



### ADDENDUM NO. 1

This Addendum No.1 consists of 79 pages. The following revisions shall be made to the CONTRACT DOCUMENTS. The Bidder shall acknowledge receipt of this Addendum No. 1 as required by ARTICLE 13.07 of EJCDC C-200, Suggested Instructions to Bidders for Construction Contracts and Article 3.01. A of EJCDC C-410, Bid Form for Construction Contracts.



#### QUESTIONS:

1. **Question:** Can the bid date for this project be extended?

**Response:** No, at this time there is no reason to extend the bid opening date. The bids are due on October 28, 2016 at 11 AM.

2. **Question:** Can you furnish CAD drawings to assist in calculating earthwork quantities?

**Response:** CAD drawings for grading sheets will be added to the City's website. Please note that these CAD files are provided for your benefit and should be utilized only for determining earthwork quantities.

3. **Question:** Does the City follow International Building Code (IBC) 2003 edition?

**Response:** Yes, the City follows IBC 2003.

4. **Question:** Do Prevailing Wages apply? If so, what is the Wage Assignment?

**Response:** Prevailing Wages (Davis Bacon) does not apply for this project. Wage rate requirements shall be per Article 22 in EJCDC C-200, Suggested Instructions to Bidders for Construction Contracts.

5. **Question:** Provide a link to access Geotechnical Report?

**Response:** Geotechnical Report is now accessible from City of Willcox website.

6. **Question:** The Geotechnical Report indicates that some large tank structures supported near existing grade (4156) within the pond area will have an applied bearing pressure of up to 2,000 psf. Therefore the upper 15 to 20 ft. below these structures supported near existing grade will required ground improvement. This is where GeoPiers can be

used. They could also be supported on drilled shafts – caissons. Some structures, however will bear at depths greater than 10 feet below existing site grades. Depending on the structures design pressure, it may be possible to support the structure on undisturbed native – no GeoPier or Caisson. You can calculate it by taking 120 pcf times the proposed bearing depth in feet below existing grade. If that number is larger than the design bearing pressure, than no improvement is needed. (Page 5 of the Geo Report). Why does the Contractor have to bear the responsibility? It's clearly a design issue. The City of Willcox Engineers can now compute and tell the bidders which structures require Geopiers.

**Response:** All options noted in the question were considered in detail by the Civil, Structural, and Geotechnical Engineering design team in consultation with specialty firms that are experienced in challenging foundation work. It was concluded that the ground improvement by the Rammed Aggregate Piers (RAP) was the most suited and cost effective option for all the structures/buildings in this project. Please refer to note " Assume existing soil requires ground improvement for an allowable bearing pressure of 3000 psf. For ground improvements, see specification section 02452-Rammed Aggregate Pier foundation system" on all structural plan view sheets. Contractor is responsible to ensure that the bearing capacity on which the structural design is based is available with these ground improvement measures.

7. **Question:** Page 11 of Geotechnical Report suggest 2 ft diameter Geopier elements, placed at a depth of 15 to 20 feet, placed on a 7 to 8 foot center-to-center grid. The 20 foot depth will keep the piers out of ground water. The report also suggested additional borings within the footprint of the proposed tank structures will be necessary to finalize the design. Where are the additional borings?

**Response:** Additional borings are recommended to confirm and/or modify engineering recommendations made in the Geotechnical Report. For bidding purposes, please follow the recommendations provided by Geopier Foundation Company Inc (GFC) of having 24-inch diameter RAP elements to a depth of 15 to 20 feet, placed on a 7 to 8 foot center-to-center grid to reduce settlements to less than 1 ½ inches beneath the planned structures.

8. **Question:** The oxidation ditch flow control structure drawing S 2-1, does not specifically reference subgrade preparation, but all of the other process structures referenced in Drawings S 2-2, and S-3 through S-10, plus the slab on grade and shallow footing structures shown on Drawings S-11 through S-13 reference Spec 02452, Rammed Aggregate Pier Foundations ?

**Response:** All structures including oxidation ditch flow control structure shown on S 2-1, shall have RAP foundation per specification 02452. It was an oversight that the note was not shown on Sheet S 2-1.

9. **Question:** Please clarify the foundation preparation requirement; specifically, please define which structures require RAP, which structures require 3' of over excavation and engineered fill and if small equipment and/or stair pads require over excavation and re-compaction or ABC subgrades?

**Response:** All structures require RAP. Please refer to note "Assume existing soil requires ground improvement for an allowable bearing pressure of 3000 psf. For ground improvements, see specification section 02452-Rammed Aggregate Pier foundation system" on all structural plan view sheets. Contractor is responsible to ensure that the bearing capacity on which the structural design is based is available with these ground improvement measures.

10. **Question:** The fact that RAP designer/Contractor is sole sourced, and the magnitude of its subcontract is significant in relation to the total Bid, offer the opportunity for the RAP designer/Contractor to sway the outcome of the bidding process if it were to show favoritism to a specific contractor. It would be beneficial to all concerned if Bid Item # 25, Rammed Aggregate Pier Foundation, be designated as an allowance?

**Response:** The RAP designer/Contractor is not sole sourced. Please refer to Section 1.4 of Specification 02452 – Rammed Aggregate Pier Foundation Systems.

11. **Question:** Drawings S 2-2, the oxidation ditches, show no construction, expansion, or contraction joints other than those between the walls and the slabs and between the walls and the decks. These joints are typically an integral part of the structural design. Please define the joint types and locations or the parameters which the Contractor may use to designate joint locations?

**Response:** Please see markups on attached Sheet S 2-2 for construction joints in the slab of the oxidation ditch.

12. **Question:** Drawings S 3-2, the clarifiers, and Drawing S 10-1, the sludge holding tank, show a construction joint sequence with 13 separate concrete placements for the slabs on grade, but no joints in the circular walls. Please define the joint types and locations or the parameters which the Contractor may use to designate joint locations?

**Response:** Maximum length of wall pours is 40 feet as stated on Sheet S-2, Concrete, 3.01F. Joints in the wall need not match those in the floor.

13. **Question:** None of the drawings for the other process structures show any construction joints. Are construction joints allowed in these structures?

**Response:** Please see markups on attached sheets S 11-2 and S 13-1 for joints in the slabs. Dimensions of other structures are within normally accepted limits of pours without construction joints.

14. **Question:** Are the "Suggested Instructions to Bidders for Construction Contracts" part of the official bid documents? The word "suggested" is misleading.

**Response:** Yes the "Suggested Instructions to Bidders for Construction Contracts" is part of the official bid documents.

15. **Question:** Article 12 of the above referenced Suggested Instructions to Bidders requires the apparent Successful Bidder, and any other Bidder requested, to submit a list of subcontractors or suppliers and their qualification statements within 5 days after the Bid Opening. Article 7 of the Bid Form requires the Bidder to submit a list of its proposed subcontractors and suppliers with the Bid. Which requirement is correct?

**Response:** Please follow Article 12 of EJCDC C-200, Suggested Instructions to Bidders for Construction Contracts.

16. **Question:** The qualification statement, required to be submitted by Article 7 G of the Bid Form, is an arduous task and unrealistic with respect to trying to attain the information from subcontractors during the final hours of the Bid preparation. We respectfully request that the information referenced above be allowed to be submitted within 5 days of the Bid Date, as suggested by Article 12 of the "Suggested Instructions to Bidders"?

**Response:** Ok, Please follow Article 12 of EJCDC C-200, Suggested Instructions to Bidders for Construction Contracts.

17. **Question:** For clarification, it will be in the CONTRACTOR's HMI Programmer's scope to develop and incorporate HMI screens into the Plant SCADA system?

**Response:** Yes.

18. **Question:** Specification Section 17450, 2.2.B, Windows XP is no longer a supported Operating System by Microsoft. Will utilize GE Recommendation of OS for current version of iFix?

**Response:** Specification Section 17450 has been revised to current standards. WonderWare will be the HMI platform.

19. **Question:** Specification Section 17455 –OIT specification is missing from spec referenced in 17456.

**Response:** Specification Section 17455 is added in this addendum.

20. **Question:** Specification Section 17450.3.2.A.1 – PC Anywhere is no longer a viable product. (<http://www.symantec.com/connect/blogs/pcanywhere-eol>) If there is (or will be) Internet available at site, we would recommend a Sonic Wall VPN solution be specified as a more secure Remote Access option

**Response:** Specification Section 17450 has been revised to current standards.

21. **Question:** We do not see any Alarm Notification Software (i.e, Win -911) in the specification, is it the desire not to have dial out alarm notification?

**Response:** Specification Section 17450 has been revised to include Alarm Notification Software and Hardware.

**SPECIFICATIONS:**

1. Specification 11328 – SEPTAGE RECEIVING STATION

- a. **REPLACE** Specification 11328 with Revised Specification 11328.
  - i. Section 2.11, D, 6, “Cabinet Air Conditioner with Thermostat (for outdoor installations)” **ADDED**.
  - ii. Section 2.12, G, 1, section revised. PLC platform revised to match Plant PLC.
  - iii. Section 2.12, G, 3, section revised. Ethernet Switch revised to match Plant Ethernet Switches.
  - iv. Section 2.12, H, 1, section revised to include “and Air Conditioner as required.

2. Specification 11335 –SECONDARY CLARIFIER MECHANISM

- a. Page 11335-15, Section 2.13.B: **DELETE** 36-inches and **REPLACE** with 20-inches
- b. Page 11335 -18, Section 2.18.B: **DELETE** Series WH02 (tank white Potapox; one coat, 4-6mils DFT) and **REPLACE** with Tnemec Series N69 - one coat, 6-8 dry mils per coat.
- c. Page 11335-18, Section 2.19.A.8: **DELETE** 2.19.A.8 in its entirety.

3. Specification 11362 – ROTARY SCREW PRESS

- a. **REPLACE** Specification 11362 with Revised Specification 11362.
  - i. Section 2.5, A, section revised to include verbiage to define conduit entry limitations.

- ii. Section 2.5, B, IEC rated motor starters revised NEMA rated motor starters.
- iii. Section 2.5, C, 2, Wiring, power and control wiring shall be MTW. THHN/THWN wire is not allowed in panels as per UL508 standards.

4. Specification 11375 – OXIDATION DITCH

- a. **REPLACE** Specification 11375 with Revised Specification 11375.
  - i. Section 2.3, C, “Operating ambient temperature range without derating: 0 degrees C to 40 degrees C (32 degrees F to 104 degrees F). Operating relative humidity range shall be 5% to 95% non-condensing.” added.
  - ii. Section 2.3, D, 3, Human Machine Terminal, section revised.
  - iii. Section 2.3, D, 4, Ethernet Switch, section **ADDED**.
  - iv. Section 2.3, G, 1, b, 4-20mA communications added.
  - v. Section 2.3, H, 16, section revised.
  - vi. Section 2.3, H, 18, bypass contactor shall be NEMA Rated.

5. Specification 16111 – CONDUITS

- a. **REPLACE** Specification 16111 with Revised Specification 16111.
  - i. Section 2.4 Intermediate Conduit removed.

6. Specification 16420 – SERVICE ENTRANCE SECTION

- a. Specification 16420, Section 2.1, K, **ADD** “Or Equal”.

7. Specification 16495 – AUTOMATIC TRANSFER SWITCH

- a. Specification 16495, Section 2.1, A, **ADD** “Or Equal”.

8. Specification 16611 – STATIC UNINTERRUPTIBLE POWER SUPPLY

- a. **REPLACE** Specification 16611 with Revised Specification 16611.
  - i. “Or Equal” added to Section 2.1, A.
  - ii. Section 2.1, A, revised to include “Relay I/O card to monitor UPS Trouble, on UPS Battery. Contacts to be wired to Digital Inputs on PLC.
  - iii. Section 2.1, H, **ADDED**

9. Specification 16912 – ETHERNET NETWORK EQUIPMENT

- a. **REPLACE** Specification 16912 with Revised Specification 16912.
  - i. Section 2.1, C, Ethernet Switch part numbers revised.
  - ii. Section 2.2, Ethernet Cable revised to “CAT 6”.

10. Specification 17120 – PRESSURE TRANSMITTERS

- a. Specification 17120, Section 1.4, A, **ADD** “Or Equal”

11. Specification 17450 – HUMAN MACHINE INTERFACE SOFTWARE AND HARDWARE

- a. **REPLACE** Specification 17451 with Revised Specification 17451.
  - i. Section 2.1, A, REMOVE “or Dial up modem connection.
  - ii. Section 2.2, A, REMOVE “or Dial up modem connection.
  - iii. Section 2.2, B, revised Windows XP to Windows 10.
  - iv. Section 2.2, J, revised to read 1920 x 1080 pixels.
  - v. Section 2.2, P, revised.
  - vi. Section 2.3, revised to current standards.
  - vii. Section 2.4, revised.
  - viii. Section 2.5, revised.
  - ix. Section 3.2, revised.
  - x. Section 3.3, revised.

12. Specification 17451 – PROGRAMMABLE LOGIC CONTROLLER SYSTEM

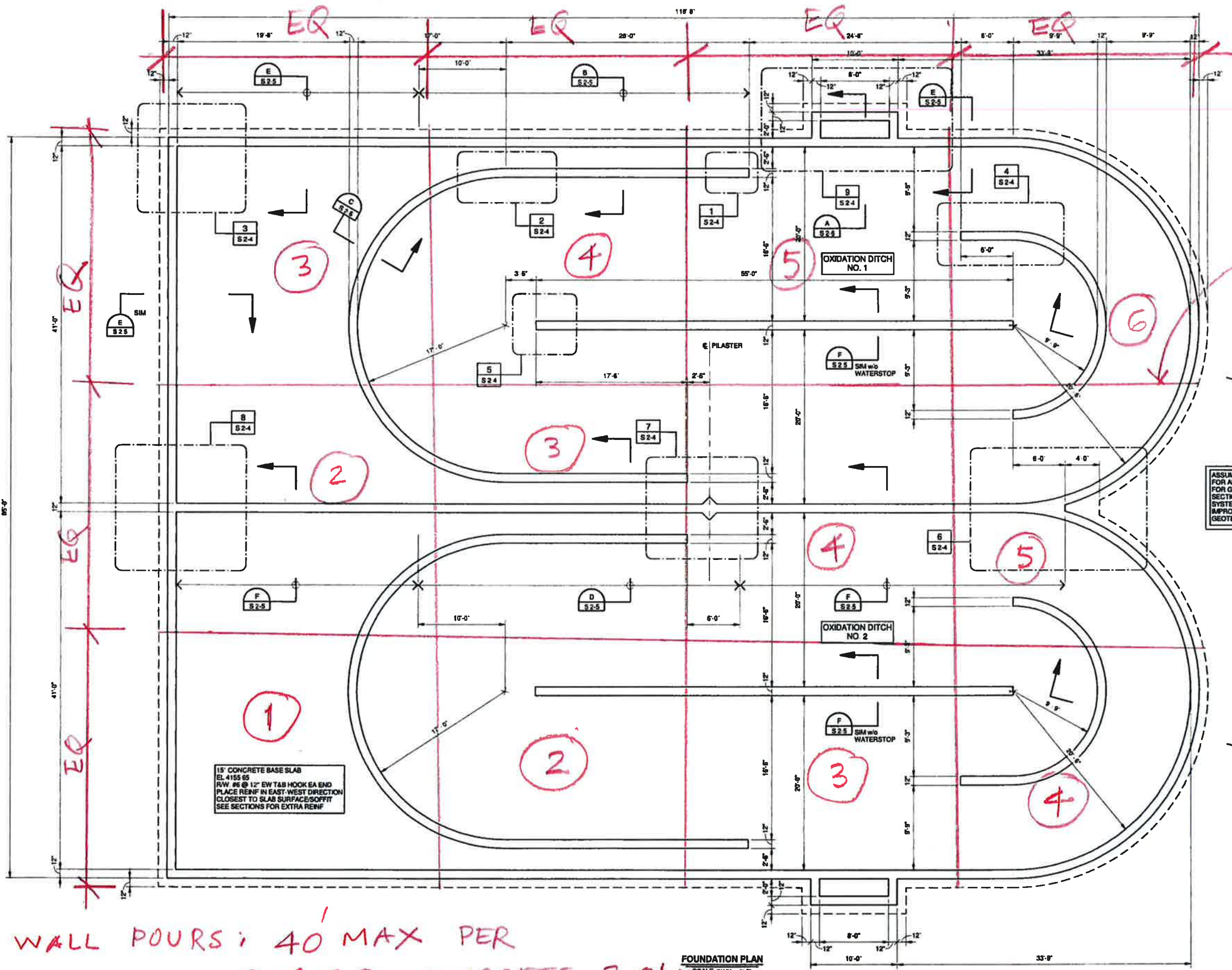
- a. **REPLACE** Specification 17451 with Revised Specification 17451.
  - i. Section 2.6, A, PLC part numbers revised.
  - ii. Section 2.8, A, reference to OIT Specification 17455 added.
  - iii. Section 3.1, E, Flash Memory Card requirements added.

13. Specification 17455 – OPERATOR INTERFACE TERMINAL SOFTWARE AND HARDWARE

- a. **ADD** Specification 17455 - OPERATOR INTERFACE TERMINAL SOFTWARE AND HARDWARE.

**END OF ADDENDUM NO. 1**





ASSUME EXISTING SOIL REQUIRES GROUND IMPROVEMENT FOR AN ALLOWABLE BEARING PRESSURE OF 3000 PSF FOR GROUND IMPROVEMENTS SEE SPECIFICATION SECTION 02452-RAMMED AGGREGATE PIER FOUNDATION SYSTEM. ACTUAL EXTENT OF BEARING SUBGRADE REQUIRING IMPROVEMENT SHALL BE CONFIRMED IN THE FIELD BY A GEOTECHNICAL ENGINEER.

① etc.  
POUR  
NUMBERS

WALL POURS: 40' MAX PER  
DWG S-2, CONCRETE, 3.01

FOUNDATION PLAN  
SCALE 3/16" = 1'-0"

- NOTE: FOR SITE LOCATION PIPE PENETRATIONS, HANOVER'S LOCATIONS & CONCRETE PILES (FLEETS ETC.) SEE PROCESS DWG'S.
- NOTE: FOR TYPICAL CONSTRUCTION JOINTS, SEE TYPICAL DETAILS ON DWG S-5.
- NOTE: (7) NO GATES DIMENSION TO BE DETERMINED BASED UPON EQUIPMENT MANUFACTURER'S SELECTED.
- NOTE: VERIFY SIZE & LOCATION OF ALL OPENINGS IN CONCRETE SLAB WALLS WITH ALL OTHER DISCIPLINES PRIOR TO START OF CONSTRUCTION.
- NOTE: CONTRACTOR TO COORDINATE OPENINGS OVER EXISTING TRACK EMBLEMMENTS. GROUT SOCKET'S AT SLICE GATES & OPERATOR PENETRATIONS - APPROVED GATE WITH DROP DWGS PRIOR TO FABRICATION SEE TYPICAL DETAILS ON DWG S-5 FOR REF.

