches) hollow-stem auger. High-strength cement grout is then injected into the hole through the auger as it is withdrawn from the hole.

3. We recommend the piles rest on the decomposed shale bedrock. Based on our borings in the area, decomposed shale bedrock was encountered at elevations ranging from 1790 ft to 1775 ft. We presume that the piles will be constructed after the fill has been placed to proposed subgrade. Based on a subgrade elevation of 1996.5 ft, pile lengths are expected to range from about 7 ft to 21 feet. A bearing capacity of 20 tsf is recommended for design of the piles resting on the decomposed shale bedrock.

4. Pile installation requires the work of a specialty subcontractor. We recommend the subcontractor be able to demonstrate experience in successfully completing projects of similar size and scope.

5. An engineer from our office should observe the foundation construction to verify the adequacy of the bearing strata and confirm that the actual soil conditions are consistent with our interpretations and assumptions.

Additionally, we would like the opportunity to review foundation plans and specifications prior to bidding the project.

Intermediate Booster Pump Station

- **Structure:** Intermediate booster pump station will be constructed along the east end of the north wall of Sedimentation Basins 1 and 2. Structure will be approximately 32 ft x 27 ft in plan dimensions. Proposed finished floor elevation is 1799 feet.

- **Expected Structural Loads:** Generally, foundation loads are expected to be light. Increases in net load are expected to be less than 1000 psf.

- **Subsurface Conditions:** The location of the structure has moved since our field work. No borings were completed within the proposed footprint of the structure. Borings 3 and 4 were made about 50 to 100 ft east of the area and Borings 11 and 12 were made about 100 ft west of the area. Each of these borings revealed about 6 to 7 ft of man-made fill above weathered shale bedrock. The fill consisted of tan silty clay with some sand and gravel. The consistency of the fill varied from soft to firm (N-values ranged from 6 to 30) and was moist to wet. No water was encountered in the borings.

- **Foundation Conditions:**

    1. Based on planned floor elevations, little cut or fill is expected. The bulk of the grade work will be required to install the new pumps and water lines. The pumps will require about a 10-ft deep excavation. We recommend all backfill of excavations be placed as controlled fill.
    2. In our opinion, the existing man-made fill is considered as marginal to provide support to the proposed structure and will require evaluation when the excavation is made. To evaluate the existing fill, we recommend proof rolling the area with suitable construction equipment, and/or observing the bottom of the exaction with test pits or using a hand auger. The excavation for the pumps will also afford additional observation of subsurface conditions.
    3. The bottom of the structures should bear on firm existing man-made fill (deemed suitable during construction), new controlled fill, or weathered shale bedrock. We recommend an allowable soil pressure of 2000 psf be used for foundation design.
    4. Establish bottom of structures at least 2 ft below exterior grade.

Flocculation Basins

- **Structure:** Flocculation basins will be constructed on the west side of the existing flocculation basins. Structure will be approximately 47 ft x 22 ft in plan dimensions and has a proposed floor elevation of 1795 feet. Several existing water lines and electrical lines will have to be removed or relocated. Based on estimated floor levels, 8 to 12 ft of cut are expected.

- **Expected Structural Loads:** Generally, foundation loads are expected to be light. Increases in net load are expected to be less than 1000 psf.

- **Subsurface Conditions:** Borings 5 was made near the southwest corner of the proposed basins. No other borings were completed in the area due to underground utilities.

  Boring 5 revealed about 8 ft of man-made fill above weathered shale bedrock. The fill consisted of tan silty clay with some sand and gravel. The fill was judged soft to firm in consistency (N-values ranged from 8 to 13) and moist to wet. Some N-values were thought to be inflated due to gravel in the samples. No water was encountered in Boring 5.

- **Foundation Conditions:**
  1. Several underground utilities will have to be relocated to build the basins. Any backfill for utility relocation should be placed as controlled fill.
  2. Weathered shale, existing man-made fill, and controlled fill are probable bearing strata.
  3. In our opinion, the weathered shale and controlled fill, if placed as directed, are suitable to support the proposed basins. The existing man-made fill is considered marginal and will require evaluation when the excavation is made. To evaluate the existing fill, we recommend proof rolling the area with suitable equipment, or observing the bottom of the exaction with test pits or hand auger.
  4. The bottom of the structures should bear on weathered shale, controlled fill or firm existing man-made fill (deemed suitable during construction). We recommend an allowable soil pressure of 2000 psf be used for foundation design.
  5. Establish bottom of structures at least 2 ft below exterior grade.

Chemical Feed Building

- **Structure:** Chemical feed building will be constructed along the west end of the north wall of Sedimentation Basins 1 and 2. Structure will be approximately 67 ft x 33 ft in plan dimensions. Estimated floor elevation is 1799 feet. Based on estimated floor levels, little cut or fill is expected.

- **Expected Structural Loads:** Generally, foundation loads are expected to be light. Increases in net load are expected to be less than 1000 psf.

- **Subsurface Conditions:** Borings 11 and 12 were made in the area of the proposed structure. From 6 to 7 ft of firm man-made fill were encountered above weathered shale bedrock. The fill consisted of red and brown silty clay with a few gravel.

  No water was encountered in Borings 11 or 12.

- **Foundation Conditions:**
  1. Based on our borings, firm existing man-made fill is probable bearing strata.
  2. In our opinion, the existing firm man-made fill is considered suitable to support the proposed structure using a shallow foundation. Minor undercut and replacement with controlled fill may be needed if soft soil is encountered.
  3. The bottom of the structure should bear on firm existing man-made fill. For design of spread and/or continuous footings, we recommend an allowable soil pressure of 2000 psf be used for foundation design.
  4. Establish bottom of footings at least 2 ft below exterior grade.

General

With the exception of the free-draining granular base to improve foundation conditions discussed above, we recommend any fill placed on the project be placed as controlled fill, described below. Additionally, controlled fill should be placed as backfill when underground utilities and vaults are removed or relocated.

All excavations should adhere to current Occupational Safety and Health Administration (OSHA) requirements.

We recommend an engineer from our office observe the foundation excavation to confirm that conditions encountered are consistent to those observed in the borings.

Based on Table 1615.1.1 of the 2003 International Building Code, we recommend that for seismic design, Site Class C be used.

Controlled Fill

- **Recommendations**

1. Place controlled fill as outlined below:

   a. Remove any topsoil in fill area.

   b. Construct controlled fill under continuous observation and testing of engineering technician from our office. Any fill materials should be approved by the project engineer.

   c. Place fill in 6- to 8-in lifts and compact each lift to at least 95% of maximum density as determined by ASTM Method D 698 (Standard Proctor).

   d. Maintain proper moisture content of fill during placement as determined by technician or engineer.

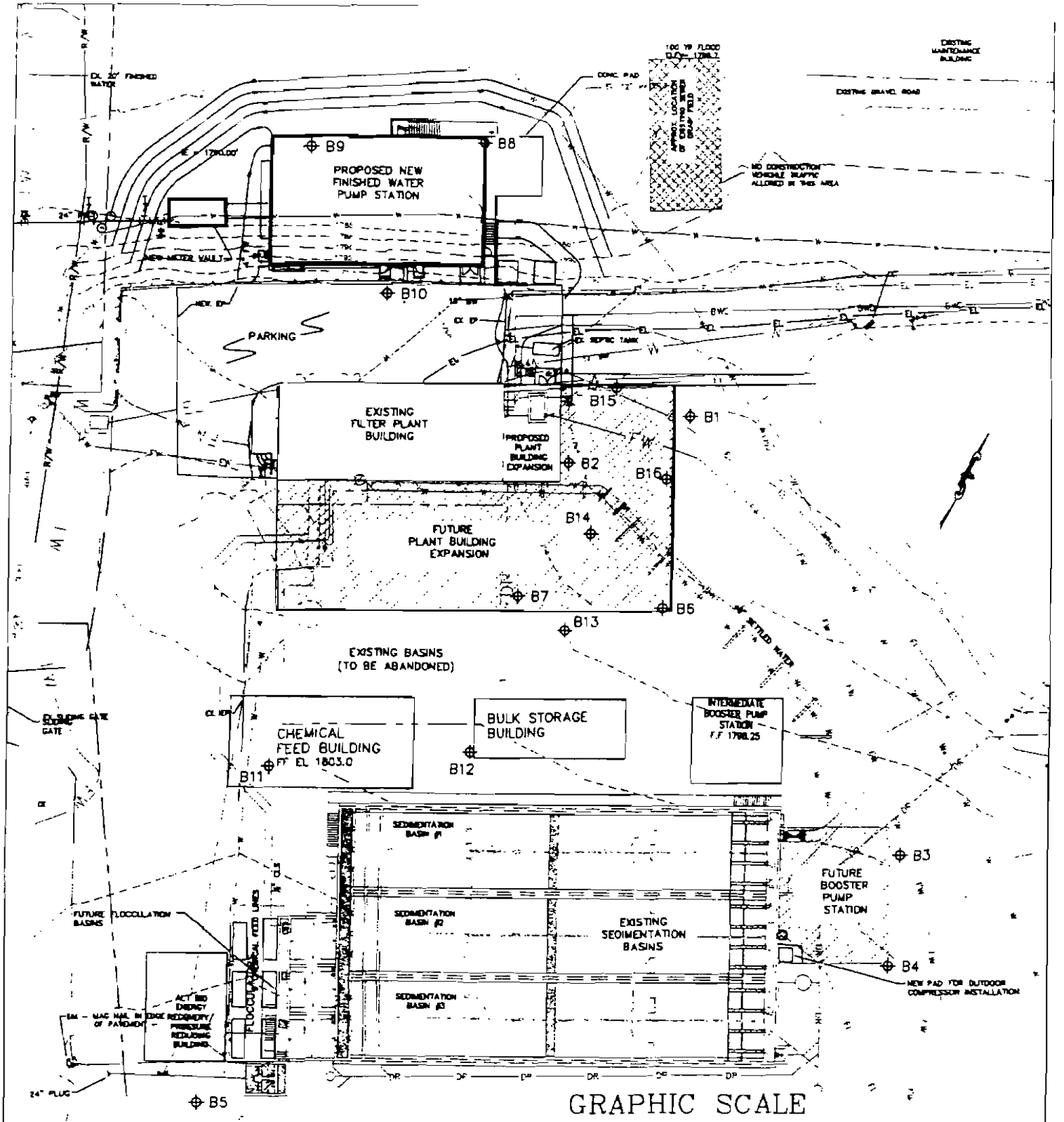
   e. Construct fill during summer or late fall, if possible, to take advantage of favorable weather conditions for soil moisture control.