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CITY OF WILLCOX  
WASTEWATER TREATMENT PLANT  
OXIDATION DITCH  
FOUNDATION PLAN

WILSON PROJECT NO. 11004

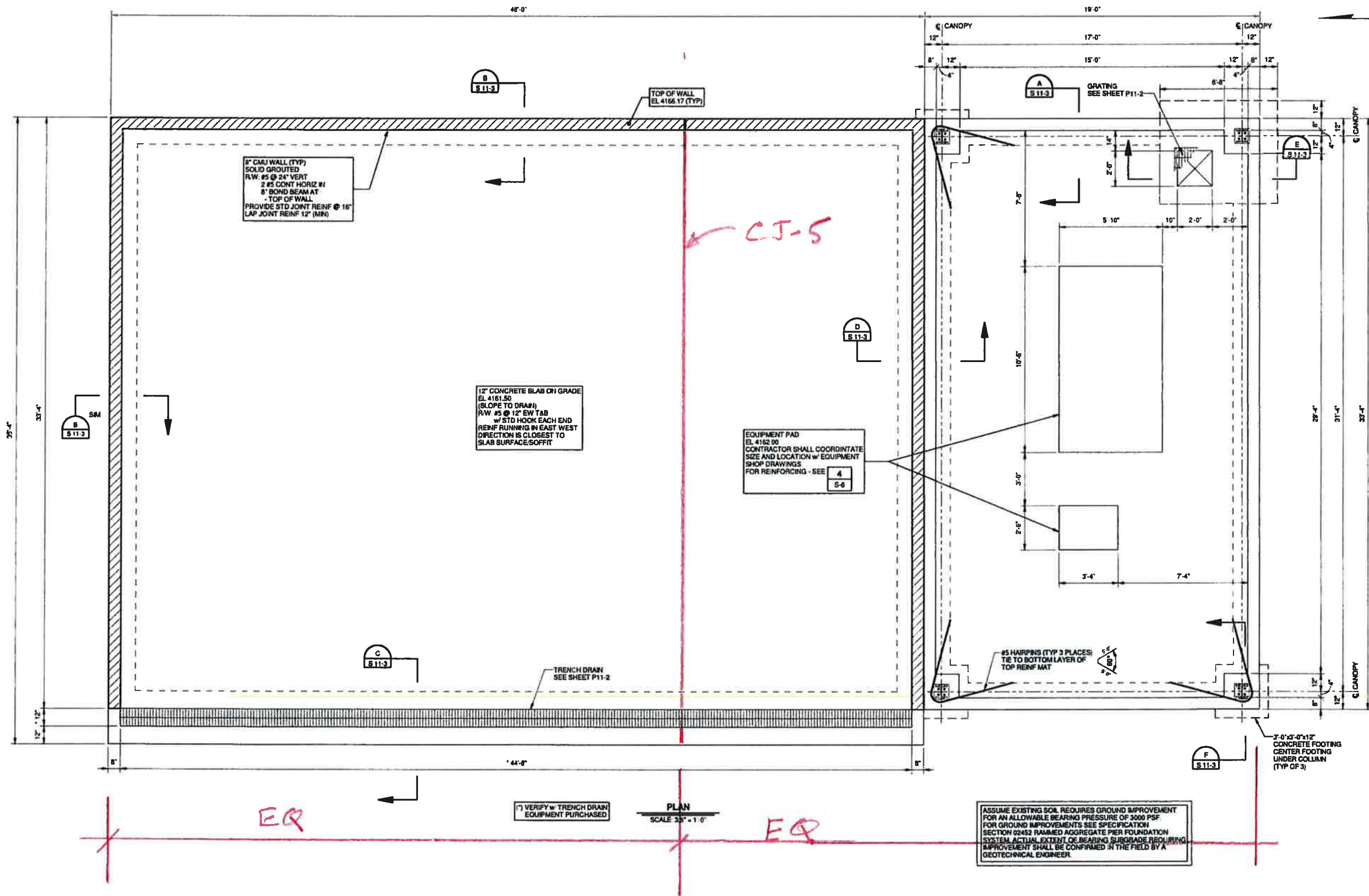
Design:	Drawn:	Checked:
SJM	Wilson	Project No. 11004
Date:	Date:	Description:
08/28/14		
Revision:	Date:	By:

VERIFY SCALES  
BAR IS ONE INCH ON ORIGINAL DRAWING  
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

21007  
STANDARD  
WATERMARK

Sheet No. S 2-2





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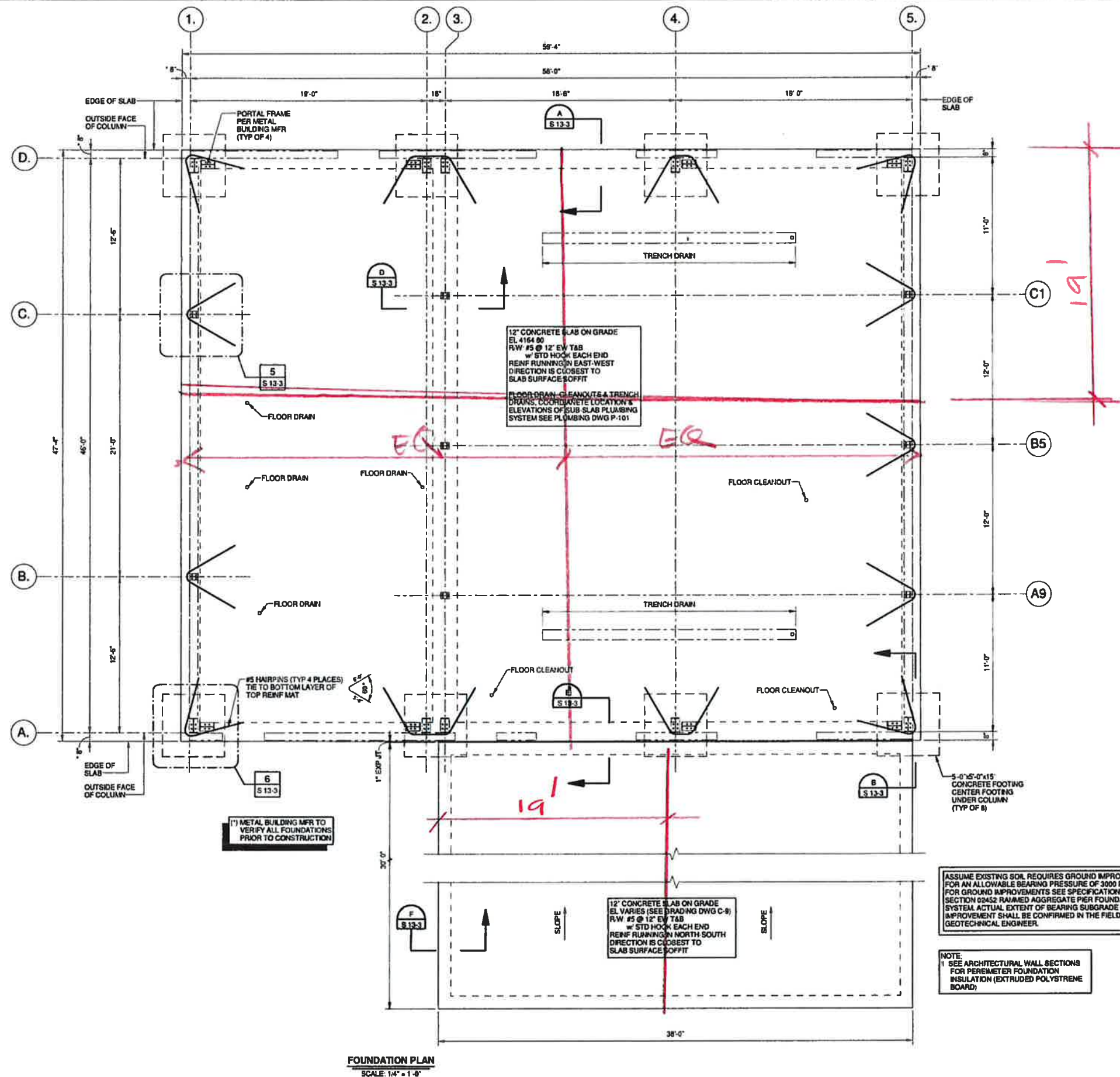
CITY OF WILCOX  
WASTEWATER TREATMENT PLANT  
DEWATERING AREA  
PLAN  
WILSON PROJECT NO. 11004

Design:	SUN	Drawn:	DG	Checked:
Date:	08/20/14	Wilson Project No. 11004		
Revision	Date	Description	By	

VERIFY SCALES  
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SCALES ACCORDINGLY



Sheet No. S 11-2



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

ASSUME EXISTING SOIL REQUIRES GROUND IMPROVEMENT FOR AN ALLOWABLE BEARING PRESSURE OF 3000 PSF FOR GROUND IMPROVEMENTS SEE SPECIFICATION SECTION 0545: RAISED AGGREGATE PIER FOUNDATION SYSTEM. ACTUAL EXTENT OF BEARING SUBGRADE REQUIRING IMPROVEMENT SHALL BE CONFIRMED IN THE FIELD BY A GEOTECHNICAL ENGINEER.

NOTE:  
1. SEE ARCHITECTURAL WALL SECTIONS FOR PERIMETER FOUNDATION INSULATION (EXTRUDED POLYSTYRENE BOARD).

NOTE:  
FOR SITE LOCATION, PIPE PENETRATIONS, MANHOLE LOCATIONS & CONCRETE PILES (PILERS), ETC. SEE PROCESS DWGS.

NOTE:  
FOR TYPICAL CONSTRUCTION DETAILS SEE TYPICAL DETAILS ON DWG S-5.

NOTE:  
"1" INDICATES DIMENSION TO BE DETERMINED BY FIELD SURVEYOR OR EQUIPMENT MANUFACTURER SELECTED.

NOTE:  
VERIFY SIZE & LOCATION OF ALL OPENINGS IN CONCRETE SLAB WALLS WITH ALL OTHER DISCIPLINES PRIOR TO START OF CONSTRUCTION.

NOTE:  
CONTRACTOR TO COORDINATE OPENING DIMENSIONS, TRACK EMBEDMENTS, GROUT SOCIETY'S AT SLURRY GATES & OPERATOR PENETRATIONS & APPROVED GATE SURF INP. PRIOR TO FABRICATION. SEE TYPICAL DETAILS ON DWG S-5 FOR NEW.

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CITY OF WILLCOX  
WASTEWATER TREATMENT PLANT  
O&M BUILDING  
FOUNDATION PLAN  
WILSON PROJECT NO. 11004

Design:	Drawn:	Checked:
SUN	Wilson	Project No. 11004
Date:	08/20/14	
Revision	Date	Description

VERIFY SCALES  
BAR IS ONE INCH ON ORIGINAL DRAWING  
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY



Sheet No. S 13-1

## SECTION 11328

### SEPTAGE RECEIVING STATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section of the Specification describes the Septage Receiving System(s) with grinder, auger, and motor controller. The equipment shall be installed as shown on the Plans, as recommended by the supplier and in compliance with all OSHA, local, State, and Federal codes and requirements.
- B. The Septage Receiving System shall have a nominal capacity of 400 gpm flow of typical septage.
- C. The Septage Receiving System shall meet all required standards for a positive connection between a truck and a sewer pipe.
- D. The unit shall include a screen or a filter, an electrically actuated control inlet valve, a magnetic flow meter, a solids washing tank with spray wash assembly, a screenings screw conveyor, liquid level sensing system, local control panel and motor controller with data collection features.

##### 1.2 REFERENCES

- A. Septage Receiving System(s) shall, as applicable, meet the requirements of the following industry standards:
  - 1. American Society for Testing and Materials (ASTM) A 36: Standard Specification for Carbon Steel Plate.
  - 2. American Society for Testing and Materials (ASTM) A 536-84: Standard Specification for Ferritic Ductile Iron Castings.
  - 3. American Society for Testing and Materials (ASTM) B-16.42-1979: Standard Specification for Class 40 Grey Iron Castings.
  - 4. American Iron and Steel Institute (AISI) 304 Stainless Steel.
  - 5. American Iron and Steel Institute (AISI) 4130 Heat Treated Alloy Steel.
  - 6. American Iron and Steel Institute (AISI) 4140 Heat Treated Hexagon Steel.
  - 7. Rockwell C.

##### 1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
  - 1. Letters of Certification of Compliance on materials, equipment, etc.
  - 2. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.

3. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, and lists of erection details.
  4. Materials of construction of all components.
  5. The formal test protocol for use during performance testing, if required.
  6. Schematic and hiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. When the integrated systems required interlocking and control of other components in normal operation, these components shall be included in the description of operation.
- B. Operation and Maintenance Manuals: Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals Section of Section 01300, Submittals.

#### 1.4 QUALITY ASSURANCE

- A. Qualifications:
1. Qualified suppliers shall have a minimum five years experience at manufacturing two-shafted grinding equipment, inclined augers, and motor controls with a minimum of 10 installations with similar equipment. Supplier shall provide a list of names and dates of installations for verification by the ENGINEER or OWNER'S representative.
- B. Regulatory Requirements: Motor controllers shall, as applicable, meet the requirements of the following regulatory agencies.
1. National Electrical Manufacturer's Association (NEMA) Standards.
  2. National Electrical Code (NEC).
  3. Underwriters Laboratory (UL).

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. The equipment shall be packaged in containers constructed for normal shipping, handling, and storage.
- B. The containers shall provide adequate protection for the equipment in an outdoor environment between  $-7^{\circ}$  F and  $+110^{\circ}$  F until time for installation.

#### 1.6 IDENTIFICATION

- A. Each unit of equipment shall be identified with a corrosion resistant nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, supplier's name, and location.



## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. The Septage Receiving System(s) shall be in compliance with these Specifications and Plans, and shall be supplied by one of the following manufacturers:
  - 1. Lakeside,
  - 2. Huber,
  - 3. Enviro-Care,
  - 4. Or approved equal.
- B. The naming of a manufacturer in this Section is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified.

### 2.2 SEPTAGE RECEIVING SYSTEM

- A. General:
  - 1. The Septage Receiving System shall be a septic waste processing system that shall effectively separate, wash, and dewater septic waste that has been delivered to the system by waste delivery vehicles. The system shall be fitted with a 4-inch male cam and groove connector to accommodate connection to delivery vehicles.
  - 2. An electrically actuated plug valve shall control the flow of material into the system and a flow meter shall measure the volume of material discharge into the system. The material shall pass into a tank containing an auger. Solid particles shall be trapped by a perforated screen or filter. The particles shall be washed by spray wash system using reclaimed water.
  - 3. The soft organics and wash water shall pass through the perforations and be discharged from the tank liquid drain. The captured and cleaned solids shall be conveyed and dewatered as they are transferred to the auger discharge.
  - 4. A data collection system shall read hauler information from magnetic swipe cards. The motor controller PLC shall authenticate card data against stored information, and ready the entire system for use. The operator shall depress START and STOP pushbuttons to activate/de-activate the system during truck discharge. The PLC shall record the volume of material discharged from each truck and save the data to a storage memory within the controller. The system shall be capable of uploading transaction data to a PC using an RS-232/Hyperterminal data connection. Data shall be formatted in a delimited text file format suitable for import into a spreadsheet software program. A printer shall make a transaction receipt available to the operator, showing the date, time, hauler number and transaction volume.
- B. Components:

1. The Septage Receiving System shall include the inlet piping, motor actuated inlet valve, flow meter, tank with a level sensor, spray wash assemblies, auger, and motor controller with data collection features.

## 2.3 INLET PIPING ASSEMBLY

### A. General:

1. An inlet piping system shall provide interconnection between the inlet cam and groove fitting and the tank, and accommodate all necessary appurtenances, including plug valves and flow meters. Neoprene gaskets and stainless steel fasteners shall be used for interconnection and all dissimilar metals shall be dielectrically isolated.

### B. Components:

1. A 4-inch cast aluminum male cam and groove fitting with a Class 150 flange adapter shall be provided for connection to influent feed hoses. A cam and groove dust cover shall be provided for odor containment when the system is not in use.

## 2.4 METAL ROCK TRAP ASSEMBLY

### A. General:

1. A metal rock trap shall be used to catch large objects that could jam the screen or obstruct the pipes in the system.

### B. Components:

1. The metal rock trap shall be constructed of an ANSI 316 stainless steel tank, access cover and stand.
  - a. The tank shall have a tapered bottom connected to a release valve.
  - b. The tank shall have on the inlet and outlet 4-inch Class 150 flanges.
2. A manual knife valve shall be used to open the bottom of the trap to release the captured objects into the drain pan below the trap.
3. Alternatively, a rock trap cleanout can be used. The cleanout spanning the full width of the tank bottom with access from either side of the tank shall be constructed of ANSI 316 stainless steel and be installed upstream from the screen enabling removal of rocks and other debris. Both ends of the cleanout shall be furnished with 8-inch NPT threads. An 8-inch schedule 80 threaded stainless steel pipe cap shall be mounted on one end and an 8-inch aluminum cam & groove male adapter with water tight dust cap on the opposite end.

## 2.5 PLUG VALVE

### A. General:

1. An electrically actuated valve shall be installed in the inlet piping system.
2. The valve shall open when the START pushbutton is depressed. The valve shall close when the STOP pushbutton is depressed.



3. In the AUTO mode the plug valve shall open and close as controlled by the level inputs to the PLC from the analog ultrasonic transducer mounted on the tank.
4. The plug valve shall conform to the requirements of Section 11295, Hydraulic Valves, and have a minimum port area percentage of 88%.

B. Components:

1. Valve Body:
  - a. Valve diameter shall be sized to match the diameter of the inlet piping system as shown in the Drawings.
  - b. The valve throat shall be coated with a corrosion-resistant material.
  - c. Flange fittings connected to dissimilar metals shall be dielectrically isolated.
2. Actuator:
  - a. The electric actuator shall conform to the requirements of Section 11290, Actuators, and ANSI/AWWA C540.
  - b. Actuator housing shall be rated NEMA 4X.
  - c. The valve shall be actuated with 120 volt power from the controller.
  - d. Valve shall be fitted with relay-contacts indicating fully open and fully closed positions.
  - e. The valve actuator shall be cycled at the factory per AWWA C540.
  - f. The valve actuator shall be manufactured by Rotork Controls Ltd. or approved equal.

## 2.6 FLOW METER

A. General:

1. A magnetic flow meter shall be installed in the inlet piping system between the plug valve and the septage-receiving tank. Refer to Specification 17137 for Magnetic Flow Meter requirements.
2. The flow meter shall provide a 4-20mA output to the control panel providing accurate flow rate measurement for the controller billing system.
3. The flow tube shall match the size as shown in the Drawings.
4. Flow Tube and Element:
  - a. The flow tube liner shall be made of polyurethane or PFA.
  - b. Electrode material shall be 316 or 316L stainless steel.
  - c. The flow tube shall be rated for usage over a temperature range of 32° F to 104° F (0° C to 40° C).
  - d. The manufacturer shall supply all the necessary hardware for the installation of the flow meter element including, but not limited to, flange gaskets, grounding straps or rings, fasteners, and lifting lugs.
5. Transmitter:
  - a. The integrally mounted flow meter transmitter shall be rated for Class 1 Division 1 service (explosion-proof).

- b. The transmitter shall be capable of empty pipe detection with associated display and configurable discrete output.
- c. The transmitter shall be rated for usage over a temperature range of 32° F to 104° F (0° C to 40° C).

## 2.7 RADAR LEVEL TRANSMITTER

- A. Refer to Specification 17125 for Radar Level Transmitter requirements.

## 2.8 TANK

- A. Tank shall be 10 gauge (0.1345-inch) thick, AISI 316 stainless steel. The tank shall include supports for the mounting of two spray wash systems.
- B. The tank shall have a straight-pipe liquid discharge port.
- C. The tank shall provide an inspection cover for access to the auger.
- D. The tank cover shall have a 4-inch minimum vent and removable cap.
- E. The tank shall provide a mounting receptacle for the ultrasonic transducer.

## 2.9 SPRAY WASH ASSEMBLIES

- A. General:
  - 1. Two spray wash assemblies shall be mounted in the tank to provide wash water for the auger screen trough. The spray wash shall rinse the organic material from the processed solids back into the waste stream.
    - a. The upper spray wash manifold shall be positioned to direct spray onto the walls of the tank and the screen trough.
    - b. The lower spray wash manifold, located on the bottom side of the screen trough shall spray onto the perforations of the trough ensuring the perforations remain open.
  - 2. Spray wash solenoid valves shall be automatically energized by the system controller allowing wash water to spray into the screen trough whenever the auger spiral is in operation. The spray wash solenoids shall be automatically de-energized, stopping the flow of wash water whenever the auger spiral is stopped.
- B. Components:
  - 1. The spray wash assemblies shall consist of a 1-inch spray wash manifold, solenoid operated valve, manually operated ball valve, and Y strainer.
  - 2. The spray wash manifolds shall be of ANSI 304 stainless steel pipes and fittings.
  - 3. The solenoid valves shall be bronze construction, fitted with an explosion proof enclosure, housing a 120 volts AC coil.

4. The manually operated ball valves shall be ANSI 316 stainless steel and shall provide adjustment for the spray wash water flow.
5. The Y-strainers shall be bronze material, with a 20 mesh ANSI 304 stainless steel screen and a plugged blow-off outlet.

## 2.10 SCREENING CONVEYOR

### A. General:

1. The dewatering screw shall be designed to transport and dewater the screened material. Screw flights shall be all AISI 316 stainless steel construction with a minimum thickness of 3/16-inch with increased 3/8-inch thick minimum thickness in the screenings collection trough and in the compaction and dewatering zone.
2. Drainage holes shall be provided along the entire length of the screenings collection trough invert to allow for gravity drainage of wash water without flushing screenings out of the trough.
3. The auger shall be installed at an inclination of 35 degrees from horizontal.

## 2.11 MOTOR CONTROLLER

### A. General:

1. The controller shall provide a data collection system that is accessed by a card reader. Authentication of the access card shall reset the flow meter and ready the system for a metered transaction.
2. All controls necessary for the fully automatic operation of the screen shall be provided.

### B. The electrical control system shall provide for automatic control of the screen via a high liquid level using an ultrasonic liquid level control system in connection with an adjustable time clock to provide a variable time between cleaning operations.

### C. The local-mounted main control panel shall include the following items:

1. Disconnect switch with door handle.
2. Control transformer.
3. Variable frequency drive with overload protection.
4. Modicon M340 programmable logic controller (PLC) to match the Plant PLC.
5. Cabinet heater with thermostat (for outdoor installation).
6. Cabinet Air Conditioner with thermostat (for outdoor installation).
7. Elapsed time meter.
8. Transient voltage surge suppressor.
9. E-Stop pushbutton.
10. Power on pilot light.
11. Screen running pilot light.
12. Overload shutdown pilot light.

13. Drive malfunction pilot light.
14. Screen stand-by pilot light.
15. Overload shutdown pushbutton.
16. Screen hand-off-auto switch.
17. Lower wash system hand-off-auto switch.
18. Screenings wash hand-off-auto switch.
19. Dewatering wash system hand-off-auto switch.
20. Tank wash system hand-off-auto switch.
21. Screen forward-off-reverse switch.
22. Phenolic nameplates.
23. 600 VAC terminal block.
24. Proximity sensor with switching amplifier.
25. Position sensor malfunction pilot light.
26. NEMA 4X stainless steel enclosure.

## 2.12 SECURITY ACCESS SYSTEM

- A. Use of the septage system shall be for authorized dischargers only with access controlled by the control system. Initial activation of the system shall require use of a plant-assigned PIN number (and/or a pre-programmed magnetic swipe card). The system shall be capable of supporting a minimum of 300 authorized dischargers. Activation of the system shall open the inlet control valve permitting septage or scavenged sludges to be discharged into the plant. Upon completion of unloading, a receipt with discharge information shall be printed for each user. If the discharge cycle is stopped due to a fault, the fault information shall be printed on the receipt.
- B. The system shall store hauler authorization criteria in a non-proprietary formatted file located in the storage memory of the operator interface. The hauler authorization criteria file shall be editable on a computer system external of the acceptance control station.
- C. The system shall be capable of securely accepting a modified hauler authorization criteria file electronically from a remote source. The hauler criteria authorization file shall be capable of identifying authorized haulers by name in addition to hauler ID number. The hauler name shall be printed on the receipt and kept in the hauler discharge information data file. Systems that are not capable of identifying the hauler by name shall not be acceptable.
- D. The system shall be capable of a minimum of one (1) year of retention of hauler discharge information. Hauler discharge information shall be kept in a non-proprietary data format.
- E. The system shall retain electronic backup copies of all discharge data in two different locations.

- F. Upon activation of the system, the controls shall provide automatic control of the associated inlet control valve by opening it to allow the hauler to utilize the system. The inlet control valve shall also be automatically controlled with high liquid level conditions in screening chamber using the screen's ultrasonic liquid level control system. If provided, a zero flow empty pipe sensor in the inlet pipe shall allow the controls to automatically close the inlet valve after a pre-determined time period or when the stop button is pressed.
- G. Each acceptance control station shall include the following components:
  - 1. Programmable Logic Controller (PLC).
    - a. The PLC shall be used for control and signal processing functions only.
    - b. The PLC shall be a Modicon M340 to match the Plant PLC.
  - 2. 10" minimum Operator Touch Screen Interface with chemical and UV protective cover over touch screen. Refer to Specification 17455 for Operator Touch Screen Interface requirements.
  - 3. Ethernet Switch. Refer to Specification 17450 for Ethernet Switch requirements.
  - 4. Panel-Mounted Thermal Receipt Printer.
    - a. Printer shall include an auto-cutter device for receipt delivery.
    - b. Provide printer with two (2) spare paper rolls.
  - 5. Emergency Stop Pushbutton.
- H. The components of the acceptance station control panel shall be provided in a NEMA 4X stainless steel enclosure:
  - 1. Provide a cabinet heater and air conditioner as required.
  - 2. Except for the E-Stop pushbutton, mount all hauler-accessible components behind a see-through hinged NEMA 4X cover and all hauler non-accessible components on an interior sub-panel.
  - 3. Enclosure shall be lockable.

## 2.13 SOURCE QUALITY CONTROL

- A. All fabricated steel components shall be ANSI 316 stainless steel completely fabricated in the United States and shall conform to the requirements of "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" published by the American Institute of Steel Construction.
- B. The equipment manufacturer's shop welding shall be performed in accordance with the requirements of the latest edition of ANSI/AWS D1.1 "Structural Welding Code - Steel" published by the American Welding Society.
- C. Fabricate all parts and assemblies from sheets and plates of ANSI 316 stainless steel sheet with a finish conforming to AISI 316 and ASTM A240 or A666, unless noted otherwise. Fabricate all rolled or extruded shapes to conform to ASTM A276. Fabricate all tubular products and fittings to conform to ASTM A269, A351 or A403.

- D. Do all welding in the factory using shielded arc, inert gas, MIG or TIG method. Add filler wire to all welds to provide for a cross section and weld metal equal to or greater than the parent metal.
- E. Bolts, nuts and washers shall be AISI 316 stainless steel furnished in accordance with ASTM A193.
- F. All surfaces that are specified to be machined shall be designed and fabricated to provide a runout of not more than 0.005 inches and concentricity to within 0.005 inches.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Septage Receiving System(s) and motor controller(s) shall be installed in accordance with the supplier's installation instructions, and in compliance with all OSHA, local, State, and Federal codes and regulations.

#### 3.2 MANUFACTURER'S FIELD SERVICE

- A. CONTRACTOR shall provide the following services in addition to any other services specified herein, and required by these Specifications. CONTRACTOR shall coordinate field service work with manufacturer's representative, OWNER and ENGINEER prior to initiating such Work. An experienced, competent, and factory trained representative of the equipment manufacturer shall travel to the job site a minimum of two times to provide the following services:
  - 1. Installation/Start-Up Certification.
    - a. Inspect the installation of the equipment covered by these specifications.
    - b. Supervise and complete pre-start up adjustments and installation checks.
    - c. Conduct initial start-up of equipment and perform operational checks.
    - d. Provide a written report certifying that the manufacturer's equipment has been installed properly, started up, and is ready for operation. The report shall conform to the requirements of Specification Sections 01400, Quality Control, and 01650, Starting of Systems.
    - e. Installation/start-up shall conform to Specification Section 01650, Starting of Systems.
  - 2. Training:
    - a. CONTRACTOR shall provide manufacturer's representatives to train OWNER'S personnel in operation and maintenance procedures. The representatives shall present training programs and on-site demonstrations designed to fully acquaint plant personnel at a minimum for the following items:
      - 1) All equipment features.



- 2) Routine scheduled maintenance procedures.
  - 3) Alternative operational modes.
  - 4) Emergency procedures.
  - 5) Spare parts inventories.
  - 6) Demonstration of the performance requirements of the Specifications.
  - 7) Training shall conform to the requirements of Specification Section 01650, Starting of Systems.
- B. All costs including travel, lodging, meals, and incidentals for the manufacturer services shall be included in the CONTRACTOR'S price.
- C. Supplier shall provide the services of a factory trained representative to check the installation and to start up each Septage Receiving System and controller. The factory representative shall have complete knowledge of proper installation, operation, and maintenance of equipment supplied. Representative shall inspect the final installation and supervise a start-up test of the equipment.

END OF SECTION

## SECTION 11362

### ROTARY SCREW PRESS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Scope: CONTRACTOR shall provide all labor, materials, equipment, appurtenances, specialty items, and services required to furnish and install one complete and operable rotary screw press equipment as shown and specified in the Contract Documents.
- B. Equipment Coordination: To ensure that all the equipment is properly coordinated and will function in accordance with the requirements of the Contract Documents, the CONTRACTOR shall obtain all the equipment specified herein from a single supplier who shall be vested unit responsibility for the proper function of the complete system. However, the CONTRACTOR shall retain ultimate responsibility under this Contract for equipment coordination, installation, operation and guarantee, and the CONTRACTOR shall furnish and install all labor, equipment, materials, appurtenances, specialty items and services not provided by the supplier but required for a complete and operable system. The equipment covered by this Specification is intended to be standard equipment of proven ability as manufactured by reputable concerns having extensive experience in the production of such equipment. The equipment furnished shall be manufactured and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed as shown and specified in the Contract Documents.
- C. Preliminary Testing: CONTRACTOR shall base its performance guarantees upon the design criteria stated herein. No sludge will be available for testing of the rotary screw press machines until the wastewater treatment facility is constructed and becomes operational.
- D. Related Work specified elsewhere that shall apply to all equipment, materials, labor and services furnished under this Section shall include, but not be limited to, the following:
  - 1. Division 1, General Requirements:
    - a. Section 01300, Submittals.
    - b. Section 01650, Starting of Systems.
  - 2. Division 2, Sitework.
  - 3. Division 3, Concrete. Blockouts and other details shown on the structural drawings may require modifications to suit the particular equipment supplied by the CONTRACTOR. Such modifications shall be made by the CONTRACTOR, after review and approval by the ENGINEER.

4. Division 5, Metals.
  5. Division 9, Painting: All protective coatings for equipment and materials shall be per Section 09900, Painting.
  6. Section 11451, Polymer Feeders.
  7. Division 15, Mechanical.
  8. Division 16, Electrical.
  9. Division 17, Instrumentation.
- E. Motors: All motors and drives shall be per Section 11100, Electric Motors, and shall be TEFC for corrosive duty and shall be sized to be non-overloading over the full range of operating conditions specified herein.
- F. All programmable logic controllers (PLC) and HMI platforms shall be per Division 16 & 17 specifications. The CONTRACTOR shall have unit responsibility for proper coordination to ensure all PLCs on the entire project are of the same manufacturer. The rotary screw press manufacturer shall furnish and install PLCs as required for the rotary screw press equipment and control panels, and shall assume unit responsibility for the PLCs furnished for the rotary screw press equipment and control panels, including input and output capacity and capability to successfully control all devices and systems to be controlled by the PLCs and to send and retrieve data over a local area network (LAN) between the rotary screw press PLC and the plant's monitoring and control PLC based system as shown and specified in the Contract Documents. The rotary screw press manufacturer shall provide a letter with his submittal stating that the PLCs to be provided are the approved PLC, that all control elements and features as shown and specified in the Contract Documents have been configured into the PLC logic, and that the PLC will successfully meet all the control requirements of the Contract Documents.
- G. All VFDs, as required for the rotary screw press equipment, shall be furnished and installed by the CONTRACTOR, shall be of the same manufacturer and shall be furnished by a single supplier under Division 16, Electrical. The CONTRACTOR shall have unit responsibility for proper coordination to ensure all VFDs furnished and installed under Division 16, Electrical, on the entire Project are of the same manufacturer. The CONTRACTOR shall have sole and total responsibility for the satisfactory installation and operation of the entire rotary screw press equipment including belt drives, motors, VFDs, and controls as shown and specified in the Contract Documents. The rotary screw press manufacturer shall assume unit responsibility for the rotary screw press equipment motors, and shall assume responsibility that the motors supplied with the rotary screw press equipment will successfully operate over the specified operating speed range, and that the rotary screw press equipment, including motors, will operate successfully over the speed range and all other operating characteristics as shown and specified in the Contract Documents. Manufacturer shall submit a letter of compliance stating that the motors for the rotary screw

press system are suitable and compatible with the VFDs furnished under Division 16, Electrical.

- H. The manufacturer shall warrant, in writing that all equipment supplied by them shall be free from defects in material and workmanship, for a period of 12 months from the date of start-up, not to exceed 18 months from the date of delivery, unless noted otherwise within the Specifications.
- I. The manufacturer of the equipment specified herein shall be required to review and satisfy all relevant requirements of other sections of the Contract Documents and the requirements of the Drawings. CONTRACTOR, manufacturer, supplier, fabricator or subcontractors furnishing or installing equipment, services and specialties associated with this Section shall fully coordinate their efforts to avoid potential claims that are based on failure to review relevant Contract Documents.

## 1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Manufacturer of the rotary screw press equipment shall have experience in providing similar type equipment and shall show evidence with his submittal of at least five installations where equipment of the same material and same application of the type specified herein have been in satisfactory operation for at least five years. The list of installations shall include the name and telephone number of the plant superintendent of each of the five qualifying installations.

## 1.3 SUBMITTAL

- A. Shop Drawings: Submit for approval the following:
  - 1. Anchor bolt details.
  - 2. Motor data as indicated in the Section 11100, Electric Motors, including type, size and model number; assembly drawings, rated size of the motors with calculations supporting the selected motor size; temperature rating.
  - 3. Complete fabrication and installation drawings for the rotary screw press equipment.
  - 4. Letters from the equipment manufacturer stating that the PLCs furnished and installed by the manufacturer, the VFDs furnished and installed by CONTRACTOR, and the rotary screw press equipment specified herein are totally compatible and will successfully operate under the operating load conditions and all other operating characteristics provided by the control package specified or shown in the Contract Documents.
  - 5. A statement from CONTRACTOR stating that the PLCs to be furnished and installed by the manufacturer, and the VFDs to be furnished and installed by the CONTRACTOR are totally compatible with the rotary screw press equipment specified herein, and that the CONTRACTOR has fully coordinated all of the efforts and requirements for complete and operable rotary screw press equipment.

6. Protective coating data as specified in Section 09900, Painting.
  7. Programmable logic controller (PLC) application software documentation shall be submitted for OWNER and ENGINEER information only and shall not be subject to formal approval. Software documentation shall include the following as a minimum:
    - a. Complete hard copies of all application (e.g., ladder diagram) programming. Documentation shall include complete external and internal I/O coil, contact and signal cross referencing, addressing and rung numbering. Documentation shall clearly distinguish between internal and real I/O and shall also incorporate extensive English language to identify contact, coil and signal functions and for labeling and description of program, sub-program and rung purpose and action.
    - b. Complete listing of external and internal I/O address assignments, register assignments, and preset constant values along with functional point descriptions. Also list all unused/undefined I/O and data table registers available. The I/O that shall be read over the LAN shall be written to allow the plant's control system (PCS) to easily read and send data, to be able to monitor and control the rotary screw press as described in this Section. The I/O shall be clearly identified in the documentation to assist the PMCS supplier to program the PCS.
    - c. Complete hard copies of all program documentation for all types of programs.
- B. Operation and Maintenance Manuals:
1. Submit complete installation, Operation and Maintenance Manuals, including copies of all approved Shop Drawings, test reports, maintenance data and schedules, description of operation, and spare parts information.
  2. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01300, Submittals.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. The rotary screw press shall be capable of dewatering biological sludge from the treatment of municipal wastewater as specified herein, after conditioning of the sludge with a liquid organic polyelectrolyte chemical (polymer) which is readily available in bulk quantities. Conditioning with inorganic chemicals such as lime or ferric chloride will not be acceptable.
- B. Each rotary screw press shall be capable of meeting the following minimum performance criteria:
1. Sludge throughput, lbs. d.w.s./hour: 748 @ 1.4%.
  2. Hydraulic capacity, g.p.m.: 105.
  3. Cake solids, percent d.w.s.: 16%.

4. Solids capture, percent: 90%.
  5. Active polymer, lbs/ton of d.w.s. in feed: 14-30.
- C. All appurtenant equipment and piping normally furnished as an integral component of the machine, (with the specific exception of the sludge feed pumps, and polymer system) and which are required for proper operation of the unit shall be furnished whether or not specific reference is made thereto in these Specifications.
- D. The entire process shall be monitored and controlled from a Rotary Screw Press Control Panel.
- E. Rotary Screw Press manufacturer shall provide a complete liquid emulsion polymer feeder system per Specification Section 11451, Polymer Feeders.