LIMITATIONS

The analysis and recommendations submitted in this report are based on data obtained from field investigations. This report does not reflect any variations that may occur between locations of subsurface exploration. Such variations may not become apparent until construction is underway. If variations become evident, we should be notified so that immediate recommendations can be rendered.

This report has been prepared for the Washington County Service Authority, Abingdon, Virginia, to be used in foundation design and construction of the proposed additions to the Middle Fork Water Treatment Plant in Abingdon, Virginia. Anyone using this report for any purpose other than the project described herein must draw his own conclusions regarding construction procedures and soil conditions. We disclaim all responsibility and liability for any part that is removed, quoted, or reproduced separately from the entire report.

APPENDIX



NOTES

1. BORINGS ARE PLOTTED TO SCALE; DIMENSIONS ARE ON FILE.
2. SKETCH BASED ON SITE PLAN BY LG.
3. ⊕ INDICATES BORING LOCATION.
4. SCALE: 1" = 50'

THE LANE GROUP

LOCATION OF BORINGS
WCSA 12 MGD IMPROVEMENTS
WASHINGTON COUNTY, VIRGINIA

NOTES TO BORING LOGS

These notes refer to and are a part of the accompanying boring logs.

1. The borings were made by a boring contractor under the observation of a representative of our firm. These boring logs were compiled from field logs and the results of visual examination of the soil samples.

2. The logs of the borings apply only at the specific boring locations and on the dates indicated. They are not warranted to be representative of subsurface conditions at other locations and times.

3. The depth of the indicated boundaries between soil strata is approximate. The transition between the strata may be gradual.

4. The groundwater levels shown on the boring log represent average or typical values observed during the period of the boring operation or shortly after completion of a boring. These observations do not reflect seasonal changes in the water table or the effects of intense rainfall or runoff. In any excavation, trickling flow or seepage may be encountered from perched water which is at levels above the water table observed in the borings.

5. "Decomposed rock" is residual material having a standard penetration resistance of 50 blows or more per six inches. Decomposed rock can be an extremely hard and compact mixture of soil and weathered fragments of rock which may require rock excavation methods for removal.

6. "Sound" and/or "relatively sound rock" are non-decomposed rock and rock in which weathering is largely confined to joints. Such rock may be fractured to varying degrees.

7. Soil samples recovered from the borings have been stored at The Lane Group in Chilhowie, Virginia and are available for inspection by appointment. The soil samples will be discarded two months after submission of our report unless a request is received to retain them for a longer period.

8. The locations and elevations of the borings were determined by survey. The locations and elevations of the borings should be considered accurate only to the degree implied by the method used.

LOG OF BORING 1

Project:	Middle Fork Plant Additions	Location:	Abingdon, VA
Type of Boring:	Soil Boring - Intermittent Sampling	Drilling Contractor:	S & ME
Elevation, ft:	1702	Date Started:	10-22-09
Date Completed:	10-27-09	Weather:	

Stratum Description	Depth, ft	BLOWS* REC./RQD**	Sample Description
	0		
Topsoil 1.0 in.			Topsoil 1.0 inch
		3-4-3	FILL - brown silty clay with gravel
FILL - brown silty clay			
Gray organic SILT and CLAY (ALLUVIUM)	5	1-2-1	Gray organic SILT, wet, soft
		WOH-1-8	Gray slightly organic CLAY, water on spoon
	10	1-1-2	Gray & brown organic SILT & CLAY, wet
Gray & brown organic SILT & CLAY			
		24-50/0.2	Tan CLAY, firm & dark gray weathered SHALE
Gray severely weathered SHALE	15		
	20	23-50/0.4	Gray severely weathered SHALE
Gray decomposed SHALE			
		50/0.2	Ditto
Boring terminated @ 23.7 ft	25		
	30		
	35		

Groundwater Data			
Depth, ft	Time, hr	Depth, ft	Time, hr
5.5	0		
5.0	24		

NOTES:

* No. of Blows Required to Drive 2" O.D., 1.375" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall

** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation

See NOTES TO BORING LOG which are a part of this log

LOG OF BORING 2

Project:	Middle Fork Plant Additions	Location:	Abingdon, VA
Type of Boring:	Soil Boring - Intermittent Sampling	Drilling Contractor:	S & ME
Elevation, ft: 1794	Date Started: 10 27 09	Date Completed: 10 27 09	Weather:

Stratum Description	Depth, ft	BLOWS* / REC./RQD**	Sample Description
Topsoil - 2 inches	0		
FILL - red & tan clay		4-3-3	FILL - red & tan clay, few limestone fragments, wet
	5	2-2-3	FILL - ditto, soft, wet
		6-4-4	FILL - ditto, limestone fragments, soft, wet
Gray organic SILT (ALLUVIUM)	10	2-2-1	Gray organice SILT, rounded pebbles, soft, wet
Gray weathered SHALE	15	50/0.2	Gray severely weathered SHALE, dry
Auger refusal @ 15.0 ft	20		
	25		
	30		
	35		

Groundwater Data

Depth, ft	Time, hr	Depth, ft	Time, hr
11.0	0		
6.0	24		

NOTES:

* No. of Blows Required to Drive 2" O.D., 1.375" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall

** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation

See NOTES TO BORING LOG which are a part of this log.

LOG OF BORING 3

Project:	Middle Fork Plant Additions		Location:	Abingdon, VA
Type of Boring:	Soil Boring - Intermittent Sampling		Drilling Contractor:	S & ME
Elevation, ft:	1209	Date Started: 10-27-09	Date Completed: 10-27-09	Weather:

Stratum Description	Depth, ft	BLOWS* REC./RQD**	Sample Description
	0		
		5-4-5	FILL - tan silty clay, sand gravel, firm, moist
FILL - tan silty clay	5	4-3-3	FILL - dino, soft to medium
		22-3-50/0.4	Gray severely weathered SHALE, dry
		50/0.2	Gray limey SHALE, dry
Gray weathered to decomposed SHALE	10		8.5 - 13.5 ft - Hard augering
		50/0.2	Gray decomposed SHALE
Auger refusal @ 14.0 ft	15		
	20		
	25		
	30		
	35		

Groundwater Data

Depth, ft	Time, hr	Depth, ft	Time, hr
Dry	0		
Dry	24		

NOTES:

* No. of Blows Required to Drive 2" O.D., 1.375" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall

** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation

See NOTES TO BORING LOG which are a part of this log

LOG OF BORING 4

Project:	Middle Fork Plant Additions	**Location:**	Abingdon, VA
Type of Boring:	Soil Boring - Intermittent Sampling	**Drilling Contractor:**	S & ME
Elevation, ft:	1891	**Date Started:**	10 27 09
Date Completed:	10 27 09	**Weather:**	

Stratum Description	Depth, ft	BLOWS* / REC./RQD**	Sample Description
	0		
FILL - tan clay & shale fragments		3-3-3	FILL - tan clay & weathered shale fragments, wet
	5	4-14-16	FILL & weathered shale & sandstone fragments,moist
Gray weathered SHALE		33-50	Gray severely weathered SHALE
Auger refusal @ 8.0 ft	10		
	15		
	20		
	25		
	30		
	35		

Groundwater Data			
Depth, ft	Time, hr	Depth, ft	Time, hr

NOTES:
No water encountered

* No. of Blows Required to Drive 2" O.D., 1.375" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall
** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation
See NOTES TO BORING LOG which are a part of this log.

LOG OF BORING 5

Project:	Middle Fork Plant Additions	**Location:**	Abingdon, VA
Type of Boring:	Soil Boring - Intermittent Sampling	**Drilling Contractor:**	S & ME
Elevation, ft.	1506	Date Started: 10 27 09	Date Completed: 10 27 09 Weather:

Stratum Description	Depth, ft	BLOWS* REC./RQD**	Sample Description
	0		
		5-3-5	FILL - tan & brown clay, few gravels, moist
FILL - tan & brown clay	5	3-6-8	FILL - ditto, soft
		3-6-7	FILL - Tan silty CLAY, rounded pebbles, some shale fragments, firm, moist
Gray weathered SHALE	10	5-14-18	Gray severely weathered SHALE
		50/0.1	Gray decomposed SHALE
Auger refusal @ 14.0 ft	15		
	20		
	25		
	30		
	35		

Groundwater Data			
Depth, ft	Time, hr	Depth, ft	Time, hr

NOTES:
No water encountered

* No. of Blows Required to Drive 2" O.D., 1.375" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall
** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation
See NOTES TO BORING LOG which are a part of this log.

LOG OF BORING 6

Project:	Middle Fork Plant Aoditions			Location:	Abingdon, VA
Type of Boring:	Soil Boring - Intermitent Sampling			Drilling Contractor:	S & ME
Elevation, ft:	1796	Date Started:	10 27 09	Date Completed:	10 27 09	Weather:

Stratum Description	Depth, ft	BLOWS* REC./RQD**	Sample Description
	0		
FILL - brown & tan clay		2-3-2	FILL - brown & tan clay with limestone fragments, soft to medium, wet
	5	2-4-9	FILL - ditto & silt
Gray weathered SHALE		50	Gray SHALE fragments, dry
		50/0.2	Gray decomposed SHALE
	10		
Auger refusal @ 10.0 ft			
	15		
	20		
	25		
	30		
	35		

Groundwater Data

Depth, ft	Time, hr	Depth, ft	Time, hr
Dry	0		
6.0	24		

NOTES:

* No. of Blows Required to Drive 2" O.D., 1.375" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall
** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation
See NOTES TO BORING LOG which are a part of this log.

LOG OF BORING 7

Project:	Middle Fork Plant Additions	**Location:**	Abingdon, VA
Type of Boring:	Soil Boring - Intermittent Sampling	**Drilling Contractor:**	S & ME
Elevation, ft:	1798	Date Started:	10/27/09
Date Completed:	10/27/09	Weather:	

Stratum Description	Depth, ft	BLOWS* REC./RQD**	Sample Description
	0		
FILL - red & tan clay		3-3-2	FILL - red & tan clay, trace limestone(?), soft, wet
FILL?? - gray shale fragments	5	4-24-24	FILL - gray weathered shale fragments
		50	FILL?? - Gray shale fragments, dry
	10	10-22-20	FILL?? - Gray weathered shale fragments with clay
Gray weathered SHALE		50/0.2	Gray decomposed SHALE
Auger refusal @ 13.7 ft	15		
	20		
	25		
	30		
	35		

Groundwater Data			
Depth, ft	Time, hr	Depth, ft	Time, hr

NOTES:
No water encountered

* No. of Blows Required to Drive 2" O.D., 1.375" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall
** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation
See NOTES TO BORING LOG which are a part of this log

LOG OF BORING 8

Project: Middle Fork Plant Additions		**Location:**	Abingdon, VA
Type of Boring: Soil Boring - Intermittent Sampling		**Drilling Contractor:**	S & ME
Elevation, ft: 1786	**Date Started:** 10 27 09	**Date Completed:** 10 27 09	**Weather:**

Stratum Description	Depth, ft	BLOWS* REC./RQD**	Sample Description
	0		
Topsoil & brown SILT		2-2-1	Topsoil & brown clayey SILT, soft, saturated
Tan & brown SILT (ALLUVIUM)	5	5-9-8	Tan & brown clayey SILT, fot, wet, rock in shoes
		24-50/0.03	Gray severel weathered SHALE
Gray weathered to decomposed SHALE		50/0.2	Ditto, few sandstone fragments
	10		
		50/0	Gray decomposed SHALE
Boring terminated at 13.5'	15		
	20		
	25		
	30		
	35		

Groundwater Data

Depth, ft	Time, hr	Depth, ft	Time, hr
0.0	0		
0.0	24		

NOTES:

* No. of Blows Required to Drive 2" O.D., 1 3/8" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall

** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation

See NOTES TO BORING LOG which are a part of this log

LOG OF BORING 9

Project:	Middle Fork Plant Additions			Location:	Abingdon, VA
Type of Boring:	Soil Boring - Intermittent Sampling			Drilling Contractor:	S & ME
Elevation, ft.	1765	Date Started:	10 27 09	Date Completed:	10 27 09
Weather:					

Stratum Description	Depth, ft	BLOWS* REC/RQD**	Sample Description
	0		
Gray organic SILT (ALLUVIUM)		3-2-3	Gray organic sandy SILT, soft, wet
Brown SAND (ALLUVIUM)	5	4-6-6	Brown silty SAND with rock fragments, some organic, soft, wet
Gray weathered to decomposed SHALE		50/0.3	Gray severely weathered SHALE
		50/0	Gray decomposed SHALE, dry
Auger refusal @ 8.0 ft	10		
	15		
	20		
	25		
	30		
	35		

Groundwater Data

Depth, ft	Time, hr	Depth, ft	Time, hr
2.0	0		
0 0	1		
0 0	24		

NOTES:

* No. of Blows Required to Drive 2" O.D., 1.375" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall

** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation

See NOTES TO BORING LOG which are a part of this log.

LOG OF BORING 10

Project:	Middle Fork Plant Additions	Location:	Abingdon, VA
Type of Boring:	Soil Boring - Intermittent Sampling	Drilling Contractor:	S & ME
Elevation, ft: 1796	Date Started: 10 27 09	Date Completed: 10 27 09	Weather:

Stratum Description	Depth, ft	BLOWS* / REC/RQD**	Sample Description
	0		
5" Asphalt 4" stone			
		2-2-3	FILL - tan & red clay, medium, wet
	5	2-4-4	FILL - ditto
FILL - tan & red clay		WOH-2-1	FILL - ditto, soft
	10	3-3-2	FILL - ditto
Gray SAND	15	4-3-3	Gray silty SAND (alluvium)
Gray weathered to decomposed SHALE	20	50/0.2	Gray decomposed SHALE, dry
		50/0.2	
Boring Terminated @ 23.7'	25		
	30		
	35		

Groundwater Data

Depth, ft	Time, hr	Depth, ft	Time, hr
23.0	0		
10.5	24		

NOTES:

* No. of Blows Required to Drive 2" O.D., 1.375" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall

** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation

See NOTES TO BORING LOG which are a part of this log.

LOG OF BORING 11

Project:	Washington County Service Authority - 12 mgd Improvements	Location:	Abingdon, VA
Type of Boring:	Soil Boring - Intermittent Sampling	Drilling Contractor:	S & ME
Elevation, ft:	Date Started: 4-12-10	Date Completed: 4-12-10	Weather:

Stratum Description	Depth, ft	BLOWS* REC./RQD**	Sample Description
Topsoil	0		
FILL - Red, brown and tan clay with few weathered shale fragments		4-6-6	FILL - red clay, firm and brown silty clay, firm, moist
	5	3-4-6	FILL - tan silty clay, few weathered shale fragments, moist
Gray severely weathered SHALE		11-25-30	Gray severely weathered SHALE, dry
Auger refusal @ 7.9 ft	10		Auger refusal @ 7.9 ft
	15		
	20		
	25		
	30		
	35		

Groundwater Data			
Depth, ft	Time, hr	Depth, ft	Time, hr

NOTES:

No water encountered.
Hole backfilled on completion.

* No. of Blows Required to Drive 2" O.D., 1.375" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall
** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation
See NOTES TO BORING LOG which are a part of this log.

LOG OF BORING 12

Project:	Washington County Service Authority - 12 mgd Improvements	Location:	Abingdon, VA
Type of Boring:	Soil Boring - Intermittent Sampling	Drilling Contractor:	S & ME
Elevation, ft:	Date Started: 4 12 10	Date Completed: 4 12 10	Weather:

Stratum Description	Depth, ft	BLOWS* / REC/RQD**	Sample Description
	0		
FILL - red and brown clay with few limestone fragments		5-7-7	FILL - red clay, firm and brown silty clay, moist
	5	4-5-4	FILL - red clay with few limestone fragments, firm, moist
Gray severely weathered SHALE		17-22	Gray severely weathered SHALE, dry
Boring terminated @ 8.8 ft	10	50/0.3	Gray severely weathered SHALE, dry
	15		
	20		
	25		
	30		
	35		

Groundwater Data			
Depth, ft	Time, hr	Depth, ft	Time, hr

NOTES:

No water encountered.
Hole backfilled on completion.

* No. of Blows Required to Drive 2" O.D., 1.375" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall
** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation
See NOTES TO BORING LOG which are a part of this log.

LOG OF BORING 13

Project:	Washington County Service Authority - 12 mgd Improvements	Location:	Abingdon, VA
Type of Boring:	Soil Boring - Intermittent Sampling	Drilling Contractor:	S & ME
Elevation, ft:	1790	Date Started:	4-12-10
Date Completed:	4-12-10	Weather:	

Stratum Description	Depth, ft	BLOWS* / REC./RQD**	Sample Description
	0		
FILL - red and tan clay with severely weathered shale fragments		4-4-7	FILL - red clay and tan CLAY with severely weathered shale fragments
Tan CLAY and severely weathered SHALE	5	15-17-25	Tan CLAY & severely weathered SHALE, dry
		50/0.5	Decomposed SHALE, wet
Decomposed SHALE		50/0.4	No Recovery
	10		
Boring terminated @ 13.7 ft	15	50/0.2	Decomposed and hard SHALE, dry
	20		
	25		
	30		
	35		

Groundwater Data			
Depth, ft	Time, hr	Depth, ft	Time, hr

NOTES:

No water encountered.
Hole backfilled on completion.