## 2.2 PRODUCT AND MANUFACTURER

- A. Manufacturers:
1. Process Wastewater Technologies,
  2. Huber,
  3. Ishigaki,
  4. Or approved equal.

## 2.3 EQUIPMENT

- A. The dewatering in the rotary screw press shall be continuous and accomplished by gravity drainage and by pressing sludge with a slowly rotating screw or auger. The filtrate shall be drained through the openings in the screen basket or casing.
- B. The overall length, width, and height of the fully assembled rotary screw press shall not exceed 276-inches, 72-inches, and 90-inches, respectively.

## 2.4 COMPONENTS

- A. The rotary screw press shall include structural frame, dewatering casing (screen basket), polymer mixing chamber, polymer metering pump, flocculation tank (pipe), dewatered sludge cake conveyor, electrical components and any other specified and necessary components.
1. Structural Frame:
    - a. The structural main frame shall be fabricated of steel members conforming to AISC Standard Specifications for Structural Steel, into a rigid structure, adequately braced to withstand intended loads without excessive vibration or deflection.
    - b. The framework shall be of welded and/or bolted construction. All welding shall conform to the American Welding Society Structural Welding Code.



- c. The structure shall be designed for installation on a prepared concrete foundation and secured with anchor bolts.
  - d. The manufacturer shall warrant the frame and the coating for a period of three years from the date of start-up, not to exceed three and a half years from the date of delivery. Any defects or corrosion occurring within the warranty period shall be repaired or replaced at no additional cost to the OWNER.
- 2. Dewatering Casing (Screen Basket):
  - a. The dewatering casing (screen basket) shall be made of stainless steel (Type 316).
  - b. An automatic mechanical and/or hydraulic cleaning means shall be provided to prevent clogging of the openings.
- 3. Polymer Mixing Chamber: Refer to specifications in Section 11451, Polymer Feeders.
- 4. Polymer Metering Pump: Refer to specifications in Section 11451, Polymer Feeders.
- 5. Dewatered Cake Conveyor:
  - a. A screw or belt conveyor shall be provided to transport the dewatered sludge cake from the solid outlet of rotary screw press to a dumpster or storage site.

## 2.5 ROTARY SCREW PRESS PROCESS CONTROL PANEL

- A. Rotary Screw Press Local Control Panel shall be furnished by the manufacturer. The control panel shall be a freestanding or attached NEMA Type 304 4X stainless steel enclosure with quick close door clamps, three point handles and provisions for bottom entry conduit entrance.
- B. General Considerations:
  - 1. The control panel shall accept a 480 VAC, 60 hertz, 3-phase power input. A main disconnect circuit breaker and operator mechanism shall be included. When the disconnect is in the open position, all power shall be removed from the control system. NEMA rated motor starters shall be provided for the hydraulic unit and washwater pump. IEC rated devices are not acceptable. A VFD will be supplied for each screw drive. Short circuit protection for each motor shall be accomplished utilizing thermal magnetic circuit breakers. Individual thermal overload protection shall be provided. A control power transformer shall be included that will provide 24 VDC and 115 VAC control powers to the system. All logic functions for the system shall be performed by general purpose plug-in style relays and timers.
  - 2. Located on the front of the control panel shall be a CONTROL POWER OFF/ON switch. When in the ON position, the CONTROL POWER ON pilot light will be illuminated and control power shall be distributed to the control system. When in the OFF position, the control system shall be held de-energized. Also located on the control panel shall be an EMERGENCY STOP pushbutton. It shall be an illuminated mushroom head style

pushbutton that when depressed shall immediately de-energize all moving equipment in the system. An alarm horn shall be included for audible alarm annunciation.

C. Control Components:

1. Enclosures:
  - a. Control panel enclosures shall be fabricated of type 304 stainless steel and shall be suitable for NEMA 4X service. Enclosures shall be manufactured by Hoffman Manufacturing, Hammond Manufacturing, or equal.
2. Wiring:
  - a. All power and control wiring shall be 600 volt, type MTW, insulation stranded copper and shall be sized for the required load, 14 AWG minimum. THHN/THWN is not allowed.
3. Circuit Breakers:
  - a. The circuit breaker for the main disconnect shall be thermal magnetic molded case units. Refer to Specification 16476 for low voltage circuit breaker requirements.
4. Motor Starters:
  - a. Motor starters shall be full voltage, non-reversing, NEMA Rated across-the-line units. Size 1 minimum. Coils shall be 120 VAC.
5. Selector Switches:
  - a. All selector switches shall be heavy duty, oil tight/watertight, corrosion resistant units rated for NEMA 4X service. Refer to Specification 16902 for Selector switch requirements.
6. Pushbuttons:
  - a. All pushbuttons shall be heavy duty, oil tight/watertight, corrosion resistant units rated for NEMA 4X service. Refer to Specification 16902 for pushbutton requirements.
7. Pilot Lights:
  - a. Pilot lights shall be heavy duty, oil tight/watertight, corrosion resistant units rated for NEMA 4X service. Refer to Specification 16902 for pilot light requirements.
8. Terminal Blocks:
  - a. Refer to Specification 16143 for terminal block requirements.
9. Programmable Logic Controller (PLC) and Variable Frequency Drive (VFD):
  - a. The PLC shall be a modular type with discrete and analog capabilities. The PLC shall be a Modicon M340 to match the Plant PLC.
  - b. The VFD shall be UL listed. Refer to Specification 16485 for VFD requirements.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install equipment as specified herein, as described in the Contract Documents, as shown on the approved Shop Drawings and as directed by the manufacturer's representative.

### 3.2 PERFORMANCE TEST

- A. After start-up of the treatment plant and accumulation of a suitable waste sludge inventory by the OWNER, the rotary screw press manufacturer shall witness and observe performance tests using the OWNER'S sludge to verify that the unit provided meets the minimum requirements specified herein. The performance test shall be scheduled for completion not later than 30 days prior to CONTRACTOR'S Substantial Completion.
- B. The manufacturer shall be notified of the time for performance tests to be conducted by the OWNER and shall provide the full-time services of a qualified factory representative for the on-site performance tests to observe the testing and analytical procedures, and to certify that the rotary screw press was operated in accordance with the operating requirements and recommendations of the manufacturer. Within seven calendar days after the performance tests, CONTRACTOR shall submit a letter from the manufacturer to certify the manufacturer's observance of the performance tests as specified above. All costs for the manufacturer services under this Part shall be included with the CONTRACTOR'S bid.
- C. Prior to the performance tests, the manufacturer shall perform testing as necessary to determine and recommend the most effective type of polymer to produce the specified performance. Any additional tests necessary beyond the initial tests shall be at the manufacturer's own expense, if the prior test fails to meet the specified performance. The rotary screw press manufacturer shall provide all polymer required for testing.
- D. After demonstrating that the unit provided meets the minimum requirements specified herein with a particular polymer, the rotary screw press manufacturer shall provide an initial supply of polymer to the OWNER. The initial supply shall consist of six (4) 55-gallon polymer drums to demonstrate performance compliance.
- E. The OWNER shall provide sludge feed, water, electrical power, and sludge cake disposal necessary to conduct the performance tests.

- F. The cost of laboratory test necessary to confirm rotary screw press performance for the initial test shall be borne by the OWNER. If a retest is required, then the manufacturer shall pay for the subsequent laboratory tests.
- G. Performance shall be determined as follows:
  - 1. One sample each shall be collected by the OWNER on the feed sludge stream, the dewatered sludge cake, and the filtrate stream for each hour during the test. The test shall consist of one continuous eight hour run-period.
  - 2. All of the samples shall be analyzed by the OWNER in accordance with the latest edition of Standard Methods.
  - 3. All of the sludge cake and filtrate samples shall meet the requirements specified above providing the sludge feed meets the requirements specified above.
- H. If, in the opinion of the OWNER, the performance test results do not meet the requirements specified herein, the OWNER will notify the CONTRACTOR of non-acceptable performance. CONTRACTOR shall within 60 days, and at his own expense, make all necessary adjustments, additions, and modifications as required to meet the performance and capacity requirements specified herein. Supplemental testing shall be completed within the same 60 days. The rotary screw press equipment shall not be accepted by the OWNER until these requirements are met.
- I. If, in the opinion of the OWNER, a performance acceptance test or retest is successful and meets the requirements specified herein, the OWNER will recommend, by letter, the official acceptance of the equipment.

### 3.3 MANUFACTURER'S FIELD SERVICES

- A. CONTRACTOR shall provide the following services in addition to any other services specified herein, and required by these Specifications. CONTRACTOR shall coordinate field service work with manufacturer's representative, OWNER and ENGINEER prior to initiating such Work. An experienced, competent, and factory trained representative of the equipment manufacturer shall travel to the job site a minimum of two times to provide the following services:
  - 1. Installation/Start-Up Certification:
    - a. Inspect the installation of the equipment covered by these specifications.
    - b. Supervise and complete pre-start up adjustments and installation checks.
    - c. Conduct initial start-up of equipment and perform operational checks.
    - d. Provide a written report certifying that the manufacturer's equipment has been installed properly, started up, and is ready for operation. The report shall conform to the requirements of Specification Sections 01400, Quality Control, and 01650, Starting of Systems.
    - e. Installation/start-up shall conform to Specification Section 01650, Starting of Systems.

2. Training:
  - a. CONTRACTOR shall provide manufacturer's representatives to train OWNER'S personnel in operation and maintenance procedures. The representatives shall present training programs and on-site demonstrations designed to fully acquaint plant personnel at a minimum for the following items:
    - 1) All equipment features.
    - 2) Routine scheduled maintenance procedures.
    - 3) Alternative operational modes.
    - 4) Emergency procedures.
    - 5) Spare parts inventories.
    - 6) Demonstration of the performance requirements of the specifications.
    - 7) Training shall conform to the requirements of Specification Section 01650, Starting of Systems.
- B. All costs including travel, lodging, meals, and incidentals for the manufacturer services shall be included in the CONTRACTOR'S price.

END OF SECTION

## SECTION 11375

### OXIDATION DITCH

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Furnish and install the following oxidation ditch system equipment:
  - 1. Two (2) VFD low speed, fixed, mechanical surface aerators. Each aerator shall consist of a drive motor, gear reducer, coupling, surface impeller, and appurtenances.
  - 2. Two (2) submersible, direct driven or gear driven mechanical mixers for installation in the anoxic zones. Each mixer shall consist of a impeller, guide rail and manual lifting hoist assembly.
  - 3. Two (2) internal recycle flow control gates. Each gate shall consist of a manual drive gear reducer, stand shaft and gate assembly.
- B. One (1) control system consisting of monitoring for each dissolved oxidation (DO) loop, oxidation reduction potential (ORP) indication for the oxidation ditch process, and control logic for the oxidation ditch system process.
- C. All equipment specified under this Section shall be furnished by a single manufacturer.
- D. The CONTRACTOR shall have the responsibility to coordinate the installation of the equipment. Any revisions necessary shall be subject to the ENGINEER'S review and approval.
- E. Related Sections:
  - 1. Section 01300, Submittals.
  - 2. Section 01640, Materials and Equipment.
  - 3. Section 01650, Starting of Systems.
  - 4. Section 11100, Motors.
  - 5. Section 11285, Hydraulic Gates.
  - 6. Section 16001, Packaged Systems and Control Panels.
  - 7. Section 17451 PLC System Hardware.

##### 1.2 REFERENCES

- A. The following is a list of standards which may be referenced in this Section:
  - 1. American Gear Manufacturers Association (AGMA).
  - 2. National Electric Manufacturer's Association (NEMA).
  - 3. American Federation of Bearing Manufacturers Association (AFBMA).
  - 4. American Society of Testing Materials (ASTM).

5. American Welding Society (AWS).
6. Steel Structures Painting Council, American National Standards Institute (SSPC).

### 1.3 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01300, Submittals.
- B. Shop Drawings:
  1. Letters of Certification of Compliance on materials, equipment, etc.
  2. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, anchor bolt locations, aerator impeller diameter, aerator impeller rotational speed (rpm), aerator impeller tip speed (fps), field connections and other pertinent dimensions.
  3. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, and lists of erection details.
  4. Shop Detail Drawings showing individual sub-assemblies and fabricated pieces with material specifications and other applicable data.
  5. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
  6. Schematic and wiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation.
  7. General bulletins and product literature describing complete apparatus including operating principles and fundamentals.
  8. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
  9. Curves and/or data for overall range of operation from minimum to maximum capacity or load, showing capacity or load, utilities motive medium required, total or incremental differential head, and other pertinent information applicable to the equipment or its component assemblies.
  10. Materials of construction of all components.
  11. Renewal parts list with diagrammatic or cross-section Drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
  12. Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.
  13. A local control panel engraved nameplate legend.
  14. Installation, operation and start-up procedures including lubrication requirements.
  15. Total weight of the equipment including the weight of the single largest item.

16. A list of spare parts that are supplied with the project.
  17. Written certification from Royal HaskoningDHV or Landustrie Sneek B.V that the proposed aerators are guaranteed to meet the specified velocity requirements. In lieu of approval by the named entities, manufacturer shall conduct an on-site velocity test and on-site clean water oxygen transfer testing in both basins per ASCE 2-06. Self-certification is not allowed.
  18. Warranty in accordance with Paragraph 1.5 of this Specification.
  19. Each Shop Drawing Submittal shall include a hard copy of the relevant Specification Section and shall be clearly marked to indicate whether the requirements for equipment and/or services in the Specification Section are met by writing "accept" or "deviate" next to each Paragraph. If clarifications are needed to any of the Paragraphs in the Specification Sections due to deviations, they shall be addressed next to the Paragraph as such and explained further with any additional information necessary. If any exceptions and/or deviations are proposed to any of the Specifications, they shall be clearly noted as such in the Submittal, and an explanation of any deviation and/or exception shall be provided. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. Failure to include a copy of the marked-up Specification sections, along with justification(s) for any requested deviations to the Specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
- C. The aeration equipment manufacturer shall submit the following information.
1. Test report of full-scale oxygen transfer test in oxidation ditch with aerators of similar size installed.
    - a. Results from aerators in square tanks or other facilities which are not full-scale operating oxidation ditches are not acceptable.
    - b. Test results must be in U.S. standard units of 1 atm, 20 C,  $\alpha=1.0$ ,  $\beta=1.0$ ,  $DO=0$ . Temperature shall be corrected with an Arrhenius coefficient of 1.024 and  $\alpha$  and  $\beta$  shall be measured on site if the test was performed using dirty water test methods.
    - c. Minimum standard oxygen transfer efficiency of the surface impeller shall be 3.5 lbs O<sub>2</sub>/HP-hr. Motor cut sheets shall be included to document efficiency used to convert wire to motor HP.
- D. Shop Test Results: Submit results of routine factory motor tests.
- E. Field Test Results: Submit a written report giving the results of the required field tests.
- F. Manufacturer's Reports: Submit written report of the results of each visit by a manufacturer's serviceman, including purpose and time of visit, tasks performed and results obtained.



- G. Operation and Maintenance Manuals: Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals Section of Section 01300, Submittals.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. The system components shall be stored and temporarily supported prior to installation in strict accordance with the Manufacturer's recommendations and instructions. All exposed surfaces shall be protected. Keep records of the storage parameters and the dates that the storage procedures were performed. The CONTRACTOR shall be responsible for work, equipment, and materials until inspected, tested and finally accepted.
- B. Gear reducers and motors shall be stored in buildings or trailers which have a concrete or wooden floor, a roof and fully closed walls on all sides. The equipment shall be protected from being contaminated by dust, dirt and moisture.
- C. Fabricated assemblies shall be shipped in the largest sections permitted by carrier regulations and shall be properly match-marked for ease of field erection. The units shall be erected and lubricated in strict accordance with the instructions of the Manufacturer's field engineer.

#### 1.5 WARRANTY

- A. The oxidation ditch system equipment manufacturer shall guarantee that the materials and/or the workmanship of the equipment supplied be free of defects for a period of one year from the date of actual start-up of the equipment and after acceptance of the system installation by the OWNER, providing the equipment has been operated and maintained in accordance with the manufacturer's guidelines. The warranty shall cover parts and labor and shall be in printed form.

#### 1.6 MAINTENANCE

- A. Special Tools and Spare Parts:
  - 1. Provide to the OWNER one set of special tools, calibration devices, or instruments required for operation, calibration, and maintenance of the equipment. It is the intent of this Specification to provide only one set of tools required for this equipment and similar equipment specified elsewhere.

#### 1.7 SYSTEM DESCRIPTION

- A. The oxidation ditch system shall be able to treat the design flow rate of 0.6 MGD (maximum month average daily flow) and peak-hour flow rate of 1.5 MGD with influent and design effluent concentrations as follows:

<u>Parameters</u>	<u>Influent</u>	<u>Effluent</u>
BOD, mg/L	360	Less than 30
TSS, mg/L	340	Less than 30
TN, mg/L	50	7
BOD and TSS Removal Efficiency	85%	
pH	6 - 9	
Temperature, °C	10 - 30	
Elevation, feet	4,160	

- B. The oxidation ditch system shall consist of two ditches so one ditch can be taken out of service as required for maintenance.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Oxidation Ditch System Manufacturer:
1. Ovivo, Salt Lake City, Utah.
  2. WesTech
  3. Or approved equal.
- B. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality, type of system, and the configuration desired.

### 2.2 AERATOR DESIGN AND PERFORMANCE

- A. Performance:
1. The surface impeller shall be capable of delivering an oxygen transfer efficiency of no less than 3.5 lb O<sub>2</sub>/HP-hr based on motor output power at standard transfer conditions. If the Manufacturer cannot provide full documentation as required in Paragraph 1.3, to demonstrate compliance with this requirement, the Manufacturer shall perform full-scale tests of oxygen transfer efficiency in the presence of the ENGINEER.
  2. Aeration equipment shall provide a minimum of 1.0 ft/sec average velocity at full power. The Manufacturer shall perform on-site testing unless either Royal HaskoningDHV or Landustrie approval has been provided. CONTRACTOR is responsible for all OSHA approved bridges required to conduct any velocity and oxygen transfer testing.
  3. The aeration equipment shall be capable of effectively mixing the basin during basin dewatering until the water level in the basin is reduced to a depth of three (3) feet.