* No. of Blows Required to Drive 2" O.D., 1.375" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall
** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation
See NOTES TO BORING LOG which are a part of this log

LOG OF BORING 14

Project:	Washington County Service Authority - 12 mgd Improvements	Location:	Abingdon, VA
Type of Boring:	Soil Boring - Intermittent Sampling	Drilling Contractor:	S & ME
Elevation, ft:	1795	Date Started: 4 12 10	Date Completed: 4 12 10	Weather:

Stratum Description	Depth, ft	BLOWS* REC/RQD**	Sample Description
	0		
		3-3-5	FILL - red clay, gravel & shale fragments, moist
FILL - red clay with gravel and shale fragments	5	34-35	FILL - ditto & gray shale fragments
		6-5-6	FILL - red silty clay with gravel, wet
	10	50/0.5	WIS, gray severely weathered shale
Gray severely weathered to decomposed SHALE			
	15	50/0.2	WIS, gray decomposed SHALE, dry
Auger refusal @ 15.0 ft			Auger refusal @ 15.0 ft
	20		
	25		
	30		
	35		

Groundwater Data			
Depth, ft	Time, hr	Depth, ft	Time, hr

NOTES:

No water encountered.
Hole backfilled on completion.
WIS - Water in Spoon

* No. of Blows Required to Drive 2" O.D., 1.375" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall
** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation
See NOTES TO BORING LOG which are a part of this log.

LOG OF BORING 15

Project:	Washington County Service Authority - 12 mgd Improvements	Location:	Abingdon, VA
Type of Boring:	Soil Boring - Intermittent Sampling	Drilling Contractor:	S & ME
Elevation, ft:	[illegible]	Date Started:	4-12-10
Date Completed:	4-12-10	Weather:	

Stratum Description	Depth, ft	BLOWS* / REC/RQD**	Sample Description
	0		
FILL - brown clay with trace of gravel		3-5-4	FILL - brown clay, medium, moist to wet
	5	2-1-2	FILL - brown clay, soft to medium, moist to wet
		1-2-1	FILL - dino and gray organic clay, soft, wet
Gray & brown organic SILT & CLAY (ALLUVIUM)	10	WOH	Gray and brown organic clay and silt with few pebbles
	15	5-6-8	brown & gray clay, rounded gravel
Gray decomposed SHALE			
	20	50/0.3	Gray decomposed SHALE Auger refusal @ 19.0 ft
	25		
	30		
	35		

Groundwater Data			
Depth, ft	Time, hr	Depth, ft	Time, hr
18.0	0		

NOTES:

* No. of Blows Required to Drive 2" O.D., 1.375" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall

** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation

See NOTES TO BORING LOG which are a part of this log

LOG OF BORING 16

Project:	Washington County Service Authority - 12 mgd Improvements	**Location:**	Abingdon, VA
Type of Boring:	Soil Boring - Intermittent Sampling	**Drilling Contractor:**	S & ME
Elevation, ft:	1793	**Date Started:**	4-14-10
Date Completed:	4-14-10	**Weather:**	

Stratum Description	Depth, ft	BLOWS* REC./RQD**	Sample Description
	0		
FILL - brown & tan silty clay		8-7-8	FILL - brown & tan silty clay
	5	2-2-2	FILL - brown clay (0.2' rec)
		1-2-2	FILL - ditto & gray organic clay, soft
	10	50/0.5	FILL - gray weathered shale fragments
Brown slightly organic SILT (ALLUVIUM)			
Gray decomposed SHALE	15	5-21-50/0.1	Gray decomposed SHALE
Auger refusal @ 19.0 ft	20	50/0.2	Auger refusal @ 19.0 ft
	25		
	30		
	35		

Groundwater Data

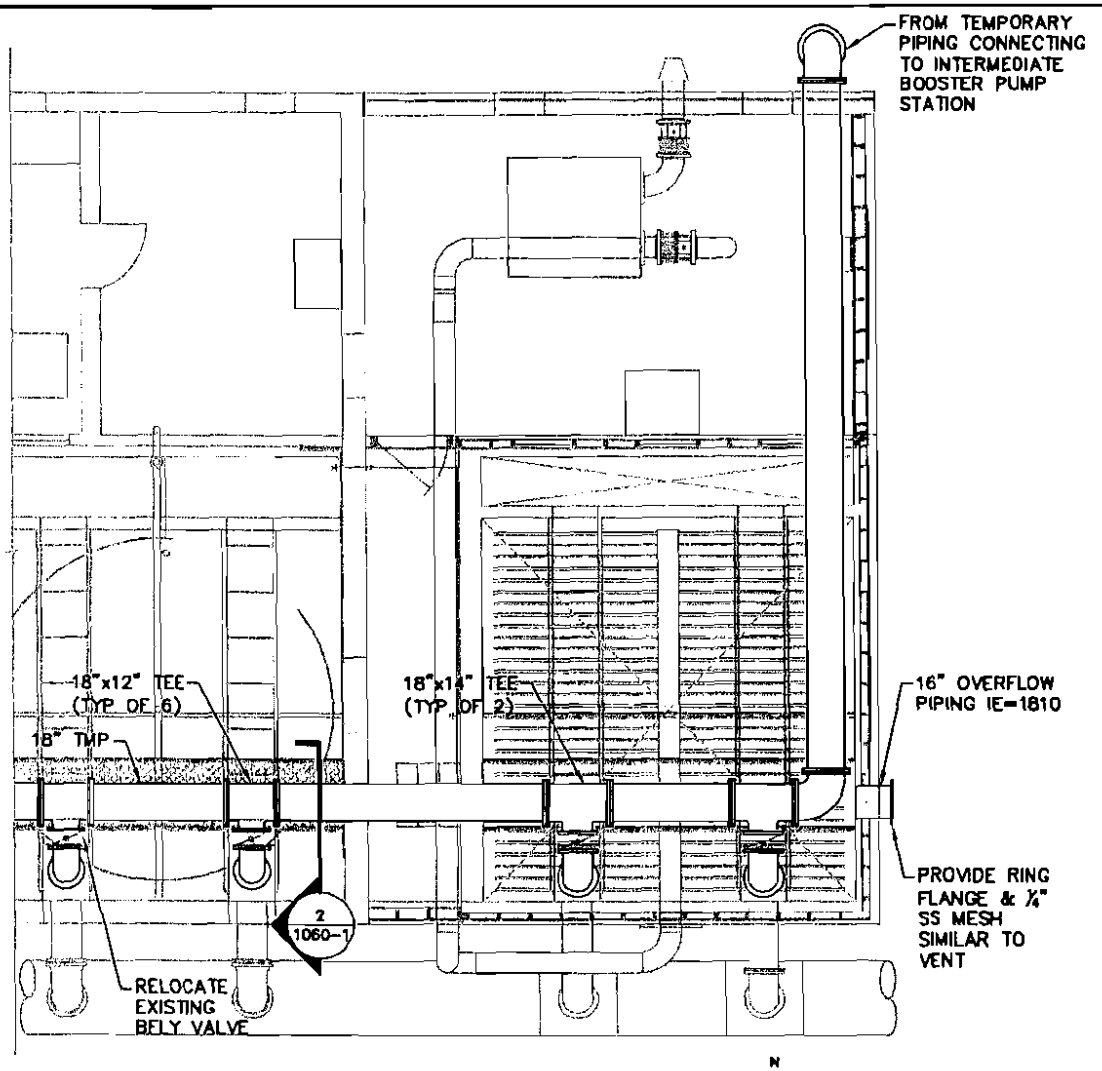
Depth, ft	Time, hr	Depth, ft	Time, hr

NOTES:

* No. of Blows Required to Drive 2" O.D., 1.375" I.D., Sampler 6" Using 140-lb Hammer, 30" Fall

** Core Recovery as Percent of Length of Drill Run. RQD is Rock Quality Designation

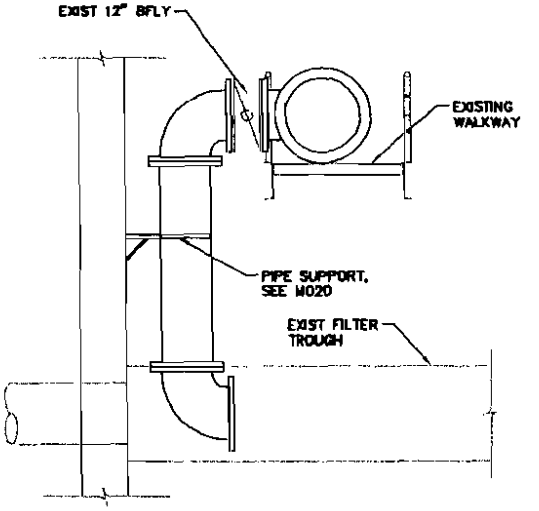
See NOTES TO BORING LOG which are a part of this log



PLANT TEMPORARY PIPING
SCALE: 1/8"=1'-0"

1 1060-1

N



TEMP PIPING SECTION
SCALE: 1/4"=1'-0"

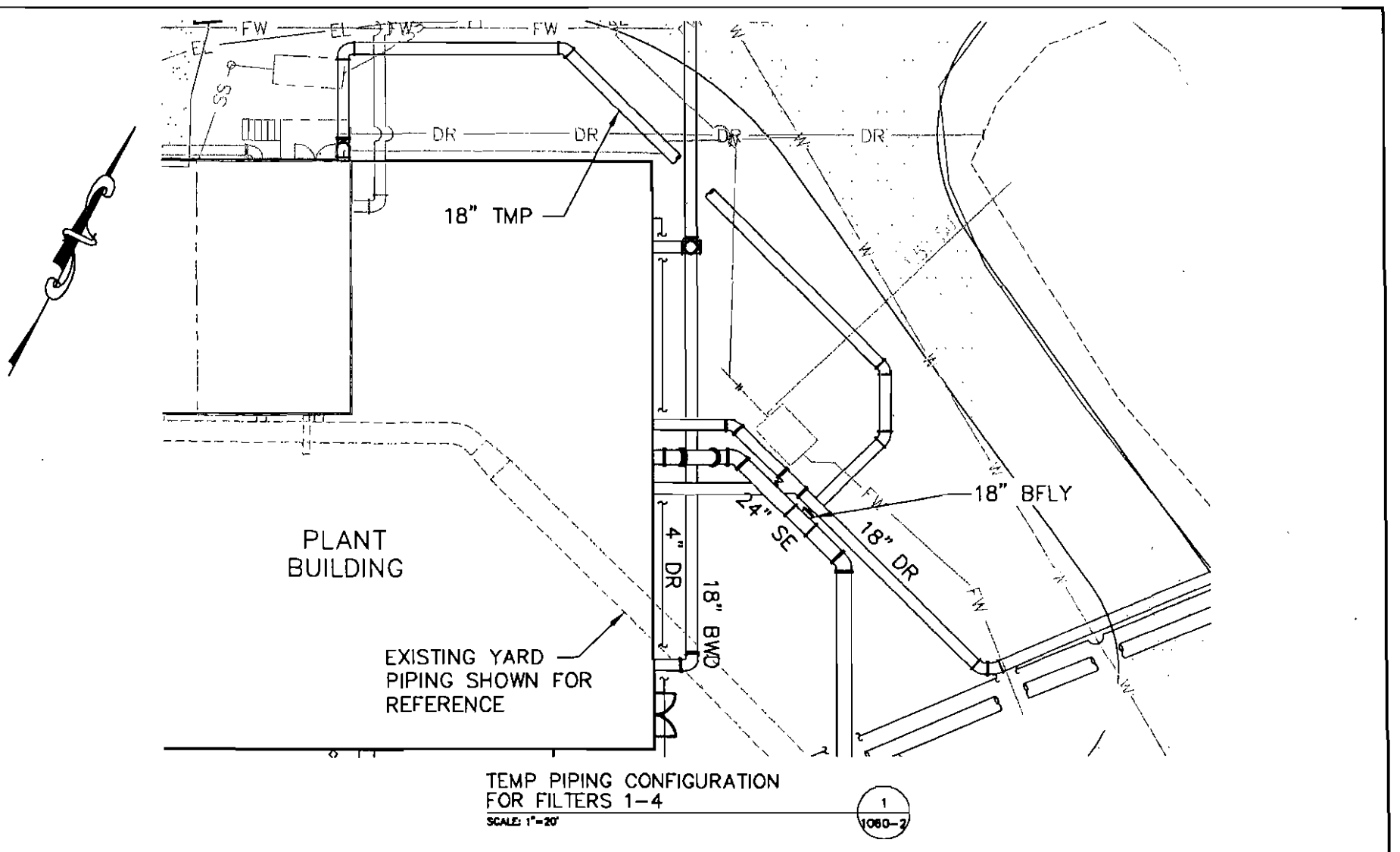
2 1060-1

WASHINGTON COUNTY SERVICE AUTHORITY
MIDDLE FORK WTP UPGRADE TO 12 MGD
TREATMENT PLANT BUILDING
PRESSURE FEED OF EXISTING FILTER

SCALE: AS SHOWN
JOB NO.:12367.13

AUG 2010
1060-1

OLVER INCORPORATED



WASHINGTON COUNTY SERVICE AUTHORITY
MIDDLE FORK WTP UPGRADE TO 12 MGD
TEMPORARY PIPING SITE PLAN

SCALE: 1"=20'
JOB NO.: 12367.13

AUG 2010
1060-2

OLVER
INCORPORATED

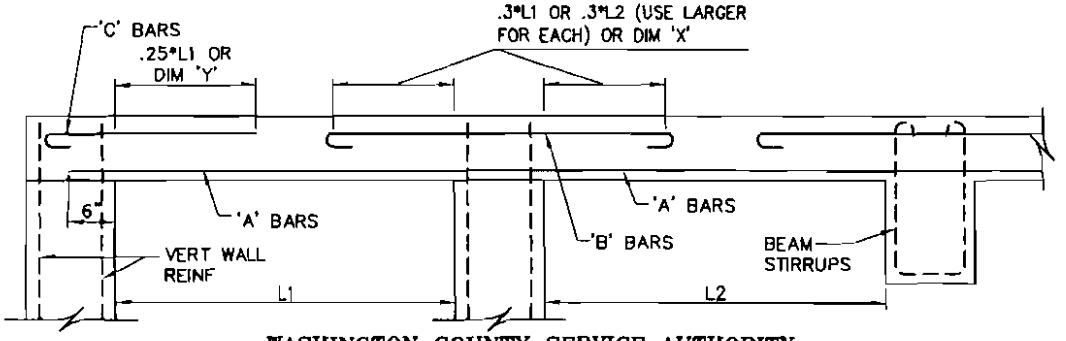
ELEVATED CONCRETE SLAB SCHEDULE

WATER TREATMENT PLANT BUILDING

SLAB	THICK	DIRECTION OF REINF	REINFORCING STEEL			REINF DIMENSIONS	
			A BARS	B BARS	C BARS	X (IN)	Y (IN)
S1	12	⟷	#5@6	–	#6@6	–	54
		OTHER	#5@9	#6@8	#6@8	54	–
S2	12	⟷	#5@6	#6@6	#6@6	–	54
		OTHER	#5@9	#6@8	#6@8	–	–
S3	12	⟷	#5@6	–	#6@6	–	54
		OTHER	#5@9	#6@8	#6@8	54	–
S4	12	⟷	#5@9	#6@8	#6@8	54	–
		OTHER	#5@12	–	#6@12	–	54
S5	8	⟷	#4@6	–	#5@6	–	–
		OTHER	#4@12	#5@12	#5@12	46	–
S6	8	⟷	#5@8	#5@6	#5@6	46	46
		OTHER	#5@12	#5@12	#5@12	46	–
S7	8	⟷	#5@8	–	#5@6	–	46
		OTHER	#5@12	–	#6@8	–	–

NOTES:

1. CONTINUE ALL 'A' BARS OVER SUPPORTS AND EXTEND A MINIMUM OF ½ OF 'A' BARS 6" ONTO OUTERMOST SUPPORTS.
2. FOR SIMPLE SPAN SLABS, PROVIDE MIN #3@12 IN TOP OF SLAB AND LAP SPLICE WITH 'C' BARS.
3. FOR MULTIPLE SPAN SLABS PROVIDE #3@12 IN TOP OF SLAB AND LAP SPLICE WITH 'B' OR 'C' BARS AS APPLICABLE.