B. Aerator Motors:

1. Each aerator shall be driven by a single speed 40 HP, totally enclosed fan cooled, constant torque, premium efficiency motor wired for 460 volt, 60 cycle, 3 phase current and suitable for VFD application with a 2:1 speed turndown. The motors shall be rated at 50 degree C ambient with Class F insulation and shall have a Class B temperature rise at full load. The motor shall have a service factor of 1.15 on sine wave power and a 1.0 service factor on VFD applied power and shall comply with the applicable provision of the Standards of NEMA. The minimum AFBMA B10 bearing life shall be 200,000 hours. The nominal motor speed shall be 1,800 rpm.
2. The motors shall be cast iron construction, Mill & Chemical or Corro-duty, and shall flange mount to the gear reducer. They shall be mounted in a vertical position to the gear reducer and furnished with a canopy cap (drip cover) and suitable lifting lugs. The motor to gear reducer connection shall be accomplished by the use of a flexible coupling.
3. Motors shall be suitable for operation in a moisture-laden atmosphere. The conduit boxes shall be gasketed with neoprene or equivalent material, so as to prevent moisture from entering the stator through the conduit box. Stainless steel condensation drains shall be suitable positioned in the lower external surface, so that any accumulation of moisture can drain completely from the motor housing. Ball bearings shall be supplied and shall be grease lubricated. Grease reservoirs shall be ample and provisions shall be made for re-greasing with a lubrication system where grease is flushed through the bearings. The winding end turns shall be dipped and baked with a non-hygroscopic varnish, the stator bores and rotor cores shall be coated with epoxy paint. The entire enclosure shall be finish painted by the motor manufacturer at the factor with a corrosion resistant paint to provide additional protection against moisture contaminants. The nameplates shall be stainless steel.
4. Each motor shall be equipped with a suitable sized space heater to keep condensation from forming when the motor is not running.
5. Each motor shall be equipped with a normally closed thermostatic heat protection device to protect the motor from overheating during operation. The unit shall immediately stop the aerator drive motor in the event of excessive heat buildup.

C. Aerator Gear Reducers:

1. Each gear reducer shall be of the helical gear type and shall be sized with a minimum service factor for all components of the reducer of at least 2.5 times the motor nameplate horsepower rating in accordance with applicable AGMA standards 2001-C95 errata June 28, 1990, when each unit is operating at full load motor horsepower, 24 hours a day continuous running under moderate shock loads. The efficiency shall be not be less than 94 percent based on the gear reducer input horsepower.
2. The gear reducers shall be designed for vertical input and output shaft operation and the housing shall be cast iron construction with provisions for

the attachment of suitable lifting devices. Each reduction unit shall have gearing of the helical gear type. Worm gearing will not be acceptable. The units shall be designed to AGMA Service Classification III. All shafts shall be supported on tapered roller or double spherical roller bearings. Gears and pinions shall be made of alloy steels. Shafting shall be made out of medium carbon steel. The gear teeth shall be through-hardened or carburized. Flame hardened gears will not be acceptable. All gears shall be made from alloy steels with sufficient hardenability to obtain case and core properties meeting the requirements for grade 2 material in accordance with ANSI/AGMA 2001-C95. The steel alloy shall be selected, and the heat treatment shall be controlled to obtain a microstructure that meets all the requirements for grade 2 material in accordance with ANSI/AGMA 2001-C95.

3. All gears shall meet the accuracy requirements for AGMA quality No. Q12 in accordance with ANSI/AGMA 2001-B88. Pitting resistance and bending fatigue resistance shall be rated in accordance with ANSI/AGMA 2001-B88.
4. All bearings incorporated within the gear reduction unit shall have a rating life expectancy (B10) of 100,000 hours rating life expectancy, except those bearings attached directly to the output shaft which shall have a rating of 250,000 hours. All bearings shall be of the anti-friction type. Bearing life shall be rated in accordance with the ANSI/AFBMA standard 11-1990 based on operating continuously at the rated full load horsepower and speed.
5. The lubrication of the speed reducer shall conform to AGMA 9005-E02. A reliable lubrication system shall be provided for the gears and bearings. Lubrication systems which rely wholly or in part upon an oil circulating pump shall incorporate a proven reliable pressure device which will immediately stop the driving motor and transmit an alarm signal to the motor control center in the event of insufficient lubrication. Each electrical switch shall be wired to its respective aerator motor control center. External oil cooling will not be permitted. The unit shall be provided with a dipstick or sight glass to observe oil levels. Oil fill and drain lines shall be sufficient size to permit efficient functioning and shall be located on the gear unit in a position which is easily accessible from the bridge platform. The oil drain piping shall be installed so that a container may be placed under the drain discharge.
  - a. The CONTRACTOR shall supply the first charge of run in oil for the reducers, and if necessary due to run time, the change of oil. The CONTRACTOR shall purchase the oil from a local firm selected by the OWNER in accordance with the information in the Operation and Maintenance manual to assure lubricant compatibility.
6. All grease lubricated bearings shall have seals to retain the grease. The low-speed shaft shall have grease lubricated bearings and shall have a dry well to prevent oil leakage. The dry well shall be 100% maintenance free with no wearing parts. The dry well shall be sealed by a non-contact double labyrinth seal with a return drain above. Additionally, the output end of the well shall include the upper and lower bearing seals and separate oil seal. All grease

lubrication pressure lines shall be fed from fittings accessibly located above the platform supporting the mechanism.

7. The housing shall be constructed of high tensile strength gray cast iron conforming to ASTM A48 class 30 minimum with integral dry well construction to eliminate oil leakage at the output shaft and prevent loss of lubrication in the event of a seal failure. The housing shall be stress relieved prior to machining. The housing shall be tested to preclude casting porosity or weld defects that could result in oil leakage. Lifting lugs shall be provided on the housing suitable located to enable safe removal of the combined electric motor and gear unit from the supporting platform. Removable inspection cover(s) or inspection port(s) shall be provided.
8. Each gear reducer shall be mounted on a support with hot dipped galvanized steel bolts. The support shall be mounted on four (4) zinc plated jack studs embedded in the platform structure and designed to withstand all normal operating loads. The jack studs shall have the capability to provide a total vertical adjustment of six (6) inches. The jack stud nuts shall be drilled and tapped with set screws and vibration isolation pas and stainless steel washers shall be provided.
9. Each gear reducer shall be equipped with a suitable oil immersion-type heater for preheating the lubrication oil prior to start up after prolonged periods of shutdown in cold weather. The heaters shall have an automatic thermostatic control shall operate on the control voltage.

D. Aerator Shop Tests:

1. The motor and gear reducer assembly shall be trial fit at the factory and match marked for ease of onsite installation. The high speed coupling halves shall be factory mounted and aligned. The CONTRACTOR shall be responsible for assuring proper alignment and gap tolerance as set forth in the installation instructions.
2. The gear reducer shall be run under no load conditions at full speed until the oil temperature has stabilized. The overall lubricant temperature and pressure shall be recorded during steady state operation.
3. After successful completion of the shop test and while the gear reducer is at operating temperature, the lubricant shall be drained and the gear reducer shall be flushed with filtered oil. The flushing oil shall be drained and the gear reducer shall be prepared for shipment.

E. Aerator Impellers, Shafts, and Couplings:

1. The surface impeller shall be of a design approved by Royal HaskoningDHV or Landustrie for use in oxidation ditch systems and shall provide oxygenation and propulsion of the mixed liquor in the oxidation ditch.
2. The impeller assembly shall consist of a surface impeller and submerged impeller (if required) connected to a common aerator shaft. The surface impeller shall provide oxygenation and propulsion of the mixed liquor in the oxidation ditch. The submerged radial impeller shall provide additional propulsion of the mixed liquor at the bottom portion of the oxidation ditch.

The impeller assembly shall operate at a maximum output speed of 49.69 rpm. The surface impeller shall present a minimum amount of edge perpendicular to the flow to prevent any attachment of solid materials.

3. Each surface impeller shall be a rim-blade type with a minimum of seven (7) equally spaced blades and constructed of ¼" minimum steel plate. The rim plate shall be submerged at all operating conditions, except during basin draining operations, to reduce the effect of variable loading on the aerator support structure and deck. This shall be clearly shown on the submittal drawings. The impeller blades and disc shall be an integral, shop welded unit requiring no field assembly or welding.
4. Each submerged radial impeller (if required) shall consist of radial pumping blades and hub that shall be an integral, shop-welded unit requiring no field assembly or welding. Each submerged radial impeller shall draw no more than 15% of the aerator nameplate horsepower at full speed immersion.
5. The submerged radial impeller (if required) shall be positioned above the basin floor and a horizontally adjustable wall extension adapter plate shall be provided unless the partition wall extension is shown on the Drawings as formed with the partition wall. If, required, the adaptor plate shall be constructed out of 304 stainless steel plate, configured to simulate thickness of the partition wall, and shall be rigidly secured to the concrete partition wall with stainless steel fasteners.
6. The aerator shaft shall be attached to the gear reducer by a rigid, cast iron flange-type coupling. A retainer plate shall be provided for mounting to the end of the gear reducer output shaft to provide protection against disengagement of the coupling from the gear reducer output shaft. The flanges and flange-type coupling shall be assembled with A325 high strength bolts only. Stainless steel fasteners are not acceptable.
7. All structural steel used in the fabrication of the aerator shall conform to the requirements of ASTM A36. All shop welding shall conform to the latest standards of AWS. Fabricated assemblies shall be shipped in convenient sections as permitted by carrier installations.
8. Manufacturers without five (5) operating US installations of dual impeller aerators of a similar design as this project and who have not been in operation for at least five (5) years must include single impeller aerators per all other requirements of this specification. Additionally, manufacturers not meeting these requirements must provide a mandatory of one in-channel flow boosting mixer per channel (4 total per project) at the midpoint of the channel straight length designed to impart 0.5 ft/sec when the aerators are off. All bridges, electrical/instrumentation/SCADA improvements and engineering calculations required for a complete and functioning system must be included in the Contractor's lump sum price.

F. Aerator Painting:

1. Unless otherwise noted, all ungalvanized fabricated iron and steel surfaces shall receive a shop cleaned surface preparation equivalent to SSPC-SP-10 immediately prior to shop priming. Shop priming shall consist of one (1)

- coat(s) of Tnemec 161-1211 primer or equal to 3.0 to 5.0 mils DFT. Touch up and finishing painting shall not be the responsibility of the manufacturer.
2. The motors and gear reducers shall receive a minimum shop cleaned surface preparation equivalent to SSPC-SP-1 immediately prior to shop priming and finish coating. Shop priming and finish painting shall consist of a coating that is compatible with a high quality finish coating that is specifically resistant to chemical, solvent, salt water, and acid environmental conditions. Touch up painting shall not be the responsibility of the equipment manufacturer.
- G. Aerator Spare Parts:
1. One (1) oil sensing cut out switch and one (1) flexible motor coupling shall be provided.
  2. One (1) complete aerator gear reducer shall be provided.
- H. Mixer Design and Performance:
1. The submersible mixers for the oxidation ditch system shall be furnished by the aerator manufacturer, and, where possible, shall be of the identical model. Each mixer shall include a motor, bearings, mechanical seals, stainless steel shafts, A48 class 35 or 40 cast iron housing, and machined fits for circular cross section O-rings, non clogging propeller, designed for mixing raw or processed sewage. Each mixer shall be mounted in the basin and each unit shall have a hoist and rail retrieval system that does not require anyone entering the basin to install or remove the mixer.
  2. The mixer design is based on the performance requirements for the biological nutrient removal system; consideration of the future long term operational and maintenance costs to the OWNER; minimum pumping rate required per basin; optimization of mixing efficiency (HP/MG) and hydraulic profile of the polyurethane or stainless steel blade design; and specific features (e.g., silicon carbide and mechanical seals, pre-chamber) to protect against moisture intrusion into the unit. No exceptions will be made to these performance requirements as specified in this Section.
  3. Anoxic Basin Mixer Details (per basin):
    - a. Number of mixers required: one.
    - b. Propeller speed: 828 rpm (minimum).
    - c. Horsepower: Maximum of 4.0 HP.
    - d. Thrust: 193 pounds (Maximum)
- I. Mixer Motors:
1. Each mixer shall be furnished with a squirrel cage, induction motor enclosed in a watertight housing suitable for use and compatible with variable frequency drive systems without special order requirements such as “inverter duty”. The motors shall be furnished with moisture resistant Class F insulation treated to be moisture resistant, NEMA B design, 1.13 service factor, designed for continuous duty and shall be non-overloading throughout the entire mixer range of operation with utilizing the motor service factor. Motors shall be capable of sustaining 15 starts per hour (unlimited starts with

VFD) at a minimum ambient temperature of 40 degrees C. Motors shall be capable of uninterrupted operation with a voltage drop of 10%.

2. The motor rotor and stator, as well as all bearings shall be located in an air filled chamber that is isolated from the seal chamber. Motor cooling shall be accomplished by submergence in the mixed liquid. Thermal switches shall be furnished to monitor stator temperature. The stator shall be equipped with two (2) thermal switches or thermistors, embedded in the end coils of the stator winding. Thermal switches shall automatically de-energize the motor when it's temperature exceeds a preset limit. The mixer manufacturer's nameplates shall be engraved or stamped on stainless steel and fastened to the motor casing with stainless steel screws or drive pins.
3. Power and cable controls shall be furnished in lengths to run continuously from the mixer to the mixer control panel as shown on the Drawings and as specified herein. Cables shall terminate with conductor sleeves. Cables shall be of the "SO" type and shall conform to industry standards for loads, resistance under submersion again sewage, and be of stranded construction. The power cables entering the motor housing shall prevent the moisture from gaining access to the motor even in the event of complete power or control cable break while under water. The cables shall enter the mixer through a heavy duty entry assembly that shall be provided with an internal grommet assembly to protect against tension once secured and must have a strain relief assembly as part of standard construction. The cables for each mixer shall be bundled in 10 ft segments for overall neatness and ease of mixer removal.

J. Mixer Shop Test:

1. Each submersible mixer shall be given a factory test during which the mixer shall be run for a minimum of one half hour. Tests shall show that the mixer has the general characteristics of amp draw, starting capability, and such other properties as appear on the approved submersible mixer shop drawings without overheating or excessive vibration.
2. One copy of all test data shall be submitted with the Operation and Maintenance manuals. At a minimum, shop test results shall include the following information for each submersible mixer:
  - a. Mechanical and electrical integrity check established by physical inspection and be megger prior to applying power.
  - b. Power leads shall be applied and the motor started to verify proper rotation.
  - c. Mixer shall be run in the submerged condition to verify amp draw, starting capability, mechanical and electrical integrity.
  - d. After running, the unit shall again be checked by megger and by physical inspection.

K. Mixer Propeller and Shaft:

1. Mixer propellers shall be PUR (polyurethane resin) and/or ductile cast iron or steel that is resistant to chemical effects and provides the highest mixing efficiency due to the blade cross section. Welded steel or stainless steel



propellers shall not be accepted. The propeller vanes shall be smooth, finished throughout, and shall be free from sharp edges. The surface of the propeller shall be free from defects and surface protrusions and shall be smooth.

2. Propellers shall be statically and dynamically balanced after assembly to the rotor. Propellers shall be slip fit and securely held to the shaft by a stainless steel washer and bolt assembly that is enclosed in a separate hub chamber.
3. The hub chamber is fitted with an O-ringed cap that seals the entrance of the propeller hub chamber device. The output shaft shall be splined to mate with the matching spline insert of stainless steel that forms the hub of the propeller. The arrangement shall be such that the propeller cannot unscrew or be loosened by torque from either forward or reverse rotation. Designs based on threaded connection between mixer shaft and impeller will not be considered.
4. Mixer shafts shall be series 421 or 316 stainless steel with a minimum 1.375" diameter. Shafts shall be supported by bearings for axial and radial thrust and bearing lift shall be designed to provide a minimum B10, 100,000 hours at design flow rate. All shafts shall be dynamically balanced and shall be amply sized to minimize shaft deflection. Shaft overhang shall not exceed 2.5 times the shaft diameter where it passes through the mechanical seal area and the overhang shall be the length of the shaft from the propeller side of the last bearing closest to the hub of the propeller.
5. The ENGINEER reserves the right to require submission of a sample of the output shaft detail drawings to independently verify submittal calculations. Carbon steel shafts with or without shaft sleeves are not acceptable or equal to stainless steel.

L. Mixer Mount Assembly:

1. Each mixer shall be provided with a stainless steel mixer mount assembly to serve as a guide mast for the mixer during installation and to guide the mixer for removal from the liquid for service. The assembly shall consist of a minimum 3 inch by 3 inch tube and an upper and lower bracket constructed of stainless steel. The assembly shall also contain a stainless steel floor mounted bracket to support and securely hold the mast assembly and shall allow horizontal rotation of the mast through not less than 120 degrees. The mast bearing shall be constructed of Teflon.
2. The mast assembly shall be capable of proper operation with the mixer operating in any direction. The mixer mast shall be designed in such a way that the mixer can be lowered onto and off of the mast. The upper guide holder assembly shall secure the system to the top platform/wall and shall provide lateral support for the guide pile and a securing device for the electrical motor cable.
3. Each mixer shall be provided with a crane assembly permanently located at the top of the basin over each mixer. The boom arm of the mixer shall be designed to properly reach and locate the mixer and to alter the angle of the mixer to assure proper mixing angles. The boom shall include a rotational

turning handle and shall be capable of rotating a minimum of 360 degrees within the receiving box by means of a Teflon bearing. Each crane assembly shall include a winch and a minimum ¼", 316 stainless steel lift cable with proper length to remove and set the mixer on the walkway. The winch assembly shall be capable of manual lift. All anchor bolts for the rail, mast and crane assembly shall be 304 stainless steel.

M. Mixer Casing and Coating:

1. Casings shall be manufactured from ASTM A48 Class 35 or 40 close-grained cast iron. The outside contours of the mixer(s) shall be shaped to reduce hydraulic losses and to aid in mixing efficiency. Each casting shall be free from porosity, voids, casting, fins and other casting quality defects. The surface shall be smooth to the touch and free from all sharp edges and coated with ceramic base or high solids epoxy coating for chemical and abrasion resistance. Corners shall have smooth radius contours to avoid sharp edged corners and surfaces.
2. The entire body of the mixer assembly shall be abrasive blasted to SSPC-SP-10 with a minimum 2.5 mil profile. The mixer shall then be immediately coated with a minimum of 15 mils of ceramic compound. The ceramic compound shall be a two part polymer/ceramic design for airless spraying, cold curing, solvent free and include reinforcing with special fillers and extenders. The corrosion resistance below the surface of the coating shall be capable of withstanding ASTM salt spray test for over 3000 hours.

N. Mixer Spare Parts:

1. One (1) set of bearings, one (1) set of mechanical seals set, and one (1) set of O-rings shall be provided.
2. One (1) complete mixer shall be provided.

O. Gate Design and Performance:

1. One flow control gate shall be furnished per oxidation ditch suitable for installation on the concrete wall of the bypass channel as shown on the Drawings. Each mechanism shall be of the hand wheel driven gear drive type, with 112.5 degree travel in forward and reverse direction.
2. The equipment furnished for each gate mechanism shall include: stand, gear reducer, rotating shaft, positioning plate/arm and lock pin, guide bearings, flow vane, stops, fasteners and anchor bolts.
3. The flow control gate is designed to direct and control the flow from the aeration basin to the upstream anoxic basin in accordance with the process design and Operation and Maintenance manual for the oxidation ditch system.
4. Except where specifically indicated otherwise, all plates and structural members designated for submerged service shall be ¼" minimum thickness and reinforced as required. 304 stainless steel anchor bolts and 304 stainless steel fasteners with necessary hex nuts and washers shall be provided for all parts of the gate assembly.