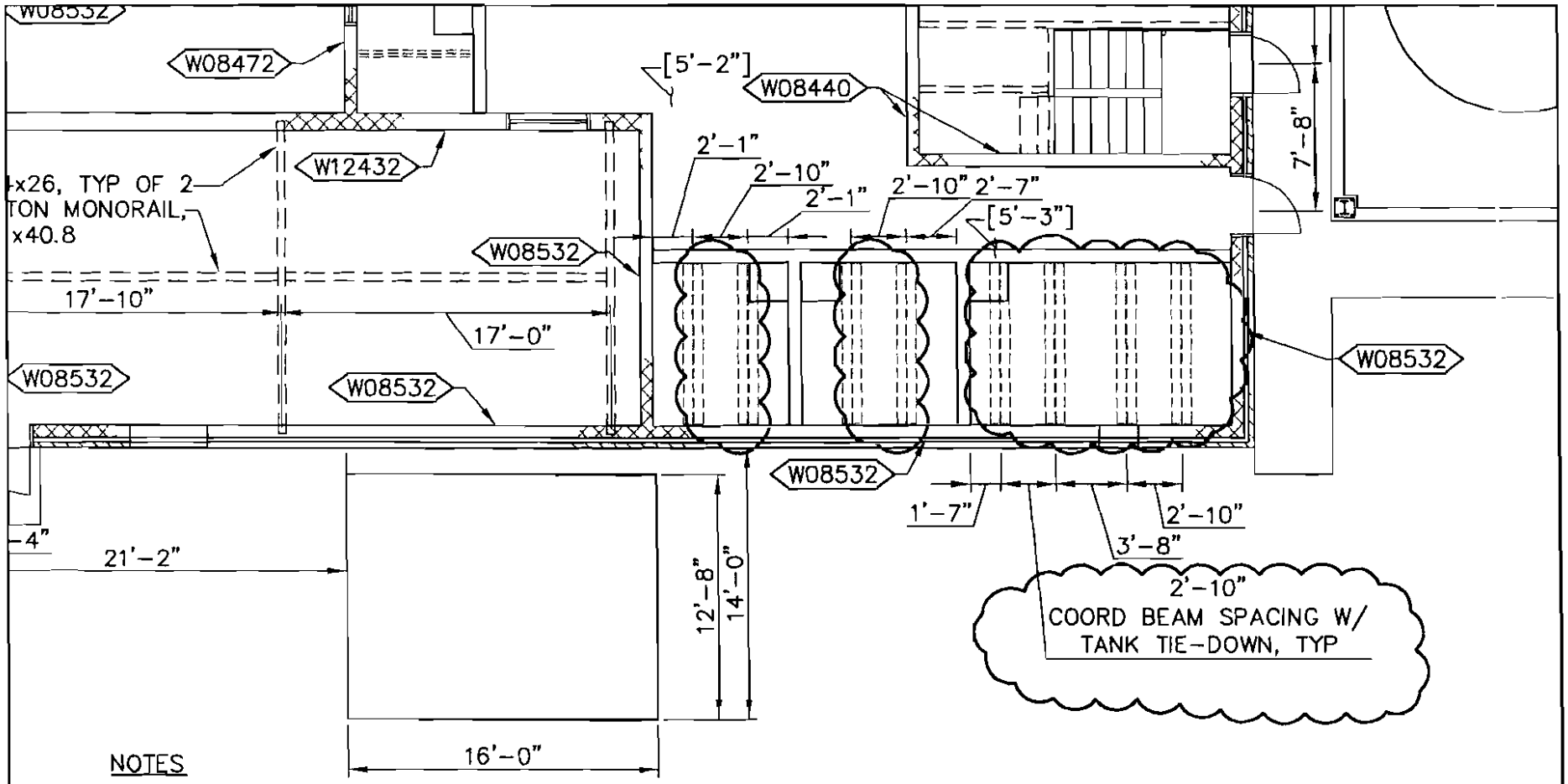
WASHINGTON COUNTY SERVICE AUTHORITY
MIDDLE FORK WTP UPGRADE TO 12 MGD
ADDENDUM NO. 1

DRAWINGS S003 – CONCRETE SLAB SCHEDULE

SCALE: NONE
JOB NO.: 12367.13

AUGUST 30, 2010

OLVER INCORPORATED



NOTES

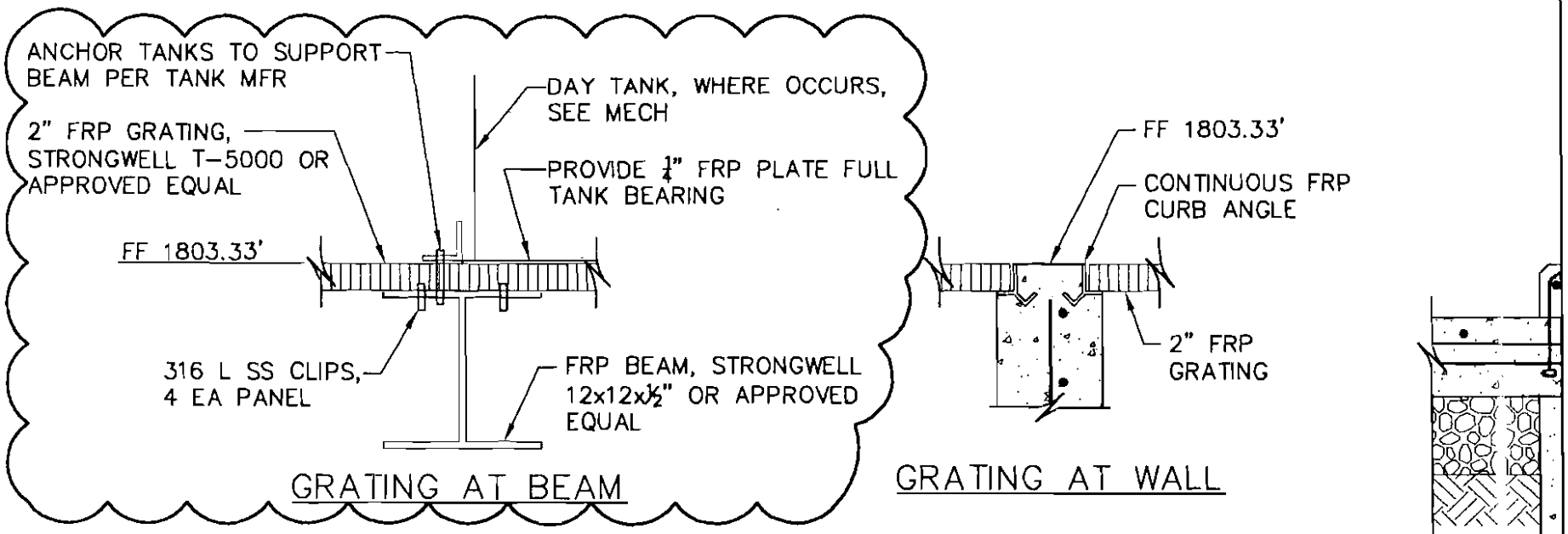
1. VINYL ESTER POLYMER CONCRETE TRENCH DRAIN, POLYCAST 600 OR APPROVED EQUAL.
2. FINISHED FLOOR ELEVATION IN LOWER CARBON ROOM IS 1797.75'. SET AS DATUM.

WASHINGTON COUNTY SERVICE AUTHORITY
S401.2 PLAN REVISIONS
ADDENDUM 1

SCALE: 1/4" = 1'-0"
JOB NO.: 12367.13

AUGUST 26, 2010

OLVER INCORPORATED



FRP GRATING

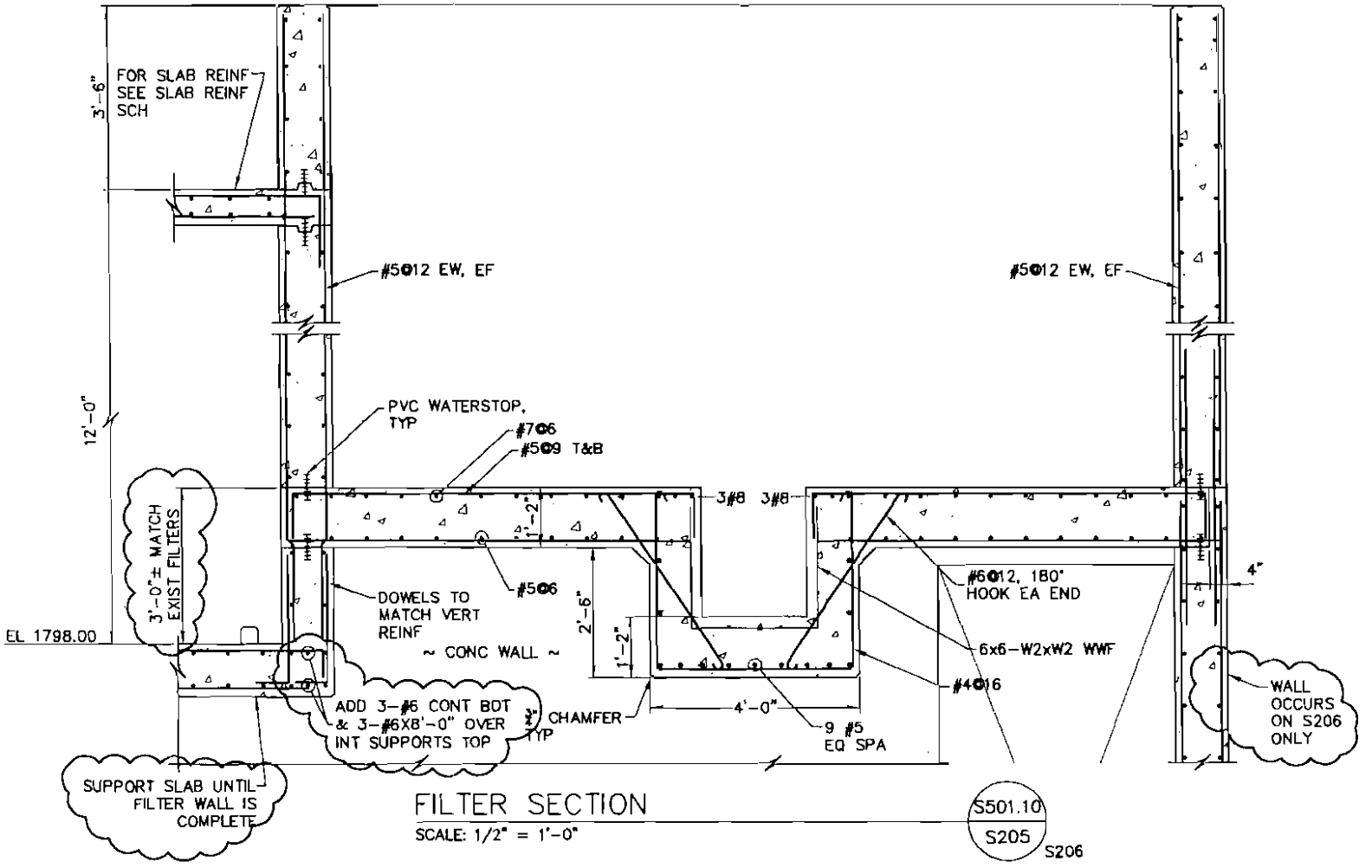
SCALE: 1"=1'-0"