5. Fabricated assemblies shall be shipped fully assembled except for attachment of the gear reducer, stand, shaft and guide bearings. The unit shall be designed to allow adjustment for concrete tolerances of  $\pm \frac{1}{2}$ ". The unit shall be erected and lubricated in strict accordance with instructions from the manufacturer.

P. Wormgear Reducer:

1. The worm gear operator shall be of heavy duty construction, totally enclosed in a cast iron housing and provided with adequate seals to protect the interior of the housing. The housing shall be designed so that all gears and bearings are grease packed and factory sealed to prevent condensate formation. The gear shall be designed to operate under the full load as applied from the rotation gate. The reducer shall be equipped with a 20" aluminum hand wheel and require no more than 25 revolutions to rotate the gate a full 112.5 degrees in one direction.
2. The gear reducer shall be of the worm gear type design and have the ability to backdrive without locking of the worm.

Q. Gate Components:

1. The reducer mechanism shall be fitted to the gate shaft with a sleeve and key for ease of assembly and disassembly.
2. The reducer shall be supported on a steel stand that is anchored to the concrete floor or side wall by epoxy type 304 stainless steel anchors. The stand shall be of proper height to allow the operator a convenient grip on the handle for clockwise or counter clockwise turning.

R. Gate Rotating Assembly:

1. Each gate shall be constructed from  $\frac{1}{4}$ " steel plate properly stiffened with rib extensions and end flares. Each gate shall include a revolving shaft assembly fixed between guide bearings mounted to the floor and stand. The floor bearing shall be a thrust type alignment bearing, supporting the entire weight of the unit. The upper guide bearing shall be an integral part of the support stand and shall be mounted just below the worm gear reducer. The center guide bearing, if required by the shaft length, shall be mounted just above the water surface on the lower part of the shaft and shall be field aligned after installation of all other components, assuring proper rotational capability.
2. The revolving shaft shall be supported at each end in such a manner that a slight vertical or horizontal misalignment shall not interfere with the smooth operation of the gate. The shaft shall revolve from the turning of the gear unit.
3. Each gate shall be designed to operate smoothly under flow conditions existing in the aeration basin. The gate shall include a position lock, lock pin with retention chain and shall be adjustable in 22.5 degree increments over a 112.5 degree range. The gate shall include a wall stop bracket, complete with 304 stainless steel wall anchors.

- S. Gate Surface Preparation and Painting:
1. Unless otherwise noted, all ungalvanized fabricated iron and steel surfaces shall receive a shop cleaned surface preparation equivalent to SSPC-SP-10 immediately prior to shop priming. Shop priming shall consist of one (1) coat of Tnemec 161-1211 Epoxoline primer or equal to 3.0-5.0 mils DFT. Touch up and finish painting shall not be the responsibility of the equipment manufacturer.
  2. Gear reducers shall be furnished with manufacturer's standard enamel.

## 2.3 CONTROL SYSTEM

- A. All equipment used to control the oxidation ditch system shall be supplied by the oxidation ditch system manufacturer.
- B. The controls shall be designed to provide high reliability. The oxidation ditch system manufacturer shall provide the programming with logic functions to match the process and operational requirements of the system. The controller shall allow the system to operate the equipment without excessive speed.
- C. Operating ambient temperature range without derating: 0 degrees C to 40 degrees C (32 degrees F to 104 degrees F). Operating relative humidity range shall be 5% to 95% non-condensing.
- D. Control Panel:
1. The control panel shall be NEMA 4X SS. A dedicated 480V, three phase, 60 Hz feed is required. A main through the door disconnect switch with security lock out shall be included. The panel shall conform to UL508A standards and carry the UL label.
  2. Programmable Controller (PLC):
    - a. The PLC shall be Modicon M340 or approved equal per specification 17451.
    - b. The PLC shall have the capability to communicate with the plant SCADA system.
  3. Operator Interface Terminal (OIT):
    - a. The OIT shall be a 10-inch TFT minimum color touch screen, industrial operator interface.
    - b. The OIT shall have an Ethernet port.
    - c. The OIT shall be Magelus by Schneider, per specification 17455.
  4. Ethernet Switch:
    - a. Refer to Specification 17450 for Ethernet Switch requirements.
  5. Terminal Blocks
    - a. Refer to Specification 16143 for Terminal Block requirements.
- E. Operation:
1. The OIT shall allow the operator the ability to modify the following, but not limited to, set points and parameters for the operation of the system:

- a. VFD speed adjustment.
  - b. DO loop set points and limits.
  - c. Aerator adjustment delay.
2. The OIT shall provide to the operator the following, but not limited to, monitoring parameters:
  - a. Real time VFD speed(s).
  - b. Real time DO level(s).
  - c. Real time ORP level(s).
  - d. Aerator status.
  - e. Loop trending.
  - f. Alarm screen.
  - g. Alarm acknowledge.
  - h. Alarm log.
  - i. Mixer status.

F. Control:

1. Aerator power input shall be adjusted to match process oxygen demands using Dissolved Oxygen (DO) concentration as the primary control parameter. The DO level shall be monitored at the location shown on the Drawings.
2. The DO signal shall be used to pace the VFD in “Auto” operation. In “Manual” the operator shall be able to control the speed manually by using the OIT.
3. Proper velocity shall be maintained while running in “Auto” operation.
4. The DO levels shall have defined limits that shall be user defined but factory preset. The factory set algorithms shall be the responsibility of the oxidation ditch system supplier and shall be specifically designed for the installed system.
5. The entire system shall be designed to restart after power outage if no alarm conditions are present that would normally shut the unit down.
6. The aerator “Off” time shall be monitored and an exercise alarm activated when a unit needs to be operated for warranty purposes.
7. Monitoring points shall be available to SCADA system via Ethernet. The points shall include:
  - a. Aerator speed reference (Hz).
  - b. Aerator alarm status.
  - c. DO reference.
  - d. DO set point.
  - e. DO alarm status.
  - f. ORP reference.
  - g. Alarms.
  - h. Mixer status.

G. Instrumentation:

1. Analyzer

- a. The analyzer shall be a microprocessor based instrument. Connections between the probe sensor and the controller shall be “plug and play” without requiring extensive programming or configuration. The system shall be able to perform automatic calibration of the dissolved oxygen monitoring system.
  - b. The controller unit shall have an RS-485 (MODBUS) serial and 4-20mA communication capability. The controller shall have wireless downloading capability through an IR port located on the controller unit to download and print real time data, calibration history and current set points in a CSV format.
  - c. The controller unit shall allow control of the sensor and interface functions using menu driven software. The interface unit shall have a built in data logger with the capacity to store data on 15-minute intervals for up to 6 months. The display for the unit shall be a graphic dot matrix LCD display, 128x64 pixels with LED backlighting. All user settings for the controller shall be retained indefinitely in on-volatile memory (EEPROM).
  - d. The controller unit shall include two analog 4 to 20mA output signals proportional to dissolved oxygen level and temperature, and shall include two independent PID control functions including high/low phasing, set points, dead bands, off delay and on delay.
  - e. The unit shall include three (3) SPDT, user configurable Form ‘C’ alarm contacts, rated at 100-230 volts AC, 5 amp resistive maximum. The unit shall be capable of providing the following alarm conditions: low alarm set point, low alarm point dead band, high alarm set point, high alarm dead band, off delay and on delay.
  - f. The controller unit shall be housed in a NEMA 4X enclosure with a corrosion resistant finish. The AC power supply to the unit shall be housed in the interface unit and shall automatically accept input in the range of 100 to 230 volts AC, single phase, 60 Hz. The interface unit shall be supplied with a sun shield. The unit shall be capable of exterior mounting, vertically on the handrail.
  - g. The controller shall be HACH Model SC 200 Controller as manufactured by the Hach Company or approved equal.
2. Dissolved Oxygen Probe:
- a. The DO probe shall be a continuous reading probe that utilizes luminescent sensor technology.
  - b. The probe material shall be foamed Noryl and Type 316 stainless steel. All parts of the probe shall be corrosion resistant and fully immersible. The DO sensor material shall be polybutyl methoacrolate.
  - c. The measurement range of the probe shall be 0.00 to 20.00 mg/L dissolved oxygen and 32.0 to 212.0 degrees F (0.00 to 100.00 degrees C) temperature. The operation of the probe/analyzer shall not be affected by H<sub>2</sub>S, pH, metals and salts normally found in domestic wastewater.

The probe shall provide for electrolyte-free operation without the requirements of sample conditioning.

- d. The probe shall not require periodic membrane changing. The sensor cap shall be easily replaceable and cleaning accomplished by periodically wiping the sensor with a clean rag. The accuracy of the sensor shall be  $\pm 0.1$  mg/L for levels less than 1.0 mg/L and  $\pm 0.2$  mg/L for DO levels greater than 1.0 mg/L. The sensitivity of the probe shall be  $\pm 0.5\%$  of the span and the repeatability of the probe shall be  $\pm 0.5\%$  of the span. The response time of the probe shall be 1 to 60 seconds to 90 percent of the value upon a step change in DO.
- e. The DO probe shall be the HACH LDO Probe for dissolved oxygen and temperature measurement as manufactured by the Hach Company.

3. ORP Probe:

- a. The ORP sensor shall be of Differential Electrode Technique design using two measuring electrodes to compare the process value to a stable internal reference standard buffer solution. The standard electrode shall have non-flowing and fouling-resistant characteristics.
- b. The sensor shall have a hex-shaped body to facilitate mounting, and shall be constructed of Ryton material for exceptional chemical resistance and mechanical strength. This material shall enable the sensor to be installed in metal fittings with leakage usually caused by heating and cooling cycles when dissimilar materials are threaded together.
- c. The sensor shall have a convertible body style featuring 1-inch NPT threads on both ends to mount into a standard 1-inch pipe tee, into an adaptor pipe for union mounting with a standard 1-1/2-inch tee or onto the end of a pipe for immersion into a vessel.
- d. The built-in electronics of the sensor shall be completely encapsulated for protection from moisture and humidity.
- e. The sensor shall have a built-in preamplifier to enable the signal to be transmitted up to 328 feet with standard cabling and up to 3,280 feet with a termination box.
- f. The ORP sensor shall include a titanium ground electrode (standard) to eliminate ground loop currents in the measuring electrodes.
- g. The ORP sensor shall be Hack Ryton ORP measurement sensor as manufactured by the Hach Company.

4. Probe Mounting:

- a. The probe(s) shall be provided with a mounting system capable of being attached to hand railing. The probe(s) shall be attached to an arm that is suspended in the basin. The arm shall be manufactured of Schedule 80 CPVC pipe and fittings and furnished by the CONTRACTOR.
- b. The swivel bracket that attaches the arm to the hand railing shall be fabricated of type 316 stainless steel. All nuts, bolts, washers and other hardware used to mount the pole to the swivel bracket and to mount the bracket to the hand railing, shall be furnished by the CONTRACTOR.

- c. The probe mounting bracket shall be constructed to allow for easy calibration or exchange of the probe without the use of tools.

H. Variable Frequency Drives:

1. The Variable Frequency Drive (VFD) system shall contain all components required to meet the performance, protection, safety and certification criteria of this specification.
2. The oxidation system VFD(s) shall be provided by the oxidation system supplier, using Allen-Bradley or approved equal.
3. The VFD(s) shall be located in the electrical room in a climate controlled building.
4. The VFD(s) shall allow for internal monitoring and control of specific oxidation ditch aeration equipment. These signals shall include but not limited to:
  - a. Oil pressure monitoring.
  - b. Motor thermal overload monitoring.
5. The VFD(s) shall be 6-pulse.
6. Hardware:
  - a. Utilize diode bridge or SCR bridge on the input rectifier.
  - b. Utilize switching logic power supply operating from the DC bus.
  - c. Incorporate phase to phase and phase to ground MOV protection on the AC input line.
  - d. Microprocessor based inverter logic shall be isolated from power circuits.
  - e. Utilize latest generation IGBT inverter section.
  - f. Inverter section shall not require commutation capacitors.
  - g. Ethernet port for direct network cable connections.
  - h. Battery receptacle for Lithium battery power to the Real Time Clock.
  - i. Additional DPI port for handheld and remote HIM options.
  - j. Dedicated Digital Input for hardware enable.
  - k. Optional onboard 24V DC Auxillary Control Power Supply.
7. Control Logic:
  - a. Ability to operate with motor disconnected.
  - b. Provide a controlled shut down, when properly protected, with no component failure in the event of an output phase to phase or phase to ground short circuit. Provide annunciation of the fault condition.
8. Power Conditioning:
  - a. Designed to operate on an AC line which may contain line notching and up to 10% of voltage harmonic distortion.
  - b. An input isolation transformer shall not be required for protection from normal line transients.
9. Current Limit:
  - a. Programmable current limit.
  - b. Current limit shall be active for all drive states: accelerating, constant speed and decelerating.



- c. The drive shall employ PI regulation with an adjustable gain for smooth transition in and out of current limit.
- 10. Flying Start:
  - a. The drive shall be capable of determining the speed and direction of a spinning motor and adjust its output to “pick-up” the motor at the rotating speed.
- 11. Inputs and Outputs:
  - a. The Input/Output option modules shall consist of both analog and digital I/O.
  - b. No jumpers or switches shall be required to configure digital inputs and outputs.
  - c. All digital input and output functions shall be fully programmable.
  - d. The control terminals shall UL Listed and be rated for 600VAC.
  - e. Inputs shall be optically isolated from the drive control logic.
  - f. The control interface card shall provide input terminals for access to fixed drive functions that include start, stop, external fault, speed and enable.
- 12. Ratings:
  - a. Voltage.
    - 1) Capable of accepting nominal plant power of 480V AC at 60 Hz.
    - 2) The supply input voltage tolerance shall be +/-10% of nominal line voltage.
  - b. Displacement Power Factor.
    - 1) Capable of maintaining a minimum true power factor (Displacement PF x Distortion PF) of .95. lagging, over the entire speed range.
  - c. Efficiency.
    - 1) A minimum of 96.5% (+/-1%) at 100% speed and 100% motor load at nominal line voltage.
    - 2) Control power supplies, control circuits, and cooling fans shall be included in all loss calculations.
    - 3) Operating ambient temperature range without derating: 0 degrees C to 40 degrees C (32 degrees F to 104 degrees F).
    - 4) Operating relative humidity range shall be 5% to 95% non-condensing.
    - 5) Operating elevation shall be up to 1250 meters (4,100 ft) without derating.
- 13. The VFD shall be rated at Heavy Duty loads and shall provide 150% overload capability for up to one minute and 180% for up to 3 seconds.
- 14. Communications.
  - a. VFD shall provide an Embedded Ethernet/IP port.
- 15. Enclose Door Mounted Human Interface Module (HIM)
  - a. VFD shall provide a HIM with integral display, operating keys and programming keys.
  - b. The HIM shall be rated NEMA/UL Type 4/12 panel mounting that is connected via cable.

- c. The display portion shall have the following features:
  - 1) The display shall be seven (7) line by twenty one (21) character backlit LCD display with graphics capability.
  - 2) The display shall show drive operating conditions adjustments and fault indications.
  - 3) The display shall be configured to display in three distinct sections.
  - 4) The first section shall be a status display for direction, status, fault/alarm conditions and Auto/Manual mode.
  - 5) The second section shall display drive output frequency.
  - 6) The third section shall be configurable as a display for either programming menus/information or as a two line user display for two additional values utilizing scaled units.
  - 7) The Human Interface shall provide digital speed control.
  - 8) The keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), and numeric keys for direct entry.
- 16. Enclosure:
  - a. Shall be rated Nema 4X 316 SS.
  - b. Shall be painted per the manufacturer's standard.
  - c. A main through the door disconnect switch with security lock out shall be included.
  - d. Shall provide entry and exit locations for power cables at the bottom of the enclosure. No penetrations permitted on top of the enclosure.
  - e. Shall contain a label for listed UL508.
  - f. The drive system nameplate shall be stamped with the Panel name, SCCR ratings inside the enclosure, Source power name, Voltage and Current draw. See Specification 16161, 2.3, B for nameplate details.
- 17. Drive Input Disconnect:
  - a. VFD shall provide a door interlocked fused disconnect switch.
  - b. Operator Handles:
    - 1) Provide externally operated handles for disconnects.
    - 2) Handles shall be lockable.
- 18. Manual Bypass Option:
  - a. Shall provide a means to manually switch a single motor from drive control to bypass (across the line operation).
  - b. Shall provide separate drive output and NEMA Rated bypass contactors. The contactors shall be electrically interlocked.
  - c. Shall provide a Drive/Off/Bypass selector switch, mounted on the enclosure door, for selection of Drive and Bypass modes of operation.
  - d. Provide a Class 10 overload for motor protection while operating in bypass mode.
- 19. Control Power Transformer:
  - a. Provide a control power transformer mounted and wired inside of the drive system enclosure.
  - b. The transformer shall be rated for the VFD power requirements.
- 20. Auxiliary Relays:

- a. Provide relays for Drive Alarm, Drive Fault, Drive Run, and System Status Faults (as required).
  - b. Refer to Specification 16902 for relay requirements.
21. Control Interface:
- a. The control terminals shall be rated for 600VAC. Refer to Specification 16143 for Terminal Block requirements.
  - b. Inputs shall be optically isolated from the drive control logic.
  - c. The control interface card shall provide input terminals for access to fixed drive functions that include start, stop, external fault, speed and enable.
22. Motor Heater Control
- a. The drive system shall provide the drive control circuitry to energize an existing motor heater whenever the motor is not running.
  - b. The heater control shall be interlocked with the drive and/or bypass and shall be energized whenever the motor is not running.
  - c. Refer to Specification 16902 for enclosure door control device requirements.

### PART 3 - EXECUTION

#### 3.1 FIELD PREPARATION AND PAINTING

- A. Finish painting and field preparation shall be performed as specified in Section 09900, Painting.
- B. The CONTRACTOR shall touch-up all shipping damage to the paint as soon as the equipment arrives on the job site.
- C. Prior to the assembly all stainless steel bolts and nut threads shall be coated with a non-seizing compound by the CONTRACTOR.

#### 3.2 INSPECTION AND TESTING

- A. The manufacturer of the mechanical surface aerators shall furnish services of a factory representative who has complete knowledge of proper operating and maintenance to inspect the final installation and supervise a test run of the equipment. The manufacturer shall furnish two separate trips and four days total onsite service.
- B. The test runs on the mechanical aerators shall be undertaken with water in the aeration tanks filled up to the high water elevation shown on the Drawings. The CONTRACTOR shall be responsible for providing sufficient water, or treated wastewater for filling tanks prior to arrival of the manufacturer's representative for the test runs on the aerators.