WASHINGTON COUNTY SERVICE AUTHORITY
S402.5 REVISIONS
ADDENDUM 1

SCALE: 1" = 1'-0"
JOB NO.: 12367.13

AUGUST 26, 2010

OLVER INCORPORATED



FILTER SECTION

SCALE: 1/2" = 1'-0"

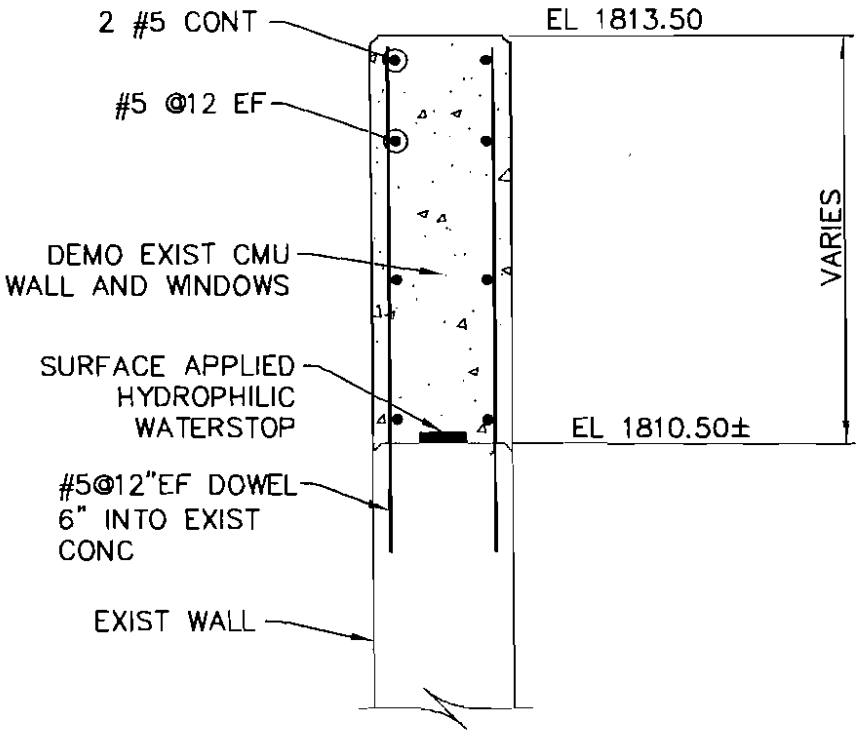
S501.10
S205
S206

WASHINGTON COUNTY SERVICE AUTHORITY
MIDDLE FORK WTP UPGRADE TO 12 MGD
ADDENDUM NO. 1
REVISED SECTION S501.10

SCALE: NONE
JOB NO.: 12367.13

SEPT 1, 2010

OLVER INCORPORATED



SECTION – FILTERS 1, 2 & 3

S505.6 / S207

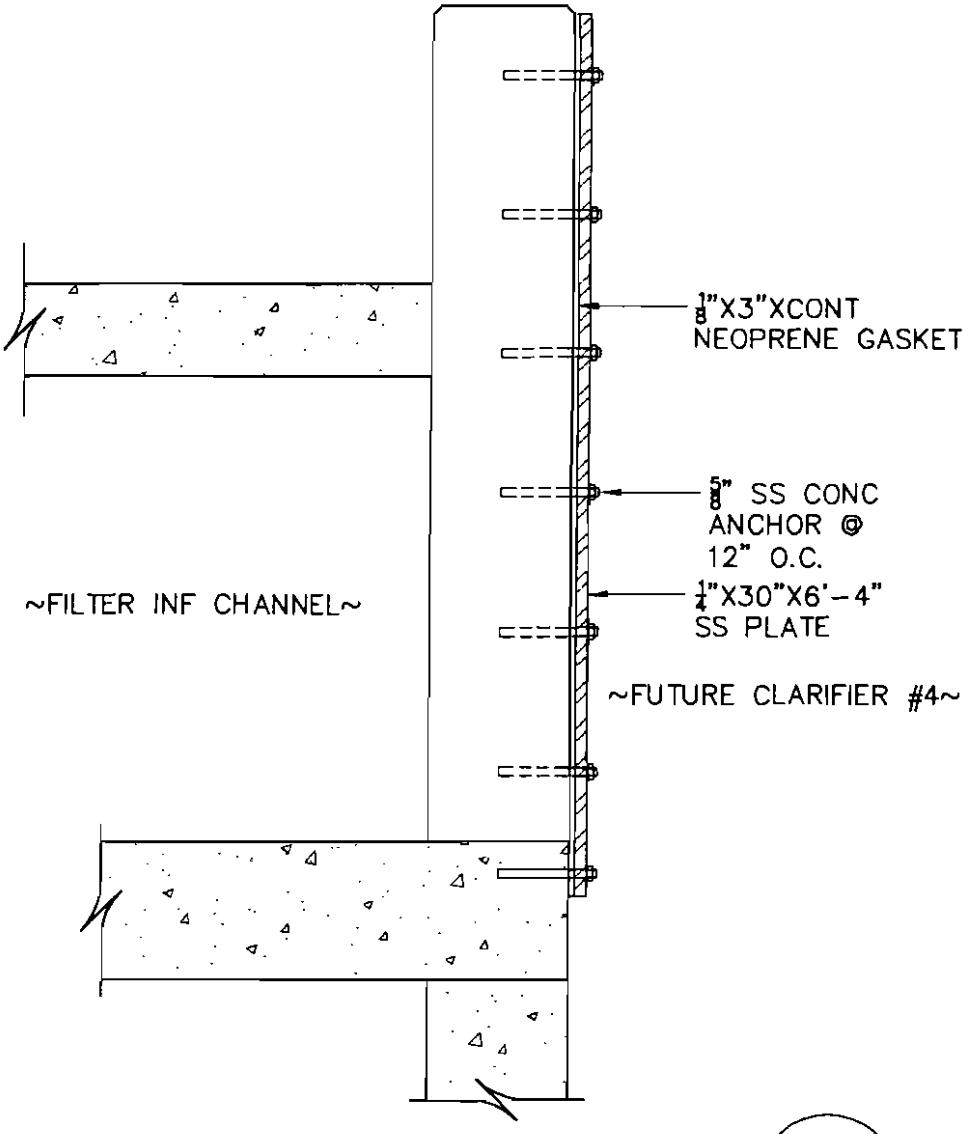
SCALE: 3/4" = 1'-0"

WASHINGTON COUNTY SERVICE AUTHORITY
MIDDLE FORK WTP UGRADE TO 12 MGD
ADDENDUM NO. 1
SECTION S505.6

SCALE: 3/4" = 1'-0"
JOB NO.: 12367.13

SEPT 1, 2010

OLVER INCORPORATED



SECTION

SCALE: 3/4" = 1'-0"

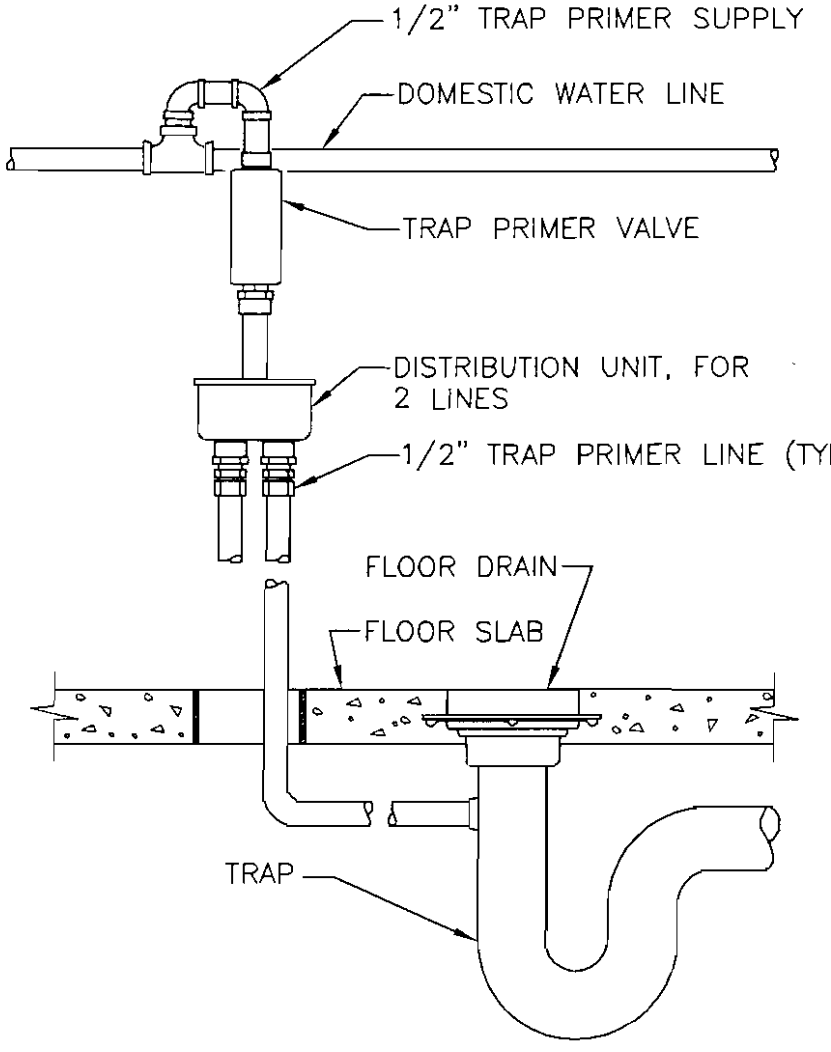
S505.7
S209

WASHINGTON COUNTY SERVICE AUTHORITY
MIDDLE FORK WTP UPGRADE TO 12 MGD
ADDENDUM NO. 1
SECTION S505.7

SCALE: 3/4"=1'-0"
JOB NO.:12367.13

SEPT. 1, 2010

OLVER INCORPORATED



TRAP SEAL PRIMER DETAIL

SCALE: NO SCALE

M006.5
TYP

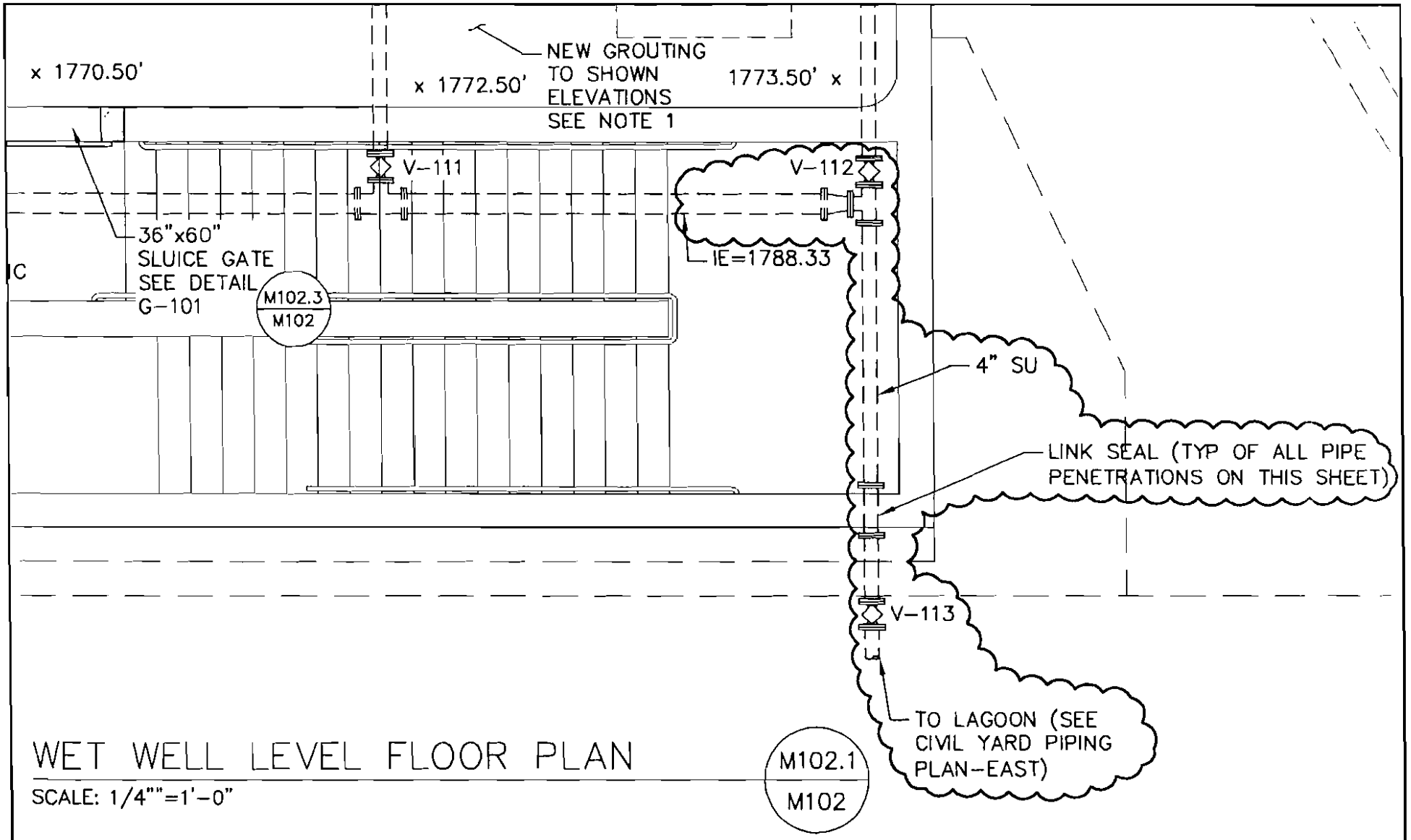
WASHINGTON COUNTY SERVICE AUTHORITY
MIDDLE FORK WTP UPGRADE TO 12 MGD
PLUMBING DETAIL

ADDENDUM 1

SCALE: NTS
JOB NO.:12367.13

SEP 2010

OLVER INCORPORATED



WET WELL LEVEL FLOOR PLAN

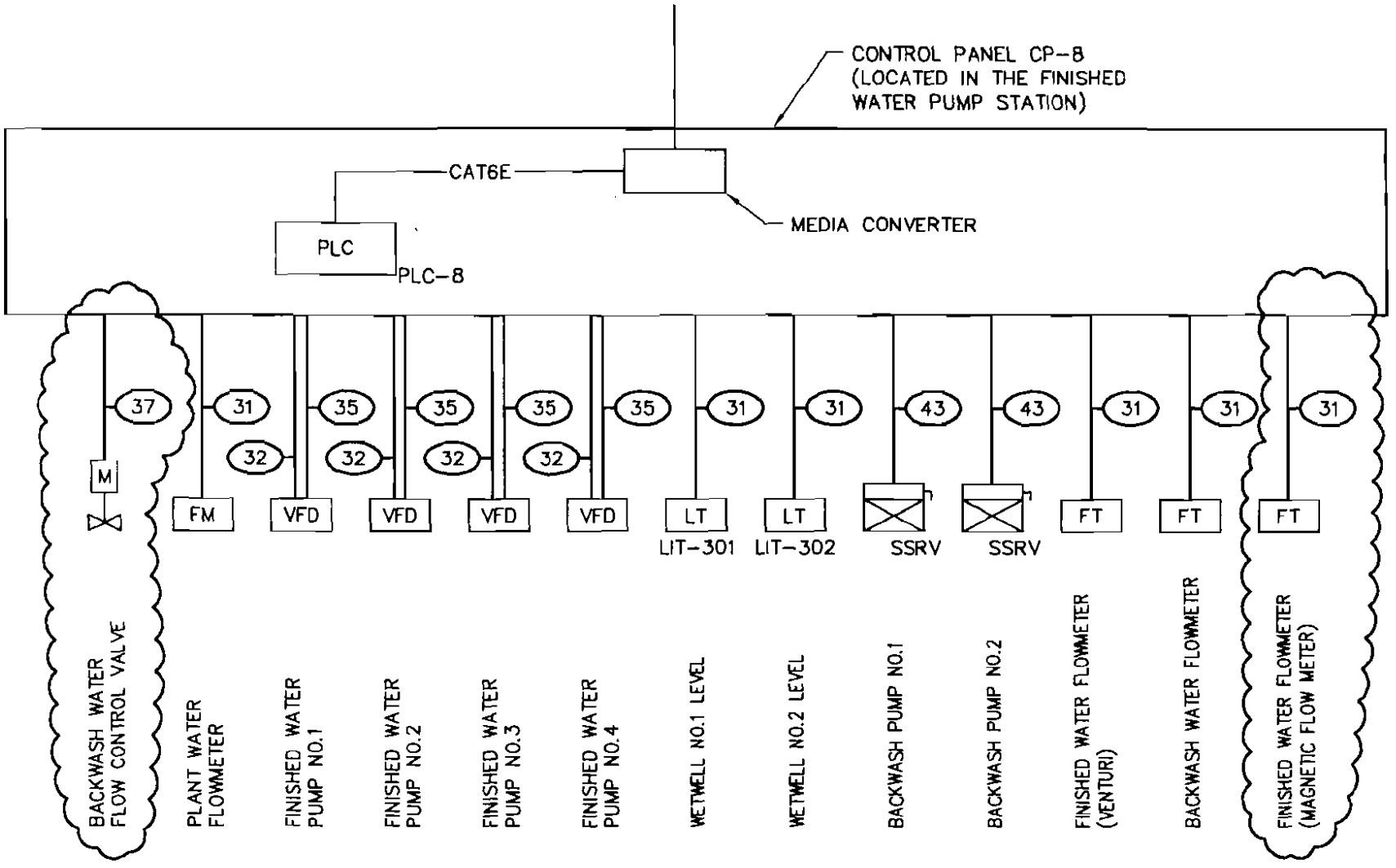
SCALE: 1/4""=1'-0"

WASHINGTON COUNTY SERVICE AUTHORITY
MIDDLE FORK WTP UPGRADE TO 12 MGD
RAW WATER PUMP STATION IMPROVEMENTS
ADDENDUM 1

SCALE: AS SHOWN
JOB NO.:12367.13

SEP 2010

OLVER INCORPORATED



WASHINGTON COUNTY SERVICE AUTHORITY
MIDDLE FORK WTP UPGRADE TO 12 MGD
E003 - SCADA SYSTEM DIAGRAM

ADDENDUM 1

SCALE: NTS
JOB NO.: 12367.13

SEP 2010

OLVER INCORPORATED