- C. After the aerator is installed and aligned, and the manufacturer's recommendations for initial startup have been implemented, the aerator shall be run at full speed and full load for a minimum of two hours after the oil temperature has stabilized. The gear reducer housing and shaft seals shall be checked for leakage of lubricant. Any leaks shall be corrected and the temperature rise of the lubricant in the oil sump of the gear reducer shall not exceed 100 degrees F above ambient.
- D. In the event of improper installation, the CONTACTOR and the manufacturer shall be responsible for supervising the correction of the work and subsequent test runs until the defects are corrected.

### 3.3 INSTALLATION

- A. Installation of the equipment specified herein shall be in strict accordance with contract documents and requirements of the manufacturer's written instructions and Shop Drawings. It is CONTRACTOR'S responsibility to verify the accuracy of all necessary dimensions in the field to ensure compatibility with the specifications and equipment.

### 3.4 MANUFACTURER'S FIELD SERVICES

- A. CONTRACTOR shall provide the following services in addition to any other services specified herein, and required by these Specifications. CONTRACTOR shall coordinate field service work with manufacturer's representative, OWNER and ENGINEER prior to initiating such Work. An experienced, competent, and factory trained representative of the equipment manufacturer shall travel to the job site a minimum of two times to provide the following services:
  - 1. Installation/Start-Up Certification:
    - a. Inspect the installation of the equipment covered by these specifications.
    - b. Supervise and complete pre-start up adjustments and installation checks.
    - c. Conduct initial start-up of equipment and perform operational checks.
    - d. Provide a written report certifying that the manufacturer's equipment has been installed properly, started up, and is ready for operation. The report shall conform to the requirements of Specification Sections 01400, Quality Control, and 01650, Starting of Systems.
    - e. Installation/start-up shall conform to Specification Section 01650, Starting of Systems.
  - 2. Training:
    - a. CONTRACTOR shall provide manufacturer's representatives to train OWNER'S personnel in operation and maintenance procedures. The representatives shall present training programs and on-site demonstrations designed to fully acquaint plant personnel at a minimum for the following items:
      - 1) All equipment features.
      - 2) Routine scheduled maintenance procedures.

- 3) Alternative operational modes.
- 4) Emergency procedures.
- 5) Spare parts inventories.
- 6) Demonstration of the performance requirements of the Specifications.
- 7) Training shall conform to the requirements of Specification Section 01650, Starting of Systems.

B. All costs including travel, lodging, meals, and incidentals for the manufacturer services shall be included in the CONTRACTOR'S price.

END OF SECTION

## SECTION 16111

### CONDUITS

#### PART 1 - GENERAL

##### 1.1 SCOPE OF WORK

- A. Furnish and install conduits as required and as shown on the Drawings. Materials employed shall be as shown on the Drawings.

##### 1.2 SUBMITTALS

- A. Submit product literature including manufacturer part number, model number, material, size, and specifications. Material shall not be installed until the ENGINEER has reviewed the submittal data.
- B. Shop Drawings shall be submitted for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit and any related Work.
- C. Proposed routing of conduits buried under floor slabs-on-grade.
- D. Identify conduit by tag number of equipment served or by circuit schedule number.
- E. Proposed routing and details of construction including conduit and rebar embedded in floor slabs, columns, etc. Identify conduit by tag number of equipment served or by circuit schedule number.
- F. Proposed location and details of construction for openings in slabs and walls for raceway runs.
- G. Refer to Section 16000, General Electrical Requirements, for further submittal requirements.

##### 1.3 REFERENCES

- A. American National Standards Institute (ANSI): C80.1, Rigid Steel Conduit - Zinc-Coated.
- B. National Electric Manufacturers Association (NEMA), RN-1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit.

- C. Underwriters Laboratories Inc. (UL):
1. 1, Flexible Metal Conduit.
  2. 6, Rigid Metal Conduit.
  3. 360, Liquid-Tight Flexible Steel Conduit.
  4. 467, Grounding and Bonding Equipment.
  5. 514, Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers.
  6. 651, Schedule 40 and 80 Rigid PVC Conduit.
  7. 870, Wireways, Auxiliary Gutters, and Associated Fittings.
  8. 884, Underfloor Raceways and Fittings.
  9. 886, Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

## PART 2 - PRODUCTS

### 2.1 RACEWAYS

- A. Exposed conduit in an unclassified or hazardous area shall be galvanized rigid steel (GRS) unless specifically indicated otherwise on the Drawings. Conduits in wet and corrosive areas shall be PVC coated GRS, unless otherwise indicated. Underground and/or concrete encased conduits shall be PVC, unless otherwise indicated. All wiring, except as otherwise noted, shall be in conduit. Conduit size shall not be less than the National Electrical Code (NEC) size required for the conductors therein and shall not be smaller than 3/4-inch. No underground conduit shall be less than 1-inch.
- B. Condulet type fittings shall be Crouse-Hinds, Appleton, or equal with wedge nut covers. All condulets located outdoors or in wet locations shall be weathertight.
- C. In unclassified areas, flexible conduit shall be grounding type, weatherproof, corrosion resistant, and watertight.
- D. Couplings, connectors, and fittings shall be standard types specifically designed and manufactured for the purpose. They shall be installed to provide a firm mechanical assembly and electrical conductivity throughout.
- E. Expansion fittings shall be OZ type AX with jumper for exposed locations and Type DX at structural expansion joints, Spring City, or equal. Conduits shall have expansion fittings in accordance with NEC.
- F. The conduits and fittings shall be supported per NEC requirements as a minimum.

### 2.2 GALVANIZED RIGID STEEL (GRS)

- A. Conduit and couplings shall be hot-dipped galvanized with zinc coated threads and outer coating of zinc bichromate, in accordance with ANSI C80.1 Standards,

as manufactured by Jones & Laughlin Steel Corporation, Allied Tube & Conduit Corporation, Triangle PWC, or equal.

- B. Steel conduit shall not be buried in earth without concrete encasement and additional corrosion protection. A half lapped rapping of 20 mil PVC based corrosion protection tape shall be used.

### 2.3 PVC COATED GALVANIZED RIGID STEEL (PVC-GRS)

- A. PVC coated GRS conduit shall be installed where shown on the Drawings or elsewhere specified and shall conform to NEMA RN-1 and ANSI C80.1 Standards.
- B. The zinc surface of the conduit shall remain intact and undisturbed on both the inside and the outside of the conduit throughout the preparation and application processing. A Polyvinyl Chloride (PVC) coating shall be bonded to the galvanized outer surface of the conduit. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic. The thickness of the PVC coating shall be a minimum of 0.040-inch (40 mil).
- C. A loose coupling shall be furnished with each length of conduit. A PVC coating shall be bonded to the outer surface of the coupling and a PVC sleeve equal to the outside diameter of the uncoated conduit shall extend beyond both ends of the coupling approximately one pipe diameter or 1-1/2-inches, whichever is smaller. The wall thickness of the coating on the coupling and the sleeve shall be a minimum of 0.040-inch (40 mil).
- D. A PVC coating shall be bonded to the inner and outer surface of all conduit bodies and fittings and a PVC sleeve shall extend from all hubs. The wall thickness of the coating on conduit bodies and fittings and the sleeve walls shall be identical to those on couplings in length and thickness. The covers on all conduit bodies shall be coated on both sides and shall be designed to be completely interchangeable. The inside of conduit bodies shall remain undisturbed in the processing.
- E. Type 304 stainless steel screws shall be furnished and used to attach the cover to the conduit body. All coated material shall be installed and patched according to the manufacturer's recommended installation and patching instructions.
- F. Conduit straps shall be PVC coated or stainless steel.
- G. PVC coated conduit and fittings shall be as manufactured by Rob-Roy, or equal.
- H. PVC coated flexible conduits shall be liquid and vaportight and manufactured in accordance with UL 360 Standards.



## 2.4 RIGID NONMETALLIC - PVC

- A. Where specifically indicated on the Drawings, or elsewhere specified, conduit may be high density Schedule 40, 90° C, heavy-duty PVC. The conduit shall be manufactured from virgin polyvinyl chloride compound which meets ASTM D1784, NEMA TC-2, ANSI C33.91, and UL 651 Standards. Smoke emissions shall be limited to less than 6 grams per 100 grams of material tested.
- B. Where conduit concrete encasement is indicated on the Drawings, conduit supports shall be installed at 5 foot intervals. PVC conduit shall be manufactured by Carlon, Triangle Conduit & Cable, or equal.

## 2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Liquidtight flexible metal conduit shall be liquid and vaportight, oil and ultraviolet ray resistant, and manufactured in accordance with UL 360 Standards. Liquidtight flexible metal conduit shall be formed of a continuous, spiral wound, galvanized steel core with an extruded PVC jacket. The PVC jacket shall be rated for high ambient heat applications, 90° C.
- B. For corrosive locations, liquidtight flexible metal conduit shall be formed of a continuous, spiral wound, aluminum core with an extruded PVC jacket. The PVC jacket shall be impervious to corrosive liquids and vapors.
- C. An external bonding conductor shall be required for flexible conduit connections containing circuits rated at 60 amps or greater and for sizes 1-1/2-inches or larger. Flexible conduit and connectors for 1-1/4-inches and smaller shall be listed for grounding.
- D. Connectors for liquidtight flexible conduit shall be galvanized, furnished with a sealing ring and locknut, and suitable for wet locations.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Conduit runs are schematic only, and shall be modified as required to suit field conditions, subject to review and acceptance by the ENGINEER.
- B. Conduit shall run continuously between outlets and shall be provided with junction boxes where connections are made. Couplings, connectors, and fittings shall be acceptable types designed and manufactured for the purpose, and shall provide a firm mechanical assembly, and electrical conductivity throughout.

- C. Conduit runs shall be straight and true. Elbows, offsets, and bends shall be uniform and symmetrical. Changes in direction shall be made with long radius bends, or with fittings of the conduit type.
- D. Conduit runs in buildings and structures shall be exposed except as specifically noted or accepted by the ENGINEER.
- E. Conduit runs shall not interfere with the proper and safe operation of equipment, and shall not block or interfere with ingress or egress, including equipment removal hatches.
- F. Exposed conduits shall be securely fastened with clamps, or straps, intended for conduit use. All exposed conduit shall be run on the walls and ceiling only and shall be parallel to the planes of the walls or ceiling. No diagonal runs will be permitted. Flexible conduit shall be used only for short lengths required to facilitate connections between rigid conduit to motors from junction boxes, or control equipment.
- G. Conduit runs on water-bearing walls shall be supported 1-inch away from the wall on an accepted channel. When channel galvanizing, or other coating, is cut or otherwise damaged, it shall be field coated to original condition. No conduit shall be run in water-bearing walls, unless specifically designated otherwise.
- H. Conduit shall be thoroughly reamed to remove burrs. IMC or GRS shall be reamed during the threading process, and rigid nonmetallic PVC shall be reamed before applying fittings. A zinc rich cold galvanizing shall be used to restore corrosion protection on field cut threads. Bushings and lock nuts or hubs shall be used at conduit termination's. The total number of bends in any run between pull points shall not exceed 360 degrees. Junction boxes and pull boxes shall be installed at points acceptable to the ENGINEER. Conduit ends shall be plugged to prevent the entrance of moisture or debris during construction. All spare conduits shall be adequately capped and shall contain a suitable pull string.
- I. Joints shall be set up tight. Hangers and fastenings shall be secure, and of a type appropriate in design, and dimensions, for the particular application.
- J. Conduit runs shall be cleaned and internally sized (obstruction tested) so that no foreign objects, or obstructions remain in the conduit prior to pulling in conductors.
- K. After installation of complete conduit runs 2-inches and larger, conduits shall be snaked with a conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85% of the nominal diameter of the conduit. Conduits through which the mandrel will not pass shall not be used.

- L. Expansion fittings shall be installed across all expansion joints and at other locations where necessary to compensate for thermal expansion and contraction.
- M. Provide trenching, backfill, and compaction for conduits installed underground.
- N. Unless approved in advance by the ENGINEER, all conduits which transition from underground to aboveground will utilize galvanized rigid steel conduit for the bend from horizontal to vertical and for the extension above the ground. Factory 90 degree GRS bends shall be used. GRS bends and conduits shall be half lapped with 20 mil PVC tape in non-corrosive areas and shall be PVC coated rigid steel in corrosive areas. Tape wrapping shall extend a minimum 6-inches above top of slab or above finished grade.
- O. Liquid tight flexible metallic conduit 1-1/2-inch and larger shall be provided with grounding style bushings and shall have an external ground wire sized and installed in accordance with the NEC.

END OF SECTION

## SECTION 16611

### STATIC UNINTERRUPTIBLE POWER SUPPLY

#### PART 1 - GENERAL

##### 1.1 SCOPE OF WORK

- A. This Section covers the requirements for uninterruptible power supplies (UPSs) to be provided as shown on the Drawings.

##### 1.2 SUBMITTALS

- A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and the Contract Documents, prior to installation.

##### 1.3 REFERENCES

- A. National Electrical Code (NEC) Article 250.

#### PART 2 - PRODUCTS

##### 2.1 GENERAL REQUIREMENTS

- A. The UPS equipment shall be manufactured by APC, Model Smart-UPS, or Equal (1,500 VA minimum) with Relay I/O card to monitor UPS Trouble, and UPS On Battery. Contacts to be wired to Digital Inputs on PLC.
- B. The UPS shall be sized for a minimum of 30 minutes of backup power for its connected load.
- C. The UPS shall be a line-interactive type, consisting of a Ferro resonant or linear transformer, battery charger, batteries, inverter, and microprocessor control. The batteries shall be maintenance free, premium type.
- D. The UPS shall pass lightning and surge protection ANSI/IEEE C62.41 standards, Category A and B. The UPS shall be UL 1449 listed.
- E. The output waveform shall be a pure sine-wave with less than 5% total harmonic distortion on the inverter.
- F. The UPS shall have a digital display for load-dependent runtime, volts in, volts out, battery voltage, percent loading, and alarm codes.

- G. The UPS shall operate between 0° C and 40° C, at a minimum of 95% efficiency on-line.
- H. Provide one external maintenance bypass switch for each UPS, rated for a minimum of UPS's full input and output load, capable of transferring the UPS's full load with a maximum interruption of 4-milliseconds.
  - 1. Provide one UPS and UPS maintenance Bypass Switch in process rack and each control panel enclosure with a PLC.
  - 2. Provide a UPS for each workstation. Maintenance UPS Bypass switch is not required for workstations.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install the UPS equipment in accordance with the manufacturers' recommendations.
- B. The UPS shall be provided with a two year parts and factory service warranty.

END OF SECTION

## SECTION 16912

### ETHERNET NETWORK EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SCOPE OF WORK

- A. This Section covers the requirements for equipment required to be provided and installed as shown on the plans for the communications system architecture and Ethernet network and specified herein.
- B. Products specified herein shall be furnished and installed without substitution. The Work shall be coordinated and scheduled with the ENGINEER and the OWNER.
- C. Plant control system shall remain operational wherever possible. No control system shall be shut-down without the approval of the ENGINEER and the OWNER.

##### 1.2 SUBMITTALS

- A. Products shall be submitted to ENGINEER for review in accordance with Section 01300, Submittals, and the Contract Documents, prior to installation.

#### PART 2 - PRODUCTS

##### 2.1 ETHERNET SWITCH REQUIREMENTS

- A. Ethernet Switch RJ-45 Copper.
  - 1. The Ethernet switch shall have the number of ports as shown in the Drawings or more. The Ethernet switch shall have LEDs for power, ready, communication error, and active status. The Ethernet switch shall be powered from a 120 VAC or 24 VDC source.
  - 2. Each port shall be standard RJ-45 8 pin. Ethernet switch shall be DIN rail or back panel mounted.
- B. Ethernet Switch with Copper and Fiber Optic ports.
  - 1. The Ethernet switch shall have the number of ports as shown in the drawings or more. The Ethernet switch shall have LEDs for power, ready, communication error, and active status. The Ethernet switch shall be powered from a 120 VAC or 24 VDC source.

2. Each port shall be standard RJ-45 8 pin and 2 uplink SFP ports for multimode fiber connection.
  3. Ethernet switch shall be DIN rail or back panel mounted.
- C. Approved Ethernet switch manufacturers and accessories:
1. Cisco ie3000 Layer2/3
  2. Cisco (2) GLC-GE-100FX-RGD SFP, or compatible
  3. LC-ST OM1 multimode fiber optic patch cable
  4. Or equal

## 2.2 CATEGORY 6 ETHERNET CABLE

- A. Ethernet cables shall be as required per drawings. Ethernet cables shall be 4 twisted pair 24 gauge solid copper known as Category 6 Ethernet Cable.
- B. Individual cable lengths between equipment shall be no longer than 100 meters.
1. Cables listed as UTP are Unshielded Twisted Pair cable.
  2. Cables listed as STP are Shielded Twisted Pair cable for RF noisy environments.
  3. Straight-Through cables are paired for normal connections.
  4. Cross-Over cables are paired for T568A and the other as T568B.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install all the above equipment, as indicated on the Plans and in accordance with the manufacturer's recommendations.

### 3.2 START UP AND TESTING

- A. Upon completion of the installation, the CONTRACTOR shall provide two days of start up and testing assistance to the OWNER'S programmer to remedy networking cable and equipment issues.

END OF SECTION

## SECTION 17450

### HUMAN MACHINE INTERFACE SOFTWARE AND HARDWARE

#### PART 1 - GENERAL

##### 1.1 SCOPE

- A. The Human Machine Interface (HMI) software shall be provided and configured for this project. The HMI software packages include, but are not limited to, database and graphics development, run-time displays, I/O communication device drivers, alarming, logging, trending, and reporting functions.

##### 1.2 GENERAL

- A. The specified Control Descriptions along with signals allocated in the P&IDs shall be used to develop the PLC control logic and the graphical user interface (GUI). The addition or modification of HMI software signals during construction and start-up to meet the requirements of the original specifications shall be implemented at no extra cost to the OWNER. Memory Type I/O tag names that must be created for the HMI software are not listed, and shall be provided as required at no extra cost to the OWNER.
- B. The CONTRACTOR shall coordinate with all OEM vendors the software platform that is to be used plant wide. And that the HMI screens are to be integrated to the Plant HMI system.
- C. The CONTRACTOR shall purchase the required software and deliver it to the HMI programmer at the same time as the PLC and HMI system equipment. The HMI programmer will program and configure the system and return it to the CONTRACTOR. The CONTRACTOR shall be responsible for all associated shipping and handling charges.

#### PART 2 - PRODUCTS

##### 2.1 HUMAN MACHINE INTERFACE SOFTWARE

- A. The software shall provide an open architecture configuration able to transfer data from the PLC(s) to all PCs connected on the network. Additionally, the data shall be accessible, over network or telephone lines to remote PC's via internet VPN connections.



## 2.2 FEATURES

- A. Data transfer shall exist from the PLC Network to the HMI software database via Dynamic Data Exchange (DDE) using the provided software communication drivers. DDE data transfer shall also be required to other PLC's and PC's on the LAN with external access via network or telephone lines to remote PC's via internet VPN connections.
- B. All software shall be compatible with the latest version of Microsoft Windows 10 operating system.
- C. NetBIOS networking protocol will be supported.
- D. Unlimited number of windows for graphics displays.
- E. Configurable 4-pen real-time trend charts with an unlimited number of charts per application.
- F. 999 alarm priorities are available for an unlimited number of alarms. Alarms shall be displayed in summary and historically with logging to a printer available as required for individual tags.
- G. Eight levels of alarm group hierarchy with up to 16 subgroups.
- H. Support for mouse, track ball, touch screen, and stylus pen.
- I. Historical trend charts with up to 8 pens using run-time selectable tag names. Capabilities shall include zooming, scrolling, and centering of charts. Historical data shall be logged to disk and displayed on the screen, with the option available to print any portion. Data shall be exportable to Microsoft Excel, Microsoft Access, text files, or any other DDE aware program.
- J. Graphics shall be object-oriented and capable of high-resolution (1,920 x 1,080 pixels minimum) with unlimited animations per window.
- K. 9999 configurable levels of password protection.
- L. Unlimited number of animation links per object. Animation capabilities shall include Discrete, Analog and String Touch inputs; Horizontal and Vertical Sliders; Discrete and Action Push Buttons; Show and Hide Window links; Object Height and Width links; Vertical and Horizontal Position links and fills; Visibility links; Rotation and Blink links; Discrete, Analog and String Value Output links.

- M. Polling shall be “reporting by exception”. Only points that change on screen, alarm points, historically logged points, or background logic points, shall be polled.
- N. Internal calculations used in logical and mathematical expressions shall use single or double precision floating point numbers.
- O. A built-in logic program space for prototyping, background calculations, and simulation via high-level action script, shall be included.
- P. The HMI software shall be the latest version of Wonderware InTouch 2014R2.  
Provide software and licensing for (1) development and (1) runtime with I/O driver, along with (1) historian and client. The Wonderware license tagging is to be based on the contract I/O with additional 250 spare I/O for future expansion. Historian should be based on 500 tag minimum.

### 2.3 DEVELOPMENT WORKSTATION WITH HISTORIAN

- A. PC Manufacturers:
  - 1. Dell.
  - 2. Or equal
- B. Minimum PC specifications:
  - 1. Processor: Intel i5 Quad Core 3.3GHz or greater
  - 2. Cache: 6 MB.
  - 3. RJ45 Ethernet network interface port 1Gbit Baud.
  - 4. Operating System: Windows 10, latest version..
  - 5. RAM Memory: 16 GB DDR RAM minimum.
  - 6. Raid 5 with raid controller.
  - 7. Hard Drive 1: 1TB GB SATA (7,200 RPM) minimum.
  - 8. Hard Drive 2: 1TB GB SATA (7,200 RPM) minimum.
  - 9. Hard Drive 3: 1TB GB SATA (7,200 RPM) minimum
  - 10. DVD +/-RW: 16x with 24 blank recordable DVD +/-RW.
  - 11. Video Card: Dual NVidia Quadro with 2 DP, or equal.
  - 12. Documentation: CD.
- C. Quantity: One.

### 2.4 RUNTIME CLIENT WORKSTATION

- A. PC Manufacturers:
  - 1. Dell.
  - 2. Or equal
- B. Minimum PC specifications:
  - 1. Processor: Intel i5 Quad Core 3.3GHz or greater

2. Cache: 6 MB.
3. RJ45 Ethernet network interface port 1Gbit Baud.
4. Operating System: Windows 10, latest version..
5. RAM Memory: 8 GB DDR RAM minimum.
6. No Raid.
7. Hard Drive 1: 500MB GB SATA (7,200 RPM) minimum.
8. DVD +/-RW: 16x with 24 blank recordable DVD +/-RW.
9. Video Card: Dual NVidia Quadro with 2 DP, or equal.
10. Documentation: CD.

C. Quantity: One.

## 2.5 WORKSTATION MONITOR (DISPLAYS)

A. Manufacturers:

1. Dell or equal.

B. Type:

1. High performance 24" LCD Flat screen monitor.
2. Support for full HD, 1,920 x 1,080 resolution, minimum.
3. On Screen Display (OSD) to adjust monitor settings.
4. Energy Star compliance for energy savings.
5. TCO95 compliance for low electromagnetic emissions.
6. Plug and Play support.

C. Quantity: Two monitors per Development workstation. One monitor per Runtime Workstation.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

Provide and install the HMI software package with the communication drivers needed to acquire data from the PLC Network. This software shall include necessary run-time and input/output (I/O) development package drivers.

### 3.2 ADDITIONAL SOFTWARE

A. Provide the following application software packages:

1. Win-911 with telephony modem.
2. Two complete packages of the latest version McAfee Total Protection.
3. Two complete packages of the latest version of the Microsoft Office Professional on CD-ROM.

4. Reporting Software with a minimum of 10 reports as required by OWNER and reporting agencies. To include weekly, monthly, quarterly, semi-annually and annual reports.
  - a. Manufacturers:
    1. Crystal Reports
    2. Dream Reports
    3. or Approved Equal

### 3.3 PROCESS RACK EQUIPMENT

#### A. Rack

1. Rack to be 14U portable roll-able rack with casters capable of handling 500lbs.
2. Racks shall be able to accommodate all standard 19" frames or components.
3. Provide key-locked front and rear door complete with key.
4. Provide NEMA-1 rated, locking casters, 16 gauge steel cabinet.
5. Provide fans for ventilation.
6. Approved Manufacturers:
  - a. Middle Atlantic. PTRK series

#### B. Ethernet Switch

1. Properties:
  - a. Hardware: 19-inch rack mountable
  - b. Power Supply:
    1. 120VAC, 60 Hertz, 1 phase
    2. Console management port
    3. Layer2/3
      - a. Performance:
        1. Forward Rate: 95.2 Mpps
        2. Switch bandwidth: 216 Gbps, min.
        3. Gigabit throughout
  - c. Environment:
    1. Operating Temperature: 32 to 113°F
    2. Humidity: 10 to 95 percent, non-condensing
  - d. Managed switch. Additional features available through software setup includes but not limited to:
    1. Port Monitoring
    2. Remote switch management
    3. Port security
    4. Switch Meshing
    5. Rapid spanning tree protocol.
  - e. Type:

1. Provide a 24 x 10/100/1000 ports with (2) Gbit SFP slots, mini-GBIC type
  2. Provide (2) Cisco GLC-GE-100FX-RGD Compatible 100Base-FX SFP (mini-GBIC) module.
2. Approved Manufacturers:
  - a. Cisco 2960 series
  2. No Equal
- C. UPS & Bypass Switch
  1. Shall meet the general requirements of Section 16611 and be rack mountable.
- D. Rack Mounted Fiber Optic Patch Panel
  1. Manufacturers:
    - a. Corning Cable Systems
    - b. Or Approved (Equal)
  2. Type:
    - a. Fiber patch panels shall be provided as complete units including the housing, the connector panels, mounting hardware and fiber connectors.
    - b. Patch panels shall be provided with hardware for a standard 19-inch rack mounting.
    - c. Capacity: Provide patch panel for 48 strand fiber terminated with ST type connector.
    - d. Final connections between patch panel and the fiber optic network equipment shall be made via fiber optic patch cords.

END OF SECTION

## SECTION 17451

### PROGRAMMABLE LOGIC CONTROLLER SYSTEM

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes solid state programmable controller.
- B. PLC Assembly: Provide a PLC assembly, as shown on the Drawings. A PLC assembly consists of PLC processor, discrete and analog I/O bases, communication ports, and power supplies.
- C. PLC assembly at the new wells shall be mounted in a PLC NEMA 3R enclosure, as shown on the Plans.

##### 1.2 SUBMITTALS

- A. Design Data:
  - 1. Modbus Plus addressing scheme.
  - 2. Modicon M340 PLC I/O and communication configuration.
- B. Operating and Maintenance Manuals: Include the following:
  - 1. Programming procedures.
  - 2. System specifications.
  - 3. Electrical power requirements.
  - 4. Submit per Section 01300, Submittals.

##### 1.3 PLC HARDWARE AND OPERATING SOFTWARE

- A. Provide programmable logic controller system components by a single manufacturer.
- B. Provide programmable logic controller system manufacturer approved hardware, such as cable, mounting hardware, connectors, enclosures, racks, communication cable, splitters, terminators, and taps.
- C. Programmable Logic Controller System Manufacturer: Modicon M340 CPU BMX P34 2010 minimum, or equal, or as shown on the Drawings.
- D. Extend existing City software license as required by manufacturer's copyright for use with equipment provided under this Contract.

## 1.4 ENVIRONMENTAL REQUIREMENTS

- A. Environmental Rating for Components of the Programmable Logic Controller System, except the Programming Equipment:
  - 1. Humidity: Maximum 95%, non-condensing.
  - 2. Ambient Temperature:
    - a. Operational: 0° C to 60° C.
    - b. Storage: -40° C to 80° C.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Programmable Logic Controller System: Modicon M340 PLC minimum, or equal, or as shown on the Drawings.

### 2.2 PROGRAMMABLE LOGIC CONTROLLER SYSTEM DESCRIPTION

- A. Programmable Logic Controller System: Underwriter Laboratories listed and CSA approved; Modular, capable of field expansion with additional hardware and software to allow tailoring of the system to process control applications.
- B. When Programmable Logic Controller Loses DC Power:
  - 1. Outputs shall immediately turn off (De-energize).
  - 2. Internal battery shall provide power to retain user logic, controller configuration information, and data register contents for at least nine months.
- C. Diagnostic LEDs: Capable of indicating major status conditions of the programmable logic controller.
  - 1. Upon power-up or power recovery, the programmable logic controller shall self-test operation of the microprocessor, check memory for integrity, verify communication between boards, and reset and resume the logic solving scan only when satisfactory.
  - 2. During each processing cycle, the programmable logic controller shall execute diagnostic routines or critical components within the system. Run time diagnostics shall determine causes of errors, flag causes, and locate failed I/O modules.
  - 3. Diagnostic information shall be available to maintenance personnel through the use of a computer based interface or other memory access devices.
- D. Memory Capacity: Maximum 75% design utilization.

## 2.3 PROCESSOR

- A. PLC processors shall be Modicon Compact Model BMX P34 2010 minimum or equal unless designated otherwise on the Drawings. Provide an exterior mounted communication port suitable for programming the CPU with the programming computer defined in these Specifications. The PLCs shall be capable of performing logic control functions described in these Specifications based upon the program stored in memory and the status of I/Os.
- B. Upon processor shutdown, outputs shall de-energize and go into a safe shutdown mode.
- C. Processor: Capable of being programmed by one or more of the following:
  - 1. Compatible PC with RS-232 Serial, or Ethernet or USB serial comms.
- D. Minimum Processor Standard Control Functions:
  - 1. Relay ladder logic.
  - 2. Latch/unlatch relays.
  - 3. Timers (0.01 sec., 0.1 sec., and 0.1 min.).
  - 4. Counters (up/down).
  - 5. Data comparisons/transfers.
  - 6. Synchronous shift registers (forward/reverse).
  - 7. Transitional output.
  - 8. Master control relay.
  - 9. Bit read and control.
  - 10. I/O forcing.
  - 11. BCD to binary and binary to BCD conversion.
  - 12. Immediate I/O update.
  - 13. Run mode programming.
- E. Additional Processor Features:
  - 1. Computer/Network Communication Interface.
  - 2. ASCII output (data handling and report generation).
  - 3. Protected logic.
  - 4. Proportional Integral Derivative Process Control.
  - 5. Multiple Function Integer and Floating Point Math.
  - 6. PLC/Radio Telemetry Communication Interface.
- F. Processor: Capable of addressing I/O modules and PLCs using Modbus Plus or TCP/IP communications network.
- G. All control functions at the respective well site shall be resident at the respective processor.



## 2.4 PROGRAM STORAGE

- A. Solid state RAM (volatile) type.
- B. RAM Battery Backup: Capable of retaining stored program information through a continuous power outage of at least nine months.
- C. Memory Word: Comprised of 16 data and 2 parity bits.
- D. Logic Words: Checked for parity upon being read from memory. Detection of a parity error shall cause immediate system shutdown and be indicated by a visual display.
- E. The system shall have the capability to program software timers and counters into memory.
- F. Timer Time Bases: Selectable from 0.01 second, 0.1 second, and 0.1 minute, minimum.

## 2.5 INPUT AND OUTPUT - GENERAL

- A. Input or Output: Modules configured to process discrete inputs, discrete outputs, and analog inputs and analog outputs shown on Instrumentation Drawings. Input and output modules shall be Modicon or equal and specifically recommended for Modicon M340 PLC platform or equal.
- B. During normal operation, a malfunction in a remote I/O channel shall affect the operation of only the malfunctioning channel and not the operation of the CPU or other channels.
- C. Upon remote channel shutdown the processor shall see inputs as de-energized on the malfunctioning channel and outputs shall de-energize on the malfunctioning channel.
- D. User Wiring to I/O Modules: Through a heavy-duty terminal strip.
- E. Power Input: 24VDC protected against short circuits with integral overcurrent and overvoltage protection.
- F. Cables, Terminators, Connectors, Miscellaneous Hardware: Provide complete PLC assembly ready for use and mounting within a CONTRACTOR supplied panel.

## 2.6 MODICON M340 HARDWARE COMPONENTS OR EQUAL

- A. Modicon Part Numbers:

<u>Part No.</u>	<u>Description</u>
PS120	BMX CPS 2000/3500 120VAC Power Supply
DI	BMX DAI 1604 16 Point 120 VAC Discrete Input Module
DO	BMX DAO 1605 16 Point 120 VAC Discrete Output Module
AI	BMX AMI 0810 8 Channel 4-20 mA Isolated Analog Input Module
AI	BMX AMI 0410 4 Channel 4-20 mA Isolated Analog Input Module
AO	BMX AMO 0410 4 Channel 4-20 mA Isolated Analog Output Module
Remote I/O Adapter - BMX-PRA-0100	
Ethernet Module – BMX NOE-0100/0110	

- B. Analog inputs shall have a minimum of 12 bits resolution and shall be configurable for 4 to 20 mA DC. The analog input shall be Modicon AMI 0410/0810 and shall be configured for current input by inserting the appropriate jumper settings on the module for the channels that will be in use. Ground the shield of each signal cable at the AMI 0410/0810 only. Provide external or user power as needed.
- C. The analog outputs shall have four independently configurable channels and can provide true 12 bit resolution with high an accuracy of (+0.2% of full scale @ 25° C).
1. The module will have the capability of detecting open current loop (broken wire) detection and warnings via LEDs and registers. The analog output shall be a Modicon AMM 0410/0810 and shall be configured for current output by setting the appropriate jumper settings on the module for the channels that will be in use. Ground the shield of each signal cable at the AMM 0410/0810 only.
- D. The discrete input shall be Modicon DAI 1604 Input and shall have 16 Optocoupled Isolated Inputs. Module response time shall be 4 ms typical. Equipment installation following approved EMC practices; i.e., protective earthing and functional earthing, connections with good conductivity, and grounding cables of sufficient cross section. Use manufacture-approved cabling. Cable routing; i.e., separation of the data and signal lines from cables, which emit disturbances (e.g., power cables with switching transients). Provide external or user power as needed.
- E. 16-point Output Module: Source voltage for any output load shall be 120VAC. Manufacture recommendations and practices will be followed. Equipment installation following approved EMC practices; i.e., protective earthing and functional earthing, connections with good conductivity, and grounding cables of sufficient cross section. Use manufacture approved cabling. Cable routing; i.e., separation of the data and signal lines from cables, which emit disturbances (e.g., power cables with switching transients). Provide interposing relays for all digital outputs.
- F. Indicator lights shall also be provided on each I/O point to indicate status of each signal. Each individual input or output point shall be optically isolated to protect the controller I/O circuitry from high voltage transients. External wiring shall terminate on removable terminal strips, or swing arms to allow quick installation, or extraction

of I/O modules without disconnecting field wiring. Labels shall be provided on modules, or wiring arms that indicate the I/O address of each termination.

## 2.7 PROGRAMMING SOFTWARE

- A. See Specification 17452, Programmable Logic Controller System Software and Accessories.

## 2.8 OIT (Operator Interface Terminal)

- A. See Specification 17445, Operator Interface Terminal Software and Hardware

## PART 3 - EXECUTION

### 3.1 SPARES

- A. Furnish a minimum of one spare I/O module of each type.
- B. Furnish 10 fuses of each type and size used in the power supply and I/O modules.
- C. Furnish one spare DC power supply to match each type of units furnished.
- D. Furnish one spare processor.
- E. Furnish one spare Flash Memory Card - BMX RMS 008MPF programmed with current program.

END OF SECTION

## SECTION 17455

### OPERATOR INTERFACE TERMINAL SOFTWARE AND HARDWARE

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

- A. Supply and programming of Operator Interface Terminals (OIT's) used to monitor and control electrical and process equipment.
- B. Startup and commissioning of control systems using OIT's.
- C. Programming software supplied to owner.

##### 1.02 SUBMITTALS

- A. Manufacturers literature showing:
  - 1. Physical characteristics, dimensions, and weights.
  - 2. Mounting and installation requirements.
  - 3. Wiring information including power requirements and communication capabilities and cabling information.
  - 4. Available memory and screen storage information.
  - 5. Recommended spare parts.
  - 6. OIT screen development software information including:
    - a. Minimum computer memory requirements for installation and use.
    - b. Communication ports and cables to download OIT programs.
- B. Proposed OIT screens showing the following:
  - 1. Number of proposed screens.
  - 2. Proposed color and graphics standards for OIT screen development.
  - 3. Menu tree showing how the operator will access all screens
  - 4. Description of each screen listing control and display points and indicating what actions the operator may perform on the screen.

##### 1.03 GENERAL

- A. OIT's are to be new, the most current version, and compatible with PLC's provided for this project.
- B. Provide the latest version of the OIT programming software and use it to develop the OIT screens. License the software in the name of the owner. Deliver it to the Owner's programmer within 30 days of accepted plant startup or the stated date of project substantial completion.

## PART 2 - PRODUCTS

### 2.01 OPERATOR INTERFACE TERMINAL

- A. Manufacturer shall be Modicon/Magelis GTO, HMIGTO5310.
- B. Shall communicate directly with the PLC via ethernet.
- C. Shall be minimum 10" diagonal screens, color, with touchscreen keys.
- D. Shall be capable of alarm detection and processing, discrete and analog display and control.

## PART 3 - EXECUTION

### 3.01 OPERATION INTERFACE TERMINAL

- A. Mount the OIT in the control panel at an elevation and location convenient for operator access.
- B. Program the OIT to perform all control and monitoring functions required by these specifications and the drawings.
- C. Test the programming to verify all required functions.
- D. Provide startup and commissioning assistance to make the plant operational.
- E. Deliver "As Built" OIT programs, documentation, and original programming disks, manuals, and literature to owner
- F. Warranty OIT programming for a period of one year from date of substantial completion. Correct errors and software "bugs" at no cost to owner for that period of time.

End of Section